Biota Environmental Sciences

Orebody 32 Surplus Water Targeted MNES Vertebrate Fauna Survey

Prepared for BHP WAIO

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Biota Environmental Sciences

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OB32 Surplus Water Targeted Vertebrate Fauna Survey

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1.0 Summary

1.1 Background

Biota Environmental Sciences (Biota) was commissioned by BHP Western Australian Iron Ore (BHP WAIO) to undertake a two-phase vertebrate fauna survey WITHIN the OB32 Surplus Water Homestead Creek Wetting Front study area (hereafter, the study area) targeting species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as Matters of National Environmental Significance (MNES). The study area is located between 4.3 km and 55 km northeast of Newman (Figure 2.1), covers approximately 13,662 ha, and encompasses active and non-active BHP WAIO Geoscience tenure, mining operational areas, and off tenure land.

The purpose of this assessment is to present zoological and ecological information on the study area through desktop review and field survey that can be used to inform future environmental assessment of the study area.

1.2 Methodology

The methodology for this assessment included a comprehensive desktop study and field survey. As part of the desktop study, a review of relevant database records and past surveys from the locality was undertaken to identify significant fauna known from, or potentially occurring within, the study area, and to inform survey design and preliminary habitat mapping.

The field survey was conducted from 7th – 16th April 2021 (Phase 1) and 13th – 23rd September 2021 (Phase 2), with a third site visit undertaken from 13th – 15th. July 2021 (mainly to rebait long-term cameras), and additional areas surveyed during a fourth visit from 9th – 11th February 2022, in accordance with Environmental Protection Authority (EPA) and EPBC Act guidance.

Sampling effort within the study area comprised:

- targeted searches conducted at 22 sites (six sites searched more than once), with over 151 km traversed and a total search effort of over 84 hours;
- nocturnal searches conducted at eight sites (one searched twice), with 73 km walked and a total search effort of approximately 32 hours;
- long-term deployment of remote infrared motion cameras to target ground-dwelling mammals at eight sites for a total of 1,277 nights;
- deployment of SongMeter echolocation call recorders targeting the bat assemblage at 19 locations (three sampled twice) for a total of 116 recording nights;
- deployment of SongMeter acoustic call recorders targeting Night Parrots (*Pezoporus occidentalis)* at eight locations for a total of 230 nights;
- habitat assessment at 62 sites and fauna habitat mapping; and
- non-systematic survey activities including night-spotting, ground foraging, identification of secondary signs and opportunistic records.

1.3 Results and Discussion

1.3.1 Vertebrate Species

Based on the desktop study, a total of 376 vertebrate species, comprising 25 native and nine introduced non-volant mammal species, 13 bat species, eight amphibian species, 116 reptile species and 205 bird species, were identified as potentially occurring in the study area locality. Of these, 31 are MNES species that are also State listed significant species, with another nine species listed at State-level only.

A total of 128 vertebrate species were recorded during the survey. All but one, the Pallid long-eared bat (*Nyctophilus daedalus*) are known from the study area locality. To date, three MNES species have been recorded within the study area, all during the current survey. A further three MNES species identified from the desktop study are likely to occur, and ten may occur within the study area. These comprise:

Recorded:

- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* (Pilbara form)) – Vulnerable under both the EPBC Act and the State *Biodiversity Conservation Act 2016* (BC Act);
- Grey Falcon (*Falco hypoleucos*) – Vulnerable under both the EPBC Act and the BC Act; and
- Pacific [Fork-tailed] Swift (*Apus pacificus*) – Migratory under both the EPBC Act and the BC Act.

Likely to occur:

- Greater Bilby (*Macrotis lagotis*) – Vulnerable under both the EPBC Act and the BC Act;
- Ghost Bat (*Macroderma gigas*) – Vulnerable under both the EPBC Act and the BC Act; and
- Pilbara Olive Python (*Liasis olivaceus barroni*) – Vulnerable under both the EPBC Act and the BC Act.

May occur:

- Australian Painted Snipe (*Rostratula australis*) – Endangered under both the EPBC Act and the BC Act;
- Princess Parrot (*Polytelis alexandrae*) – Vulnerable under the EPBC Act and listed as Priority 4 by the Department of Biodiversity, Conservation and Attractions (DBCA);
- Australian [Gull-billed] Tern (*Gelochelidon [nilotica] macrotarsa*) – Migratory under both the EPBC Act and the BC Act;
- Oriental Plover (*Charadrius veredus*) – Migratory under both the EPBC Act and the BC Act; and
- Six migratory shorebird species (Scolopadicae spp.) – Migratory under the EPBC Act and the BC Act: Sharp-tailed Sandpiper (*Calidris acuminata*), Red-necked Stint (*Calidris ruficollis*), Common Sandpiper (*Actitis hypoleucos*), Marsh Sandpiper (*Tringa stagnatilis*), Wood Sandpiper (*Tringa glareola*) and Common Greenshank (*Tringa nebularia*).

While these significant species utilise/are likely to, or may utilise the study area, none are restricted to the study area.

1.3.2 Fauna Habitats

Five fauna landscapes (broad fauna habitats) were identified and mapped:

1. Vegetated sandy/stony drainage systems (BHP fauna habitat type 'Major Drainage Line');
2. Sandy *Triodia* plains (BHP fauna habitat type 'Sand Plain');
3. Floodplains – open shrubland with patches of mulga (BHP fauna habitat type 'Drainage Area/ Floodplain);
4. Undulating low hills and ironstone outcrops (BHP fauna habitat type 'Undulating Low Hills');
5. Cleared/disturbed, including artificial water bodies, roads/tracks rail etc.

Based on desktop study and field survey results, six MNES species utilise or are likely to utilise the identified fauna landscapes within the study area: Critical and supporting habitat is present for Greater Bilby (*Macrotis lagotis*) and Grey Falcon (*Falco hypoleucos*), supporting habitat only is present for Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* (Pilbara form)), Ghost Bat (*Macroderma gigas*), and Pilbara Olive Python (*Liasis olivaceus barroni*), and the Pacific [Fork-tailed] Swift (*Apus pacificus*) is not considered to utilise any habitat as it is entirely aerial when in Australia.

All fauna habitats identified as utilised or having the potential to be utilised by MNES species within the study area are not restricted to the locality and occur contiguously with the same habitat types outside of the study area. No gorges, gullies or caves were present in the study area.

2.0 Introduction

2.1 Project Background and Purpose

Biota Environmental Sciences (Biota) was commissioned by BHP Western Australian Iron Ore (BHP WAIO) to undertake a two-phase targeted Matters of National Environmental Significance (MNES) vertebrate fauna survey of the OB32 Surplus Water Homestead Creek Wetting Front study area and associated areas (hereafter, the study area), located between 4.3 km and 55 km northeast of Newman (Figure 2.1). The study area covers approximately 14,849 ha and encompasses active and non-active BHP WAIO Geoscience tenure, mining operational areas, and off tenure land.

The purpose of this assessment is to present zoological and ecological information on the study area through desktop review and field survey that can be used to inform future environmental assessment of the study area.

2.2 Scope and Objectives

The scope of this study was to undertake a two-phase targeted MNES terrestrial fauna survey of the study area consistent with Environmental Protection Authority (EPA) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) guidance. The key elements of the scope comprised:

- preparation of a desktop study including database and literature searches, in order to consolidate all available and relevant existing data for contextual comparison;
- targeted vertebrate fauna survey of the study area, to be undertaken in accordance with relevant EPA/EPBC Act guidance (see Section 3.3.1);
- assessment and description of fauna habitats, including those deemed significant for supporting known or potential populations of MNES fauna; and
- identification and assessment of the likelihood of occurrence of MNES fauna, and probable habitat utilisation, within the study area.

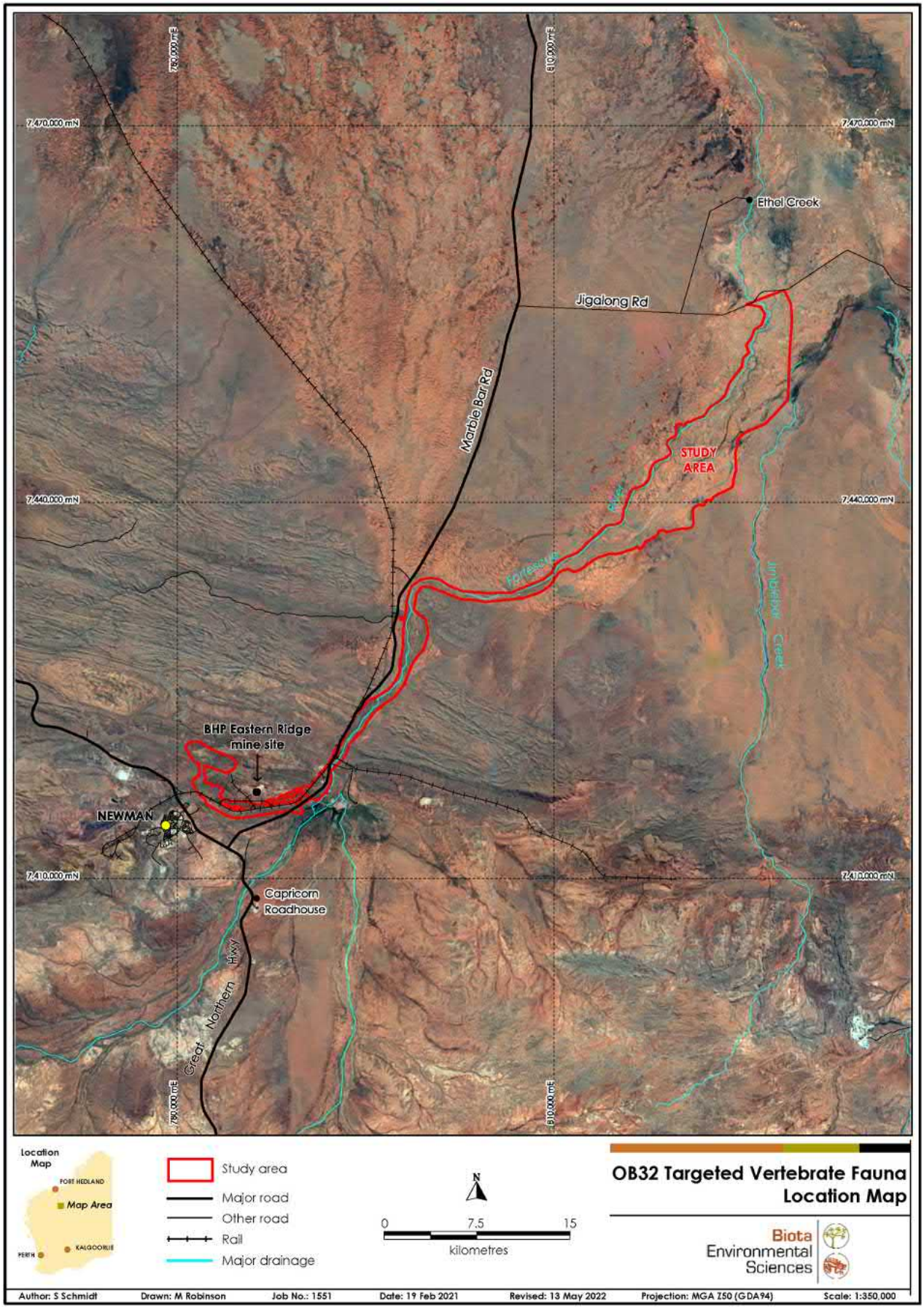

Figure 2.1: Location of the study area.

3.0 Methodology

3.1 Desktop Study

The aim of the desktop study was to review information relevant to the study area to identify known features of significance and identify MNES fauna species potentially present within the study area. This review considered regional information and previous biological surveys completed in the locality (Section 3.1.1), and the results of database searches (Section 3.1.2).

3.1.1 Literature Review

The literature review comprised:

- regional information, including bioregion and subregion data (Kendrick 2003), land systems mapping (van Vreeswyk et al. 2004), vegetation descriptions and mapping by Beard (1975a, 1975b), and surface geology (Geoscience Australia 2008).
- relevant biological surveys previously completed in the locality since 2010.

The results of the literature review and database searches are summarised in Section 4.0 and detailed results are provided in Appendix 1.

3.1.2 Database Searches

The following databases were searched as part of the desktop assessment:

- The Atlas of Living Australia online database, searched to identify species previously recorded within or adjacent to the study area; and
- NatureMap, a joint project of the Department of Biodiversity, Conservation and Attractions (DBCA) and the Western Australian Museum (WAM), searched to obtain a list of all fauna species recorded within or adjacent to the study area, primarily to identify records of conservation significant fauna known from the locality. This database represents the most comprehensive source of information on the distribution of Western Australia's fauna, comprising records from the following databases:
    1. DBCA Threatened Fauna database (to identify species listed under the WA *Biodiversity Conservation Act 2016* (BC Act), or those species listed as Priority by DBCA, that have previously been recorded within or adjacent to the study area);
    2. Fauna Survey Returns Database (managed by the DBCA);
    3. WAM Specimen Database;
    4. BirdLife Australia Atlas of Australian Birds; and
    5. Federal Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (to identify fauna species listed under the EPBC Act potentially occurring within the study area).

Database searches were centred on three coordinates at the south end, centre, and north end of the study area, with search results requested for a 40 km radius from each central point:

- 23.3378° S, 119.7692° E – southern point;
- 23.1617° S, 120.0458° E – central point; and
- 22.9653° S, 120.2014° E – northern point.

3.1.3 Assessment of Likelihood of Occurrence in the Study Area

Results from the literature review and database searches were used to compile a list of terrestrial MNES fauna species that had previously been recorded from the locality. The likelihood that each target taxon would occur in the study area was then assessed after the survey taking into

account habitat ground-truthing/assessment and fauna sampling conducted (see Section 5.3) using the rankings and criteria provided in Table 3.1, based on consideration of:

- the documented distribution of the species;
- the proximity of the study area to existing records;
- preferred habitats; and
- biology and mobility of the species.

Habitats were defined according to vegetation units, landforms apparent on aerial imagery, and taking into account existing information regarding the environment. The term 'close proximity' is defined as being within 20 km of the study area, while the broader 'locality' comprises the area up to 40 km from the study area.

Table 3.1: Criteria used to assign the likelihood of occurrence of a species within the study area.

Rank	Criteria
Recorded	1. The species has been previously recorded in the study area.
Likely to occur	1. There are existing records of the species in close proximity to the study area (within 20 km); and • the species is strongly linked to a specific habitat, which is present in the study area; or • the species has more general habitat preferences, and suitable habitat is present.
May occur	1. There are existing records of the species from the locality (within 40 km), however • the species is strongly linked to a specific habitat, of which only a small amount is present in the study area; or • the species has more general habitat preferences, but only some suitable habitat is present. 2. There is suitable habitat in the study area, but the species is recorded infrequently in the locality.
Unlikely to occur	1. The species is linked to a specific habitat, which is absent from the study area; or 2. Suitable habitat is present, however there are no existing records of the species from the locality despite reasonable previous search effort in suitable habitat; or 3. There is some suitable habitat in the study area, however the species is very infrequently recorded in the locality or the only records are historic (>40 years ago).
Would not occur	1. The species is strongly linked to a specific habitat, which is absent from the study area; or 2. The species' range is very restricted and does not include the study area; or 3. The species is not considered extant in the locality.

3.1.4 Nomenclature

Consistent with the EPA (2020) Technical Guidance, species nomenclature for herpetofauna and mammals follows the WAM fauna taxonomic checklist, which is revised and released every six months or as necessary[1]. Nomenclature for avifauna follows the International Ornithological Congress (IOC) version 11.2 (Gill et al. 2021), as we consider this to be the closest of the major international checklists in taxonomic approach to the WAM checklist used for other vertebrate groups. As of 2021, the WAM checklist for birds is being updated with reference to the IOC checklist. Where nomenclature differs from species list provided by BHP WAIO, this is indicated (Appendix 1)[2].

3.1.5 Threatened Fauna Statutory Framework

Native fauna species that are rare, threatened with extinction, or have high conservation value, are specially protected by law under the State BC Act and/or the Federal EPBC Act. Migratory and Marine species are also protected under the EPBC Act as MNES. In addition, the DBCA also maintains a list of Priority fauna species that have not been assigned statutory protection under the

[1] Current checklist released June 2021 (http://museum.wa.gov.au/research/departments/terrestrial-zoology/checklist-terrestrial-vertebrate-fauna-western-australia)
[2] Data supplied matching BHP species list as requested with report nomenclature provided in addition (comments).

BC Act, but are still considered to be of conservation priority, or are considered to be rare but not threatened and are in need of monitoring. Appendix 2 details the categories of conservation significance recognised under these three frameworks.

3.2 Field Survey

3.2.1 Survey Timing and Team

The field survey was undertaken over two phases by a team of two zoologists (Table 3.2) from 7th – 16th April 2021 (Phase 1) and 13th – 23rd September 2021 (Phase 2), with a third site visit undertaken from 13th – 15th. July 2021 for maintenance of long-term monitoring equipment. Subsequently, another site visit was undertaken from 9th – 11th February 2022 to survey an additional area (mainly ground-truthing/habitat mapping, see Figure 3.2 and Figure 3.3). The survey was completed under "Fauna Taking (Biological Assessment)" Licence No. BA27000388 and "Authorisation to take or disturb threatened species' TFA 2021-0022 issued to Dr. Sylvie Schmidt (Appendix 3).

Table 3.2: Summary of Biota personnel involved in the fauna survey.

Name	Position	Qualification	Years of Experience	Survey Role
Garth Humphreys	Director / Principal Ecologist	BSc. Hons	33	Project Director Final report review
Sylvie Schmidt	Senior Biologist	BSc. Hons PhD MBA	16	Project Manager Survey design Desktop review Field Team Leader Data analysis and reporting Peer review
Michael Greenham	Senior Zoologist	BSc.	21	Field survey
Dan Kamien	Principal Zoologist	BSc. Hons	23	Bat call analysis
John Graff	Zoologist	BSc. Hons	11	Desktop review Bird call analysis Data analysis and reporting

3.2.2 Daily Weather Observations

Weather data were obtained from the Bureau of Meteorology weather station at Newman Airport (No. 007176), located approximately 7.5 km south of the southwestern end of the study area (Table 3.3). Weather conditions were warm to hot for most of both phases of survey, with cooler temperatures on average during the September phase, and a cool change late in the first phase associated with heavy rainfall. The September phase was dry, but heavy rainfall fell before and during the first phase in April, resulting in wet conditions and flooding during the survey. Conditions were also wet during the site visit in February 2022 with over 36.4mm of rainfall in the two days immediately prior to and an additional 28.6mm during the site visit at Newman Airport (also see Section 3.4).

3.2.3 Climate

Long-term climate data were obtained from the Newman Airport weather station (Figure 3.1). Mean maximum and minimum temperatures prior to the survey were relatively consistent with long-term averages, though slightly above average in the cooler months (June – September) in both 2020 and 2021. Conditions for the survey were wetter than average, particularly for the first phase in April, with above average rainfall falling during the 2020-21 wet season, with particularly high rainfall in February 2021.

Table 3.3: Weather observations from Newman Aero during the two survey phases.

	Phase 1				Phase 2		
	Max Temp (°C)	Min Temp (°C)	Rainfall (mm)		Max Temp (°C)	Min Temp (°C)	Rainfall (mm)
7th April	36.3	16.1	0	**13th Sept**	28.7	11.7	0
8th April	36.1	18.7	0	**14th Sept**	31.7	10.1	0
9th April	36.7	22.0	0	**15th Sept**	33.4	13.5	0
10th April	35.8	21.4	0	**16th Sept**	28.1	13.2	0
11th April	36.3	21.1	0	**17th Sept**	26.4	12.6	0
12th April	36.0	22.6	0	**18th Sept**	28.4	10.9	0
13th April	30.8	24.0	0.2	**19th Sept**	29.4	8.1	0
14th April	23.7	19.7	54.4	**20th Sept**	32.0	11.6	0
15th April	26.7	18.2	0.2	**21st Sept**	31.2	15.9	0
16th April	27.6	15.8	0.2	**22nd Sept**	29.4	14.0	0
Mean/Total	**32.6 ± 4.9**	**20.0 ± 2.7**	**55.0**	**23rd Sept**	31.6	7.7	0
				Mean/Total:	**30.0 ± 2.1**	**11.8 ± 2.5**	**0**

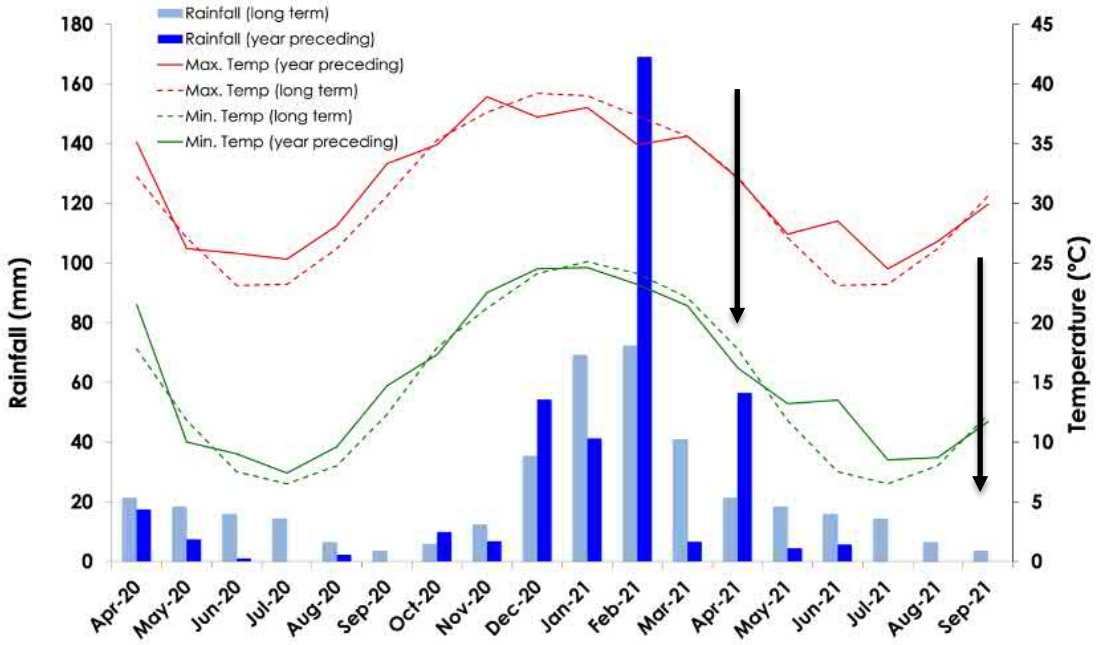

Figure 3.1: Climate and weather graph depicting long-term averages and the twelve months preceding the survey phases (April 2019 – September 2020). (Long-term data rainfall 1971-2020, temperatures 1996 – 2020; arrows indicate survey timing)

3.3 Survey Design

3.3.1 Survey Methods

The methodology was developed with reference to the following guidance documents:

- Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020);
- Survey Guidelines for Australia's Threatened Birds (DEWHA 2010a);
- Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011a);
- Survey Guidelines for Australia's Threatened Bats (DSEWPaC 2010);
- Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011b);
- Survey Guidelines for Australia's Threatened Frogs (DEWHA 2010b);
- Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (DotE 2013);

- Guidelines for surveys to detect the presence of bilbies, and asses the importance of habitat in Western Australia (DBCA 2017a); and
- BHP WAIO's Guidance for Vertebrate Fauna Surveys in the Pilbara (SPR-IEN-EMS-015).

The vertebrate fauna survey consisted of a combination of systematic and non-systematic opportunistic sampling and targeted searching (Section 3.3.3).

Preliminary site selection was determined through assessment of aerial photography and thematic layers including land systems, geology and Beard's vegetation mapping (see Section 4.1) and was revised in the field based on on-ground habitat assessments and any access limitations.

3.3.2 Target Species

Based on the desktop review, 40 significant vertebrate species were identified as having the potential to occur within the study area, either due to previous records from the locality or due to the likely presence of suitable habitat (see Table 4.4 and Table 4.5), including 31 MNES species.

While the survey was targeted specifically at MNES species, any opportunistic sightings or signs of other vertebrate fauna detected were also recorded, including significant and introduced fauna.

3.3.3 Fauna Sampling

In addition to targeted searches, nocturnal searches and habitat assessments, the following sampling techniques were used to specifically target the different target vertebrate groups (detailed descriptions of sampling methods and sites are provided in Sections 3.3.3.1 to 3.3.3.6):

- non-volant mammals: motion cameras, and hair traps (if active burrows were detected);
- bats: echolocation call recorders;
- reptiles: motion cameras;
- frogs: acoustic recorders; and
- avifauna: acoustic recorders.

Additional fauna observation techniques were used to investigate fauna habitats identified from the desktop review and microhabitats identified during the course of the survey, comprising:

- opportunistic searches and observations for all targeted fauna groups, including non-listed and introduced species;
- identification of secondary signs (where possible) including tracks, scats, skins, mounds, hollows, nests and diggings; and
- identification of road-kill and other animal remains (where encountered).

3.3.3.1 Sampling Locations

An overview of all sampling locations and methods used across the study area is included below in Table 3.4 and Figure 3.2. The following sections provide additional information for each sampling method employed, including dates and survey effort.

Table 3.4: Summary of sampling sites and methods.

Site ID	Latitude (°S)	Longitude (°E)	Land System	Sampling Methods
OBT-01	-23.338132	119.771645	Elimunna	Bat call recorder
				Targeted search
OBT-02	-23.342298	119.779872	Elimunna	Habitat assessment
OBT-03	-23.345315	119.834481	Elimunna	Bat call recorder
				Targeted search
OBT-04	-23.296451	119.869111	River	Bat call recorder

Site ID	Latitude (°S)	Longitude (°E)	Land System	Sampling Methods
				Nocturnal search
OBT-05	-23.312640	119.853056	Newman	Cellbase*
OBT-06	-23.147743	120.053969	River	Acoustic sound recorder
OBT-07	-23.231492	119.911081	River	Acoustic sound recorder
				Nocturnal search
OBT-08	-23.231753	119.913262	River	Nocturnal search
OBT-09	-23.292195	119.869974	River	Nocturnal search
OBT-10	-22.971747	120.180457	Fortescue	Bat call recorder
OBT-11	-22.984534	120.199764	Fortescue	Habitat assessment
OBT-12	-23.113031	120.150873	Divide	Acoustic sound recorder
OBT-13	-23.144069	120.095013	Fortescue	Acoustic sound recorder
OBT-14	-23.185724	119.994566	Newman	Acoustic sound recorder
OBT-15	-23.318460	119.852903	Elimunna	Bat call recorder
				Targeted search
OBT-16	-23.314707	119.858270	River	Bat call recorder
				Targeted search
OBT-17	-23.205927	119.912388	River	Bat call recorder
				Targeted search
OBT-18	-23.178288	119.925449	River	Bat call recorder
OBT-19	-23.175578	120.023231	River	Bat call recorder
				Nocturnal search
OBT-20	-23.331520	119.854486	River	Motion camera
OBT-21	-23.205004	119.914499	River	Motion camera
OBT-22	-23.293214	119.870559	River	Motion camera
				Targeted search
				Nocturnal search
OBT-23	-23.298340	119.869652	River	Motion camera
				Targeted search
OBT-24	-23.311041	119.873674	Newman	Repeater*
OBT-25	-23.302065	119.859509	Rocklea	Motion camera
OBT-26	-23.315084	119.858566	River	Motion camera
OBT-27	-23.338439	119.771158	Elimunna	Motion camera
				Targeted search
OBT-28	-23.263899	119.890714	River	Motion camera
				Nocturnal search
				Targeted search
OBT-29	-23.264945	119.897982	River	Targeted search
OBT-30	-23.332346	119.854191	River	Bat call recorder
OBT-31	-23.297792	119.869398	River	Bat call recorder
OBT-32	-23.207070	119.912658	River	Acoustic sound recorder
OBT-33	-23.175424	120.023640	River	Bat call recorder
OBT-34	-23.113465	120.087417	River	Habitat assessment
OBT-35	-23.070218	120.122180	Fortescue	Bat call recorder
				Targeted search

Site ID	Latitude (°S)	Longitude (°E)	Land System	Sampling Methods
OBT-36	-23.097244	120.162297	Fortescue	Habitat assessment
OBT-37	-23.095603	120.157623	Fortescue	Habitat assessment
OBT-38	-23.130989	120.082272	River	Bat call recorder
				Targeted search
OBT-39	-23.132006	120.083611	Fortescue	Acoustic sound recorder
				Targeted search
OBT-40	-23.165354	120.040044	Fortescue	Acoustic sound recorder
				Targeted search
OBT-41	-23.274095	119.884937	River	Bat call recorder
OBT-42	-22.965125	120.193949	Fortescue	Targeted Search
OBT-43	-23.199909	119.920210	Newman	Habitat assessment
OBT-44	-23.237156	119.913699	River	Habitat assessment
OBT-45	-23.287030	119.877529	River	Bat call recorder
OBT-46	-23.234678	119.918274	River	Bat call recorder
OBT-47	-23.201328	119.919059	River	Bat call recorder
				Targeted search
OBT-48	-23.309991	119.768145	Newman	Habitat assessment
OBT-49	-23.312633	119.766945	Boolgeeda	Habitat assessment
OBT-50	-23.315014	119.769596	Boolgeeda	Habitat assessment
OBT-51	-23.343016	119.773167	Elimunna	Habitat assessment
OBT-52	-23.310816	119.750602	River	Targeted Search
OBT-53	-23.313154	119.758615	Bolgeeda	Targeted Search
OBT-54	-23.340151	119.826183	Elimunna	Habitat assessment
OBT-55	-23.342728	119.809105	Elimunna	Habitat assessment
OBT-56	-23.346214	119.784686	Elimunna	Habitat assessment
OBT-57	-23.337997	119.765655	Elimunna	Bat call recorder
OBT-58	-23.335969	119.761136	Elimunna	Habitat assessment
OBT-59	-23.345965	119.828652	Elimunna	Targeted Search
OBT-60	-23.346860	119.832157	Elimunna	Habitat assessment
OBT-61	-23.344741	119.832828	Elimunna	Habitat assessment
OBT-62	-23.342529	119.826564	Elimunna	Targeted Search
OBT-63	-23.334057	119.767017	Newman	Habitat assessment
OBT-64	-23.327776	119.757799	Elimunna	Targeted Search

* Long term camera equipment (data relay system components), outside study area.

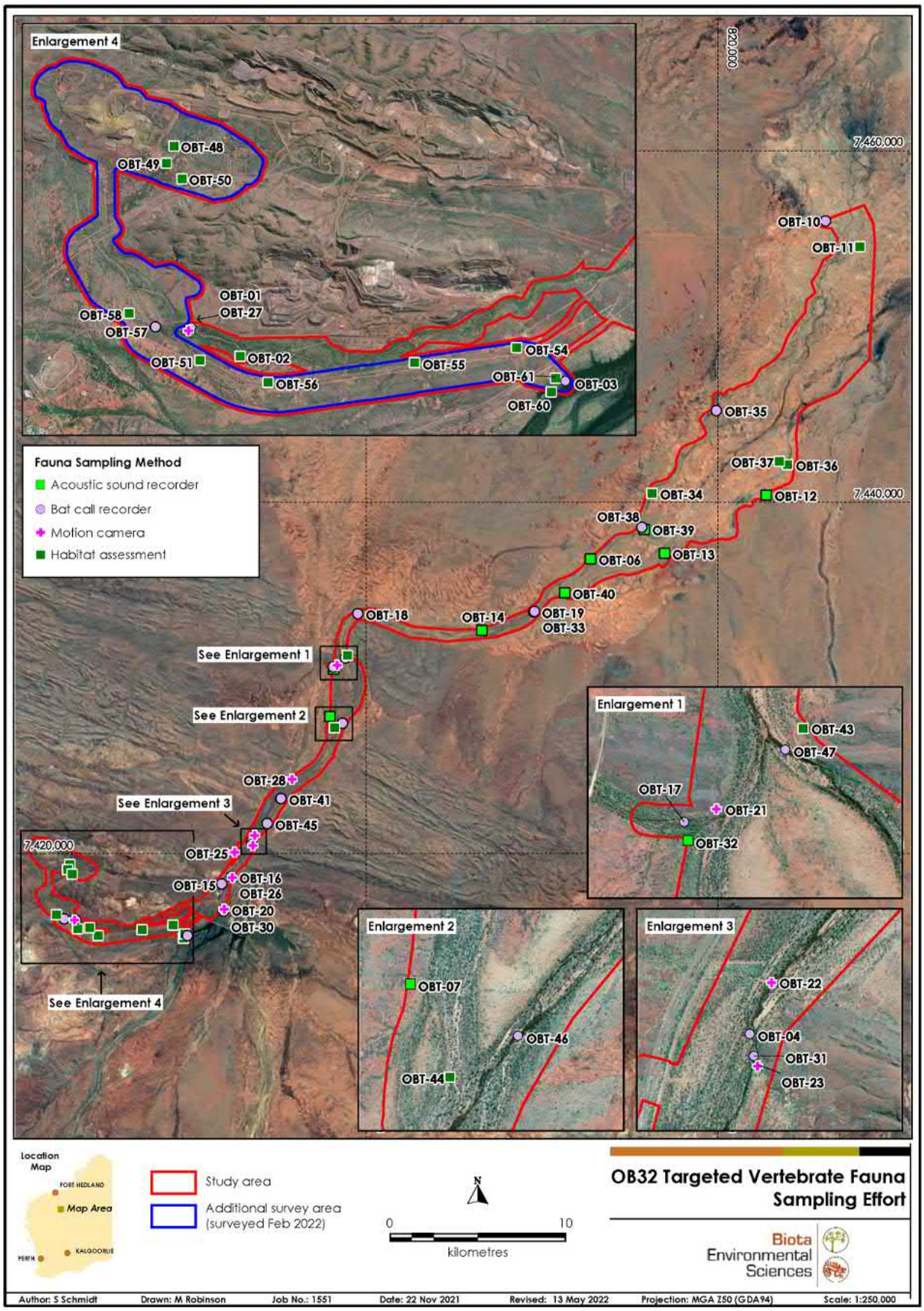

Figure 3.2: Vertebrate fauna sampling sites in the study area.

3.3.3.2 Targeted Searches

Targeted searches were conducted at 22 sites, with a total search effort of over 151km walked (83.33 hours). Table 3.5 details each targeted search conducted, and Figure 3.3 shows individual zoologist's tracks walked for each targeted and nocturnal search.

Table 3.5: Targeted search sites and effort.

Site	Landform	Date	No. of zoologists	Search Time (Person minutes)	Total Distance (km)
OBT-01	Major Drainage Line	08/04/21	2	258	3.9
OBT-03	Major Drainage Line	08/04/21	2	164	3.9
OBT-15	Drainage Area/Floodplain	11/04/21	2	20	0.7
		22/09/21	2	40	1.4
OBT-16	Major Drainage Line	11/04/21	1	10	0.4
		21/09/21	1	23	0.5
OBT-17	Major Drainage Line	11/04/21	2	76	1.3
		17/09/21	2	268	7.8
OBT-22	Major Drainage Line	16/09/21	2	701	15.2
OBT-23	Major Drainage Line	16/04/21	1	55	1.2
OBT-27	Major Drainage Line	20/09/21	2	209	9.2
OBT-29	Major Drainage Line	15/04/21	2	182	5.4
		15/07/21	2	235	8.9
		17/09/21	2	604	17.5
OBT-35	Drainage Area/Floodplain	18/09/21	2	95	1.7
OBT-38	Major Drainage Line	15/09/21	2	503	11.4
		21/09/21	1	37	2.1
OBT-39	Drainage Area/Floodplain	15/09/21	2	142	4.0
		21/09/21	1	89	4.8
OBT-40	Drainage Area/Floodplain	15/09/21	2	279	11.4
OBT-41	Drainage Area/Floodplain	16/09/21	1	52	2.0
OBT-42	Drainage Area/Floodplain	16/09/21	2	129	4.4
OBT-47	Major Drainage Line	19/09/21	2	430	18.2
OBT-52	Medium Drainage Line	10/02/22	2	90	1.6
OBT-53	Drainage Area/Floodplain	10/02/22	2	30	0.8
OBT-59	Drainage Area/Floodplain	11/02/22	1	75	1.8
OBT-62	Drainage Area/Floodplain	11/02/22	1	40	1.0
OBT-63	Drainage Area/Floodplain	11/02/22	2	84	4.0
OBT-64	Major Drainage Line	11/02/22	2	140	4.6
			Total	**5,060**	**151.1**

3.3.3.3 Nocturnal Searches

Nocturnal searches were conducted on foot at eight sites with a total search effort of 73 km walked (31.85 hours). Nocturnal searching was focused on the area of the river adjacent to the rocky areas in the south of the study area as these were the most prospective habitats to encounter the target species. Details for each nocturnal search conducted are included below in Table 3.6 and Figure 3.3.

Table 3.6: Nocturnal search sites and effort.

Site	Landform	Date	No. of zoologists	Search Time (Person minutes)	Total Distance (km)
OBT-04	Major Drainage Line	08/04/21	2	306	9.3
OBT-07	Drainage Area/Floodplain	21/09/21	2	110	5.8
OBT-08	Major Drainage Line	09/04/21	2	293	13.3
OBT-09	Major Drainage Line	10/04/21	2	174	5.5
OBT-19	Major Drainage Line	11/04/21	2	146	4.4
OBT-22	Major Drainage Line	18/09/21	2	254	8.1
		20/09/21	1	166	6.3
OBT-28	Major Drainage Line	20/09/21	1	180	8.1
OBT-47	Major Drainage Line	19/09/21	2	282	12.2
			Total	**1,911**	**73.0**

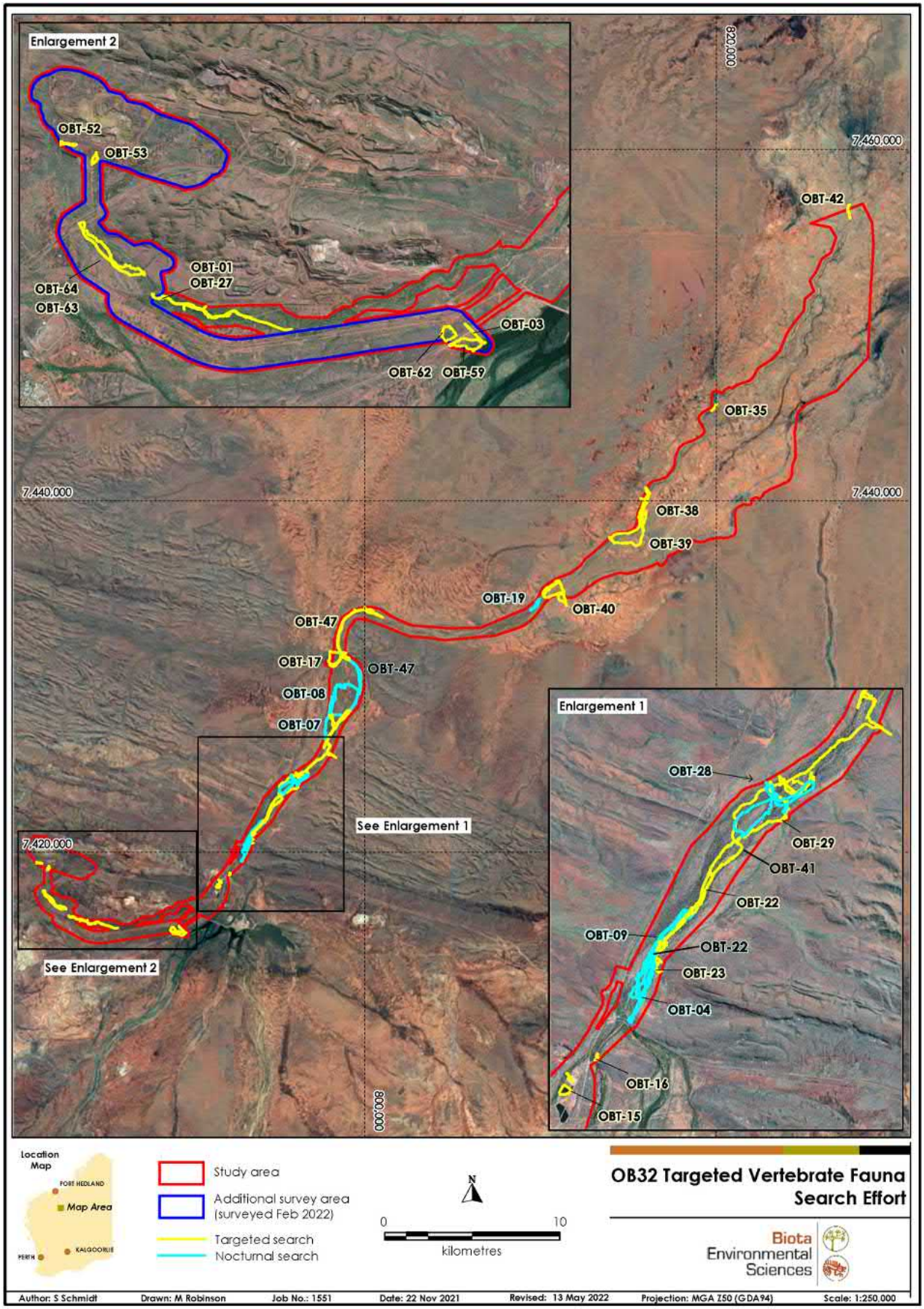

Figure 3.3: Targeted and nocturnal search effort in the study area.

3.3.3.4 Motion Cameras

Remote infrared motion cameras were deployed primarily to target Northern Quoll and the Night Parrot. Cameras were set up at eight sites within the study area, primarily in drainage lines, for a combined total of 1,277 sampling nights (Table 3.6). Universal bait was deployed within a PVC tube with a scent lure in front of each camera to better preserve the bait for long-term deployment. Cameras were (re)baited in April (Phase 1), July (site visit) and September (Phase 2).

Table 3.7: Motion camera sites and effort.

Site	Landform	Start Date	End Date	Sampling Nights
OBT-20	Major Drainage Line	12/04/21	20/09/21	161
OBT-21	Major Drainage Line	14/04/21	21/09/21	160
OBT-22	Major Drainage Line	12/04/21	20/09/21	161
OBT-23	Major Drainage Line	13/04/21	21/09/21	161
OBT-25	Undulating Low Hills	14/04/21	20/09/21	159
OBT-26	Major Drainage Line	14/04/21	20/09/21	159
OBT-27	Major Drainage Line	15/04/21	20/09/21	158
OBT-28	Major Drainage Line	15/04/21	20/09/21	158
			Total	**1,277**

3.3.3.5 Bat Call Recorders

Bat call recorders were deployed at 19 locations across the study area for a combined total of 116 sampling nights (Table 3.8), targeting all potentially occurring bat species. Echolocation calls were recorded using SM2 SongMeters, SM4BAT FS SongMeters, and SM4mini SongMeters, which detect and record ultrasonic echolocation calls. Selectable filters, triggers and audio settings used followed the manufacturer's recommendations for bat detection (Wildlife Acoustics 2010, 2019). The SongMeters were placed in locations considered likely to provide records of target species, including fresh water, potential flyways through drainage lines and along breakaways (no gorges, gullies or caves were present in the study area).

Table 3.8: Bat call recorder sites and effort.

Site	Landform	Sampling Round	Start Date	End Date	Recording Unit Type	Sampling Nights
OBT-01	Major Drainage Line	1	08/04/21	14/04/21	SM4mini	6
		2	13/09/21	20/09/21	SM4Bat FS	7
OBT-03	Major Drainage Line	1	08/04/21	14/04/21	SM4mini	6
OBT-04	Major Drainage Line	1	08/04/21	14/04/21	SM4mini	6
OBT-10	Medium Drainage Line	1	10/04/21	14/04/21	SM2	4
OBT-15	Drainage Area/Floodplain		11/04/21	16/04/21	SM2	5
OBT-16	Major Drainage Line	1	11/04/21	16/04/21	SM2	5
		2	20/09/21	22/09/21	SM2	2
OBT-17	Major Drainage Line	1	11/04/21	14/04/21	SM2	3
		2	16/09/21	19/09/21	SM4Bat FS	3
OBT-18	Major Drainage Line	1	11/04/21	15/04/21	SM4mini	4
OBT-19	Major Drainage Line	1	11/04/21	05/05/21	SM4Bat FS	24
OBT-30	Wetland	1	13/09/21	20/09/21	SM2	7
OBT-31	Drainage Area/Floodplain	1	13/09/21	20/09/21	SM4Bat FS	7
OBT-33	Major Drainage Line	1	14/09/21	18/09/21	SM4Bat FS	4
OBT-35	Drainage Area/Floodplain	1	14/09/21	18/09/21	SM4Bat FS	4
OBT-38	Major Drainage Line	1	15/09/21	21/09/21	SM4mini	6
OBT-41	Drainage	1	16/09/21	20/09/21	SM4mini	4

Site	Landform	Sampling Round	Start Date	End Date	Recording Unit Type	Sampling Nights
	Area/Floodplain					
OBT-45	Major Drainage Line	1	18/09/21	22/09/21	SM4Bat FS	4
OBT-46	Drainage Area/Floodplain	1	19/09/21	21/09/21	SM4Bat FS	2
OBT-47	Major Drainage Line	1	19/09/21	21/09/21	SM2	2
OBT-57	Drainage Area/Floodplain	1	10/02/22	11/02/22	SM4Bat FS	1
					Total	**116**

Bat echolocation call analysis was undertaken by Dan Kamien of Biota using Kaleidoscope Pro software (version 5.0.3) and following methods recommended by the Australasian Bat Society (2006), in conjunction with available reference material (Churchill 2008, McKenzie and Bullen 2009). Only sequences containing good quality search phase calls were considered for identification.

3.3.3.6 Acoustic Sound Recorders

The Interim Guideline for Preliminary Surveys of the Night Parrot (*Pezoporus occidentalis*) (DBCA 2017b) recommends passive acoustic surveys as an effective low impact survey method. SM4mini SongMeter acoustic recording units were deployed in areas of potentially suitable habitat within the study area (predominantly *Triodia* grassland with large hummocks), and set to record each night for three hours starting 30 minutes before sunset, and again for 2.5 hours ending 30 minutes after sunrise. Sampling was undertaken at eight locations, with SongMeters deployed for a total of 230 sampling nights (Table 3.9).

Audio files were analysed by John Graff of Biota using Kaleidoscope Pro software (version 5.0.3) with a classifier built using Night Parrot calls recorded in Western Australia. Potential matches were then assessed manually by visual inspection of spectra and listening to recordings. Other bird species detected opportunistically through this process were also recorded.

Table 3.9: Acoustic sound recorder sites and effort.

Site	Landform	Start Date	End Date	Sampling Nights
OBT-06	Sand Plain	09/04/21	03/06/21	56
OBT-07	Drainage Area/Floodplain	09/04/21	15/04/21	6
		14/09/21	21/09/21	7
OBT-12	Drainage Area/Floodplain	10/04/21	13/05/21	34
		14/09/21	21/09/21	7
OBT-13	Drainage Area/Floodplain	10/04/21	03/06/21	55
OBT-14	Stony Plain	10/04/21	25/05/21	46
OBT-32	Drainage Area/Floodplain	14/09/21	21/09/21	7
OBT-39	Drainage Area/Floodplain	15/09/21	21/09/21	6
OBT-40	Drainage Area/Floodplain	15/09/21	21/09/21	6
			Total	**230**

3.3.4 Habitat Mapping

Vertebrate fauna habitats of the study area were identified and mapped based on Biota's fauna landscape approach (Biota 2013), which characterises habitats based on functional landforms within a broader landscape. Preliminary fauna habitat descriptions were based on land systems, as the main framework, as these are mapped more widely at regional scale, and additionally considered available digital aerial imagery, contour mapping, regional vegetation mapping and surface geology in order to validate and inform the extent of identified habitats.

Fauna landscapes, while not necessarily equating to the distribution of any single species, offer a parallel grouping of landforms and substrates comprising a suite of ecological niches distinct from those in other landscapes.

Preliminary desktop-based habitat mapping was ground-truthed in the field and revised after the survey. This included identification and classification of potential critical habitat for MNES species, adopting criteria aligned with the broad criteria used by DAWE (DotE 2013, 2016), and as inferred from previous controlled action decisions for Pilbara mining projects (see Section 5.3.3).

During the survey, habitat assessment data were collected at each vertebrate fauna sampling site (45 sites inside the study area), and at 17 additional (habitat assessment-only) locations throughout the study area in accordance with BHP WAIO's data requirements (SPR-IEN-EMS-015), including dominant fauna habitat type at the location, selected from prescribed values (see Appendix 4). Additional information collected included dominant vegetation, site pictures and other relevant data, in accordance with BHP WAIO's vertebrate fauna survey guidance (SPR-IEN-EMS-012, Section 3.7).

All sampling sites were then assigned to a land system and fauna landscape to place these into broader context within the study area and locality, and the more detailed attributes documented for each sampling site provided for finer scale habitat assessment and fauna landscape mapping. Fauna landscapes are presented alongside BHP fauna habitat types for cross-reference (see Figure 5.1 Table 5.1 and Appendix 4).

3.4 Study Limitations

In accordance with the EPA Technical Guidance 'Terrestrial Fauna Surveys' (EPA 2016c), potential constraints and limitations of the survey are addressed in Table 3.10.

Table 3.10: Potential constraints and limitations of the fauna survey.

Potential Constraint	Statement of Limitations
1. Availability of contextual information	Contextual information is readily available at a regional level and there has been adequate recent vertebrate fauna survey effort in the study area locality, including at least seven previous Detailed vertebrate fauna surveys, and at least seven Basic and/or targeted surveys (see Section 4.2). However, these previous surveys have all been conducted near the southern end of the study area, and often in habitats different to those occurring in the study area, i.e. in rocky habitats, while the study area is dominated by sandy drainage systems. Local level contextual information is considered to be a minor limitation for this study.
2. Competency and experience of survey team	The field survey team consisted of two senior zoologists with 16 and 21 years of experience, including numerous similar surveys in the Pilbara bioregion. Required resources were available. Experience and competency of the survey team is not considered to be a limitation for this study.
3. Proportion of fauna recorded and any identification issues	A two-season MNES targeted vertebrate fauna survey of the study area was commissioned and this was adequately completed in accordance with relevant guidance documents. Approximately one third of species known from the locality were recorded during the survey (despite not using traps and access constraints, see below). Use of SM4minis to record bats during 32 of 116 sampling nights may have resulted in lower than expected detection probability for Pilbara Leaf-nosed Bats at some sites (reduced sensitivity to high-frequency calls in SM4minis compared to SM4Bat FS and SM2 bat call recorders, mainly during Phase 1 of the survey. Some of these sites were resampled with alternative recording units (SM2 or SM4Bat FS SongMeters, and additional locations were sampled during Phase 2 to increase survey effort and detection probability of Pilbara Leaf-nosed Bat. The species was detected at seven of 19 sites including one site (OBT-41) where an SM4mini was used (single Pilbara Leaf-nosed Bat call recorded); detailed discussion of results, see Section 5.3.1.1). Records of fauna considered to be a minor limitation due to potentially reduced detection probability of Pilbara Leaf-nosed Bat at sites where SM4minis were used.

Potential Constraint	Statement of Limitations
4. Appropriate area fully surveyed	The study area was surveyed thoroughly with 45 vertebrate fauna sites sampled, some more than once, and extensive foot traverses completed both during the day (over 151 km) and at night (73 km), with important areas searched on multiple occasions. Habitat assessments were conducted at each vertebrate fauna sampling site and at an additional 17 locations (62 sites inside the study area in total). Sampling techniques and effort were adequate to inform future environmental impact assessment despite some access constraints (see below). Survey techniques and effort were in accordance with or exceeding those outlined in relevant guidance documents (Section 3.3). Survey effort and extent is not considered to be a limitation.
5. Access constraints	The majority of the study area was not accessible by vehicle as usable tracks were limited. Access to some areas was also limited due to active mining tenure restrictions, and, and parts of the study area had heritage restrictions. In addition, during Phase 1, access to large parts of the study area downstream from Ophthalmia Dam was further restricted due to discharge from the dam, which resulted in the Fortescue River flowing along throughout the study area, i.e. beyond the northern boundary. As the river was flowing, there were few areas with shallow or stagnant water suitable for Pilbara Olive Python searches and very limited opportunities to deploy bat call recorders at small pools or bottle necks (to increase probability of detection). In addition, unusually heavy rainfall due to a localised storm further restricted access as large parts of previously usable vehicle tracks were inundated, which resulted in some bat and bird call recording sites unable to be sampled for as long as planned, however, additional survey effort was able to be applied during Phase 2. Parts of the additional area surveyed in February 2022 were also unable to be accessed due to flooding and inundated tracks. Due to limited vehicle track access, only areas accessible on foot from vehicle tracks could be searched, sampled and assessed. Access to the entire study area is considered to be a minor limitation because representative areas of all habitat types present were accessible and able to be adequately sampled and assessed despite access constraints.
6. Survey timing, rainfall and season	Historical climate data were not available for the study area but were taken from the closest weather station located approximately 7.5 km from the study area at Newman Airport. Seasonal survey timing and conditions including rainfall prior to survey were optimal and are not considered to be a limitation.
7. Disturbance that may have affected the survey results	The majority of the study area was undisturbed with only a small proportion cleared/disturbed. As the northern part of the study area is located on Ethel Creek Station, weed and cattle were present in some areas. Disturbance was considered a minor limitation.

4.0 Desktop Assessment

4.1 Regional Context of the Study Area

4.1.1 IBRA Bioregion and Subregion

The study area lies within the Pilbara bioregion, one of 89 bioregions defined by the Interim Biogeographic Regionalisation for Australia (IBRA) (DSEWPaC 2012). The Pilbara bioregion is divided into four subregions. The study area lies within the Fortescue plains subregion, more specifically in the southwest of the subregion, where it borders the adjacent Gascoyne (bioregion) Augustus subregion. The Fortescue plains subregion is described by Kendrick (2003) as follows:

"Alluvial plains and river frontage. Extensive salt marsh, mulga-bunch grass, and short grass communities on alluvial plains in the east. Deeply incised gorge systems in the western (lower) part of the drainage. River gum woodlands fringe the drainage lines. Northern limit of Mulga (*Acacia aneura*). An extensive calcrete aquifer (originating within a palaeo-drainage valley) feeds numerous permanent springs in the central Fortescue, supporting large permanent wetlands with extensive stands of river gum and cadjeput *Melaleuca* woodlands. Climatic conditions are semi desert tropical, with average rainfall of 300 mm, falling mainly in summer cyclonic events. Drainage occurs to the north-west. Subregional area is 2,041,914 ha"

4.1.2 Land Systems

A total of 105 land systems have been identified and mapped in the Pilbara bioregion[3]. Land systems mapping covering the study area has been prepared by van Vreeswyk *et al*. (2004). The study area intersects nine land systems (Fortescue, River, Elimunna, Divide, Newman, Boolgeeda, Rocklea, Adrian, and Fan), with the majority of the study area (72.5% by area) located within the Fortescue land system (Table 4.1; Figure 4.1).

The study area contains only a very small proportion of the regional extents of most of the land systems it intersects (<1% for seven of the nine land systems, and slightly over 1% for an eighth), but does contain just over 20% of the extent of the Fortescue land system in the Pilbara (Table 4.1).

Table 4.1: Land systems intersected by the study area (Data from Payne et al. 1988, and van Vreeswyk et al. 2004.)

Land System	Description	Total Area of Land System in the Pilbara Bioregion (ha)	Extent within Study Area (ha) & Percentage of Study Area	Proportion of Total Land System that occurs in the Study Area
Fortescue (RGEFTC)	Alluvial plains and flood plains supporting patchy grassy woodlands and shrublands and tussock grasslands.	49,025	9,878 (66.5%)	20.15
River (RGERIV)	Active flood plains, major rivers and banks supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands.	497,421	2,889 (19.5%)	0.58
Elimunna (RGEELI)	Stony plains on basalt supporting sparse acacia and cassia shrublands and patchy tussock grasslands.	62,956	1,155 (7.8%)	1.83

[3] This information was obtained by merging the Ashburton land system mapping (Payne et al. 1988) and Pilbara land system mapping (van Vreeswyk et al. 2004) and intersecting this with the Pilbara bioregion (Environment Australia 2000).

Land System	Description	Total Area of Land System in the Pilbara Bioregion (ha)	Extent within Study Area (ha) & Percentage of Study Area	Proportion of Total Land System that occurs in the Study Area
Newman (RGENEW)	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	1,993,745	573 (3.9%)	0.029
Boolgeeda (RGEBGD)	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	961,637	231 (1.56%)	0.024
Divide (RGEDIV)	Sandplains and occasional dunes supporting shrubby hard spinifex grasslands.	437,577	101 (0.68%)	0.023
Rocklea (RGEROC)	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands.	2,881,897	12.0 (0.08%)	<0.001
Adrian (RGEADR)	Stony plains and low silcrete hills supporting hard spinifex grasslands.	23,497	7.3 (0.05%)	0.031
Fan (RGEFAN)	Washplains and gilgai plains supporting groved mulga shrublands and minor tussock grasslands.	148,205	2.7 (0.02%)	0.002

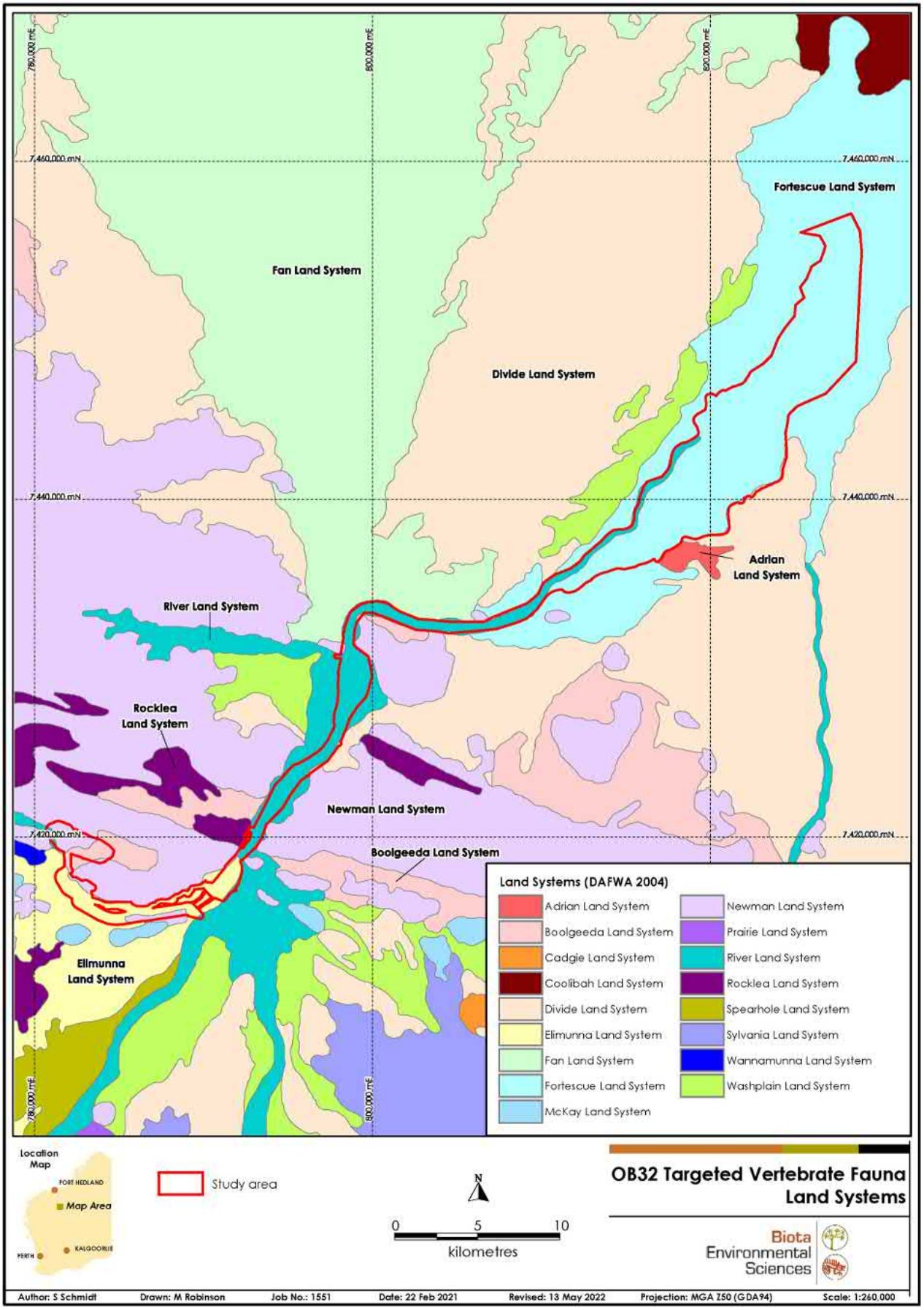

Figure 4.1: Land systems of the study area.

4.1.3 Surface Geology

A total of 12 surface geological units (Geoscience Australia 2008) occur within the study area (Table 4.2; Figure 4.2). The majority of the study area encompasses alluvial (55%) and sandy (35%) sediments.

Table 4.2: Geological units of the study area.

Geological Age	Code	Geological Description	Extent within Study Area (ha) & Percentage of Study Area
Holocene	Qa	Alluvial sediment: Channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted	8,181 (55%)
Cenozoic	Czs	Sand – Residual: 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	5,178 (35%)
Neoarchean	Achm	Chert, ferruginous chert, jaspilite, banded iron-formation, minor shale, siltstone, mudstone.	603.2 (4.1%)
Cenozoic	Czk	Calcrete: Pisolitic, nodular or massive calcrete; ferruginous inclusions; calcareous cementing of bedrock and transported materials; locally with intercalated chalcedony; as low mounds, in playa lakes, or as valley calcrete; locally dissected and karstified	272.2 (1.8%)
Quaternary	Qrc	Colluvial sediment: 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	167.9 (1.1%)
Paleoproterozoic - Neoarchean	Lch	Undivided chert, banded iron-formation, jaspilite, dolomite, mudstone, siltstone	165.9 (1.1%)
Paleoproterozoic	Lchk	Banded iron-formation, chert, mudstone and siltstone	151.3 (1.0%)
Paleoproterozoic	Lchb	Fine-grained, finely laminated, dark grey-brown to black flaggy iron-formation, minor chert, jaspilite, shale.	78.9 (0.53%)
Paleoproterozoic - Neoarchean	Lcpj	Chert breccia, poorly bedded chert	18.6 (0.13%)
Paleoproterozoic	Lchw	Banded iron-formation (commonly jaspilitic), mudstone, siltstone; common interlayered metadoleritic sills	16.8 (0.11%)
Paleoproterozoic	Lfhw	Rhyolite, rhyodacite, rhyolitic volcaniclastic breccia and banded iron formation	11.8 (0.08%)
Neoarchean	Ashm	Interbedded shale, chert, banded iron-formation	3.96 (0.03%)

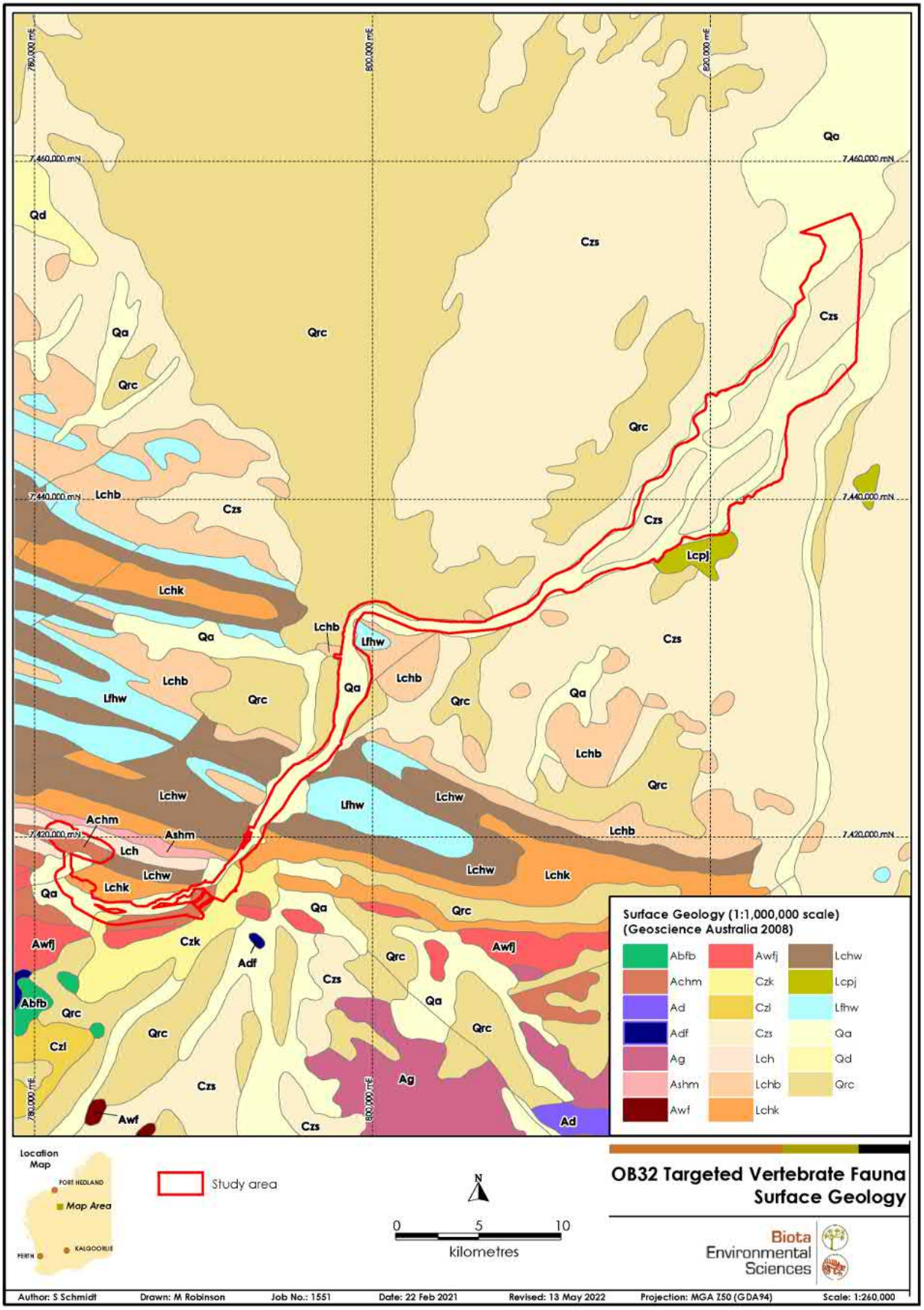

Figure 4.2: Surface geological units of the study area.

4.1.4 Vegetation

Beard (1975b, 1975a) described and mapped the vegetation of the Pilbara at a scale of 1:1,000,000. The study area lies within the Fortescue Botanical District (generally characterised by tree and shrub steppes) of the Eremaean Botanical Province as defined by Beard (1975b, 1975a). The vegetation of this province is typically open, and frequently dominated by spinifex, wattles and occasional eucalypts.

The study area intersects nine Beard vegetation units (Table 4.3; Figure 4.3), most of which are characterized by low *Acacia* woodland or hummock grassland.

Table 4.3: Beard's vegetation units in the study area.

Vegetation Unit	Description	Extent within Study Area (ha) & Percentage of Study Area
Fortescue Valley 166	Low woodland; mulga & *Acacia victoriae*	9,395 (63%)
Fortescue Valley 111	Hummock grasslands, shrub steppe; *Eucalyptus gamophylla* over hard spinifex	1,178 (7.9%)
Fortescue Valley 216	Low woodland; mulga (with spinifex) on rises	1,075 (7.2%)
Hamersley 82	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	1,029 (6.9%)
Fortescue Valley 29	Sparse low woodland; mulga, discontinuous in scattered groups	923.2 (6.2%)
Hamersley 18	Low woodland; mulga (*Acacia aneura*)	700.7 (4.7%)
Kumarina Hills 29	Sparse low woodland; mulga, discontinuous in scattered groups	420.4 (2.8%)
Fortescue Valley 157	Hummock grasslands, grass steppe; hard spinifex, *Triodia wiseana*	106.1 (0.71%)
Fortescue Valley 82	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	22.01 (0.15%)

4.1.5 Conservation Reserves in the Locality

The closest DBCA managed land is a section of Roy Hill pastoral lease proposed for conservation approximately 53 km to the northwest of the study area. Karijini National Park is located approximately 118 km west of the study area and Collier Range National Park is located approximately 122 km south.

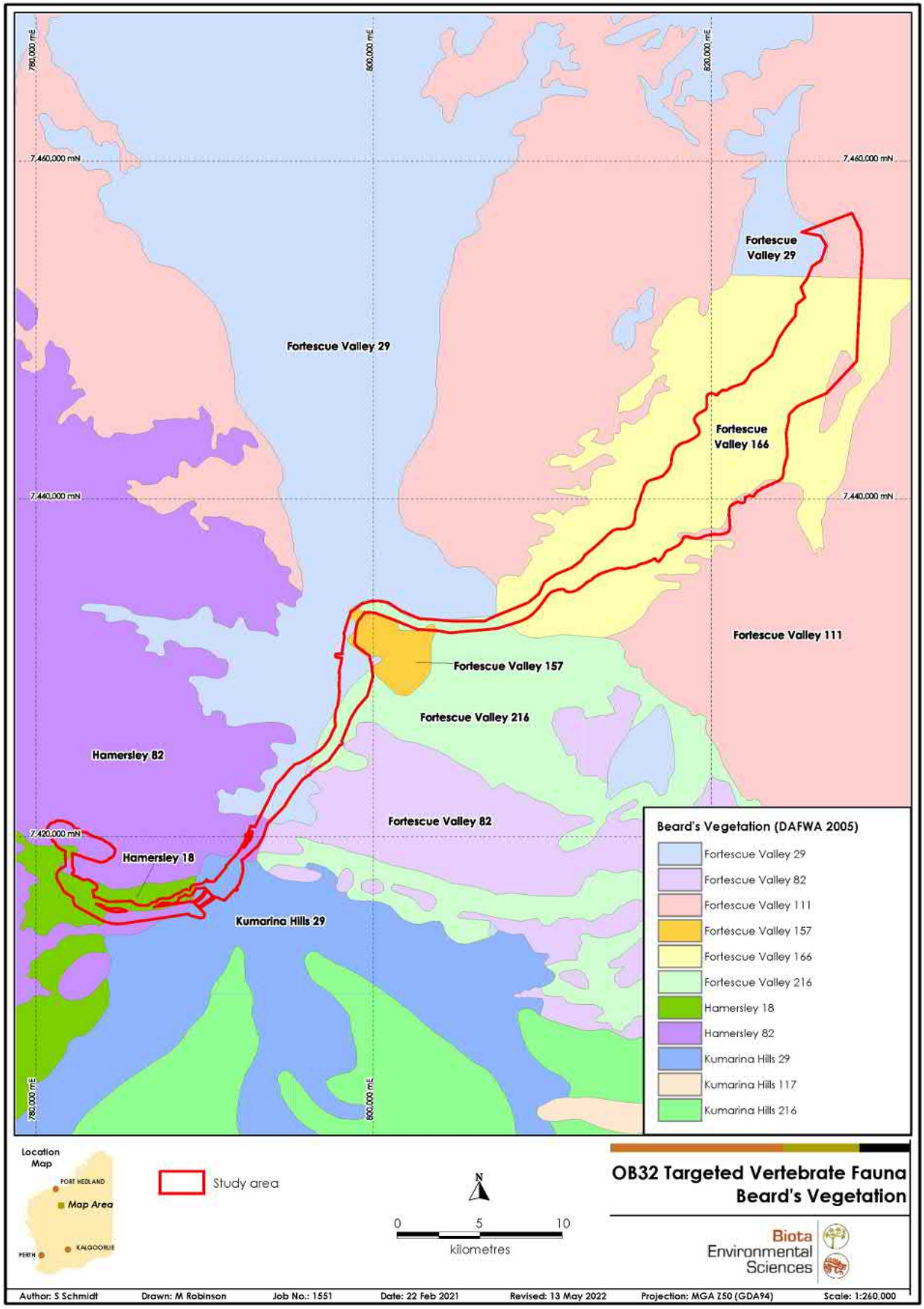

Figure 4.3: Beard's vegetation units of the study area.

4.2 Database Searches and Previous Fauna Surveys

4.2.1 Summary of Desktop Study Results

A total of 376 vertebrate species were identified as potentially occurring in the locality of the study area, based on the results of the desktop study (Table 4.4; Appendix 1).

Table 4.4: Vertebrate species identified from the desktop review.

Vertebrate Fauna Group	Number of Species	Number of Significant Species
Ground mammals	34	7
Bats	13	2
Amphibians	8	-
Reptiles	116	5
Birds	205	26
Total	**376**	**40**

Of these, 31 are MNES fauna species which are also listed at State level, and nine species are only listed at State level and thus were not targeted by this survey (Table 4.5).

As none of the Marine listed species are true marine species, these are excluded from further discussion in this report. The study area does not encompass marine environs, and many Marine-listed species are considered to be listed erroneously, as they do not rely upon marine environments for survival (and in many cases do not use marine environments at all), and all are relatively common and widespread.

4.2.2 Previous Surveys

Previous surveys conducted in the locality (within 40 km of the study area) are summarised in Table 4.6, and mapped in Figure 4.4. Detailed results of the literature review and database searches are provided in Appendix 1, including taxonomic and nomenclature changes that have occurred for species recorded during previous surveys since the time of those studies.

Table 4.5: Vertebrate species of significance identified through the desktop review.

Family	Species Name	Common Name	Conservation Status	
			State	Commonwealth
Non-volant mammals				
Dasyuridae	*Dasycercus blythi*	Brush-tailed Mulgara	Priority 4	
	Dasyurus hallucatus	Northern Quoll	Endangered	Endangered
	Sminthopsis longicaudata	Long-tailed Dunnart	Priority 4	
Thylacomyidae	*Macrotis lagotis*	Greater Bilby*	Vulnerable	Vulnerable
Macropodidae	*Lagorchestes conspicillatus leichardti*	Spectacled Hare-wallaby	Priority 4	
Muridae	*Leggadina lakedownensis*	Short-tailed Mouse	Priority 4	
	Pseudomys chapmani	Western Pebble-mound Mouse	Priority 4	
Bats				
Rhinonycteridae	*Rhinonicteris aurantia*	Pilbara Leaf-nosed Bat	Vulnerable	Vulnerable
Megadermatidae	*Macroderma gigas*	Ghost Bat	Vulnerable	Vulnerable
Herpetofauna				
Scincidae	*Ctenotus uber johnstonei*		Priority 2	
	Lerista macropisthopus remota		Priority 2	
	Liopholis kintorei	Great Desert Skink	Vulnerable	Vulnerable
Typhlopidae	*Anilios ganei*		Priority 1	
Pythonidae	*Liasis olivaceus barroni*	Pilbara Olive Python	Vulnerable	Vulnerable
Birds				
Apodidae	*Apus pacificus*	Pacific [Fork-tailed] Swift	Migratory	Migratory
Charadriidae	*Charadrius dubius*	Little Ringed Plover	Migratory	Migratory
	Charadrius veredus	Oriental Plover	Migratory	Migratory
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	Endangered	Endangered
Scolopacidae	*Limosa limosa*	Black-tailed Godwit	Migratory	Migratory
	Calidris pugnax	Ruff	Migratory	Migratory
	Calidris acuminata	Sharp-tailed Sandpiper	Migratory	Migratory
	Calidris ferruginea	Curlew Sandpiper	Critically Endangered, Migratory	Critically Endangered, Migratory
	Calidris subminuta	Long-toed Stint	Migratory	Migratory
	Calidris ruficollis	Red-necked Stint	Migratory	Migratory
	Calidris melanotos	Pectoral Sandpiper	Migratory	Migratory
	Actitis hypoleucos	Common Sandpiper	Migratory	Migratory
	Tringa totanus	Common Redshank	Migratory	Migratory
	Tringa stagnatilis	Marsh Sandpiper	Migratory	Migratory
	Tringa glareola	Wood Sandpiper	Migratory	Migratory
	Tringa nebularia	Common Greenshank	Migratory	Migratory

Family	Species Name	Common Name	Conservation Status	
Laridae	*Gelochelidon* [nilotica*] macrotarsa*	Australian [Gull-billed] Tern	Migratory	Migratory
	Hydroprogne caspia	Caspian Tern	Migratory	Migratory
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis	Migratory	Migratory
Falconidae	*Falco hypoleucos*	Grey Falcon	Vulnerable	Vulnerable
	Falco peregrinus	Peregrine Falcon	Other Specially Protected Fauna	
Psittacidae	*Polytelis alexandrae*	Princess Parrot	Priority 4	Vulnerable
	Pezoporus occidentalis	Night Parrot	Critically Endangered	Endangered
Hirundinidae	*Hirundo rustica*	Barn Swallow	Migratory	Migratory
Motacillidae	*Motacilla tschutschensis (flava)*	Eastern Yellow Wagtail	Migratory	Migratory
	Motacilla cinerea	Grey Wagtail	Migratory	Migratory

* Referred to as Greater Bilby in this report for consistency with EPBC Act listing in line with purpose of report, contra usage of Bilby in current WA Museum taxonomy

Table 4.6: Summary of previous relevant surveys conducted in the locality of the study area.

Survey (Reference)	Survey Timing & Type	Seasonal Conditions	Fauna Survey Techniques & Effort	Summary of Species Richness	Current Significant Species (MNES species in **bold**)	Limitations
Dynasty Level 2 Vertebrate Fauna Survey (Biologic 2016a)	Single-phase Level 2 (now Detailed) survey 6 – 16th September 2016	No rainfall in month prior to survey, but above average winter rainfall.	Pitfall, funnel and Elliott trapping Targeted search transects Active searching Ultrasonic recorders Motion cameras Spotlighting	87 vertebrate fauna species: 7 non-volant mammal; 8 bat; 39 bird; 31 reptile; and 2 amphibians	• *Ctenotus uber* subsp, *johnstonei* • Brush-tailed Mulgara (*Dasycercus cristicauda*)	Single-phase only No systematic avifauna surveys
Orebody 19 Level 2 Vertebrate Fauna Survey (Biologic 2014a)	Two-phase Level 2 (now Detailed) survey	Generally consistent with long-term averages	Pitfall, funnel, cage and Elliott trapping Avifauna surveys Targeted search transects Active searching Ultrasonic recorders Motion cameras Spotlighting	136 vertebrate fauna species: 18 non-volant mammal; 7 bat; 62 bird; 48 reptile; and 1 amphibian	• **Pilbara Olive Python (*Liasis olivaceus barroni*)** • **Ghost Bat (*Macroderma gigas*)** • *Anilios ganei* • Brush-tailed Mulgara (*Dasycercus blythi*) • Western Pebble-mound Mouse (*Pseudomys chapmani*)	None noted
Orebody 31 Vertebrate Fauna Survey (Biologic 2014b)	Single-phase Level 2 (now Detailed) survey 2-11 October 2013, night sampling 2-6 December 2013	Generally consistent with long-term averages	Pitfall, funnel, cage and Elliott trapping Avifauna surveys Targeted search transects Active searching Ultrasonic recorders Motion cameras Spotlighting	101 vertebrate fauna species; 13 non-volant mammals; 9 bats; 39 birds; 40 reptiles;	• Brush-tailed Mulgara (*Dasycercus blythi*)	Single-phase only in report – additional "phase" (Level 1 only) conducted previously
Orebody 35 and Western Ridge Vertebrate Fauna Survey (Biologic 2011)	Two-phase Level 2 (now Detailed) survey 4 -15 March and 27 July – 6 August 2011	Dry conditions, rainfall below average prior to surveys	Pitfall, funnel, cage and Elliott trapping Avifauna surveys Hair traps Targeted search transects Active searching Ultrasonic recorders Motion cameras Spotlighting	165 vertebrate fauna species; 16 non-volant mammals; 9 bats; 82 birds; 56 species; 2 amphibians	• **Ghost Bat (*Macroderma gigas*)** • **Pilbara Olive Python (*Liasis olivaceus barroni*)** • Peregrine Falcon (*Falco peregrinus*) • *Anilios ganei* • Western Pebble-mound Mouse (*Pseudomys chapmani*) • **Common Greenshank (*Tringa nebularia*)** • **Wood Sandpiper (*Tringa glareola*)**	Relatively dry conditions Trapping not completed in some habitats Nocturnal work limited
South West Jimblebar Vertebrate Fauna Survey (Biologic 2013a)	Single-phase Level 2 (now Detailed) survey 4 – 17 March 2013	Generally consistent with long-term averages	Pitfall, funnel, cage and Elliott trapping Avifauna surveys Targeted search transects Ultrasonic recorders Motion cameras Spotlighting Opportunistic records	118 vertebrate fauna species; 15 non-volant mammals; 7 bats; 55 birds; 39 reptiles; 2 amphibians	• Brush-tailed Mulgara (*Dasycercus blythi*) • *Ctenotus uber johnstonei*	Single phase only
Wheelarra Hill North Fauna Assessment (ENV Australia 2012)	Two-phase Level 2 (now Detailed) survey 7 – 18 April and 4 – 13 October 2011	Generally consistent with long-term averages, slightly higher rainfall	Pitfall, funnel, cage and Elliott trapping Avifauna surveys Active searching Ultrasonic recorders Motion cameras	137 vertebrate fauna species; 13 non-volant mammals; 8 bats; 59 birds; 55 reptiles; and 2 amphibians	• Western Pebble-mound Mouse (*Pseudomys chapmani*)	n/a
Cathedral Gorge Level 1 and Targeted Vertebrate Fauna Survey (Biologic 2016b)	Single phase Level 1 (now Basic) and Targeted Survey 30 September – 5 October 2015	Dry conditions with little rainfall in two months prior to survey	Targeted search transects Active searching Ultrasonic recorders Motion cameras	72 vertebrate fauna species 8 non-volant mammals; 8 bats; 46 birds; 10 reptiles	• **Ghost Bat (*Macroderma gigas*)** • **Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* (Pilbara form))** • **Pilbara Olive Python (*Liasis olivaceus barroni*)** • Western Pebble-mound Mouse (*Pseudomys chapmani*)	Basic level of survey only Single phase only Conditions dry No nocturnal survey work undertaken
Dynasty Vertebrate Fauna Monitoring 2018 (Biologic 2018)	Single phase "Level 2 equivalent" survey 6 – 11 February 2018	Generally consistent with long-term averages, previous season above average rainfall	Pitfall, funnel, and Elliott trapping Targeted search transects Ultrasonic recorders Motion cameras Acoustic recorders	62 vertebrate fauna species; 8 non-volant mammals; 10 bats; 25 birds; 15 reptiles; and 4 amphibians.	• *Ctenotus uber* subsp. *johnstonei* • Brush-tailed Mulgara (*Dasycercus cristicauda*)	Single phase and lower effort than Level 2/Detailed Not aimed at species inventory

Survey (Reference)	Survey Timing & Type	Seasonal Conditions	Fauna Survey Techniques & Effort	Summary of Species Richness	Current Significant Species (MNES species in **bold**)	Limitations
Eastern Ridge (OB23/24/25) Fauna Assessment (ENV Australia 2011a)	Single phase Level 1 (now Basic) survey 17 – 21 May 2011	Generally consistent with long-term averages, slightly higher rainfall	Active searching Ultrasonic recorders	71 vertebrate fauna species; 2 non-volant mammals; 8 bats; 46 birds; 13 reptiles; and 2 amphibians	• **Pilbara Olive Python (*Liasis olivaceus barroni*)** • Western Pebble-mound Mouse (*Pseudomys chapmani*)	Basic level of survey only Single phase only Some access limitations
Ninga Level 1 Vertebrate Fauna Assessment (Eco Logical 2013)	Single phase Level 1 (now Basic) survey 10 – 16 May 2013	Generally consistent with long-term averages	Targeted search transects Ultrasonic recorders Motion cameras	72 vertebrate fauna species; 9 non-volant mammals; 5 bats (plus 2 unconfirmed); 41 birds; 16 reptiles; and 1 amphibian	• **Pilbara Olive Python (*Liasis olivaceus barroni*)** • **Grey Falcon (*Falco hypoleucos*)** • Brush-tailed Mulgara (*Dasycercus blythi*) • Western Pebble-mound Mouse (*Pseudomys chapmani*) • **[Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* Pilbara form)) – unconfirmed]**	Basic level of survey only (no trapping) Single phase only
Ore Body 24 Targeted Vertebrate Fauna Survey (Biologic 2013b)	Single phase Level 1 (now Basic) and Targeted survey 3 - 10 May 2013	Generally consistent with long-term averages, above average rainfall in months prior to survey	Elliott and cage trapping Targeted search transects Ultrasonic recorders Motion cameras	81 vertebrate fauna species; 8 non-volant mammals; 9 bats; 45 birds; 18 reptiles; and 1 amphibian	• **Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* (Pilbara form))** • **Pilbara Olive Python (*Liasis olivaceus barroni*)** • Peregrine Falcon (*Falco peregrinus*) • Brush-tailed Mulgara (*Dasycercus blythi*)	Basic level of survey only (no pitfall or funnel trapping) Single phase only No nocturnal survey work Significant parts of study area recently burnt at time of survey
Orebody 25 Targeted Vertebrate Fauna Survey (Biologic 2014c)	Single phase Level 1 (now Basic) and Targeted survey 5 - 10 August 2013	Generally consistent with long-term averages, high rainfall event month prior to survey	Targeted search transects Ultrasonic recorders Motion cameras	47 vertebrate fauna species; 4 non-volant mammals; 9 bats; 28 birds; and 6 reptiles	• **Pilbara Olive Python (*Liasis olivaceus barroni*)**	Basic level of survey only (no trapping) Single phase only No nocturnal survey work
Orebody 37 Level 1 Vertebrate Fauna Assessment (Eco Logical 2012)	Single phase Level 1 (now Basic) survey 15 – 16 March, 23 – 25 April 2012 (interrupted by tropical cyclone)	Relatively wet conditions, with double average rainfall in 3 months prior to survey	Active searching Ultrasonic recorders Motion cameras	92 vertebrate fauna species; 16 mammals; 64 birds; 11 reptiles; and 1 amphibian	Nil	Basic level of survey only (no trapping) Single phase only No nocturnal survey work
Orebody 42/43 Flora, Vegetation and Fauna Assessment (ENV Australia 2011b)	Single phase Level 1 (now Basic) survey 2 – 6 December 2010	Generally dry, with rainfall for the previous year well below long-term average, but above average in the three months prior to survey	Opportunistic records - no specific details on methodology	81 vertebrate fauna species: 5 non-volant mammals; 6 bats; 66 birds; and 4 reptiles	• **Common Sandpiper (*Actitis hypoleucos*)**	Basic level of survey only (no trapping) Single phase only No nocturnal survey work Limited information on methodology
Ophthalmia Dam Avian Fauna Survey (MWH 2015)	Two phase targeted avifauna survey 7 – 12 December 2014 and 12 – 17 March 2015	Relatively dry during December survey, relatively wet for March survey following rainfall	Systematic point counts Systematic searches Targeted searches Spotlighting Call playback	123 bird species	• **Curlew Sandpiper (*Calidris ferruginea*))** • **Little Ringed Plover (*Charadrius dubius*)** • **Common Sandpiper (*Actitis hypoleucos*)** • **Sharp-tailed Sandpiper (*Calidris acuminata*)** • **Pectoral Sandpiper (*Calidris melanotos*)** • **Long-toed Stint (*Calidris subminuta*)** • **Black-tailed Godwit (*Limosa limosa*)** • **Ruff (*Philomachus pugnax*) (now *Calidris pugnax*)** • **Wood Sandpiper (*Tringa glareola*)** • **Common Greenshank (*Tringa nebularia*)** • **Marsh Sandpiper (*Tringa stagnatilis*)** • **Glossy Ibis (*Plegadis falcinellus*)** • **Pilbara Olive Python (*Liasis olivaceus barroni*)**	Bird survey only
Western Ridge Biological Survey (Onshore Environmental 2014)	Single phase Level 1 (now Basic) survey 21 – 24 June 2014	Generally consistent with long-term averages, above average rainfall in year prior to survey	Targeted search transects Ultrasonic recorders Motion cameras	61 vertebrate fauna species: 7 non-volant mammals; 8 bats; 36 birds; and 8 reptiles.	Nil	Basic level of survey only (no trapping) Single phase only No nocturnal survey work Cold conditions markedly limited reptile activity

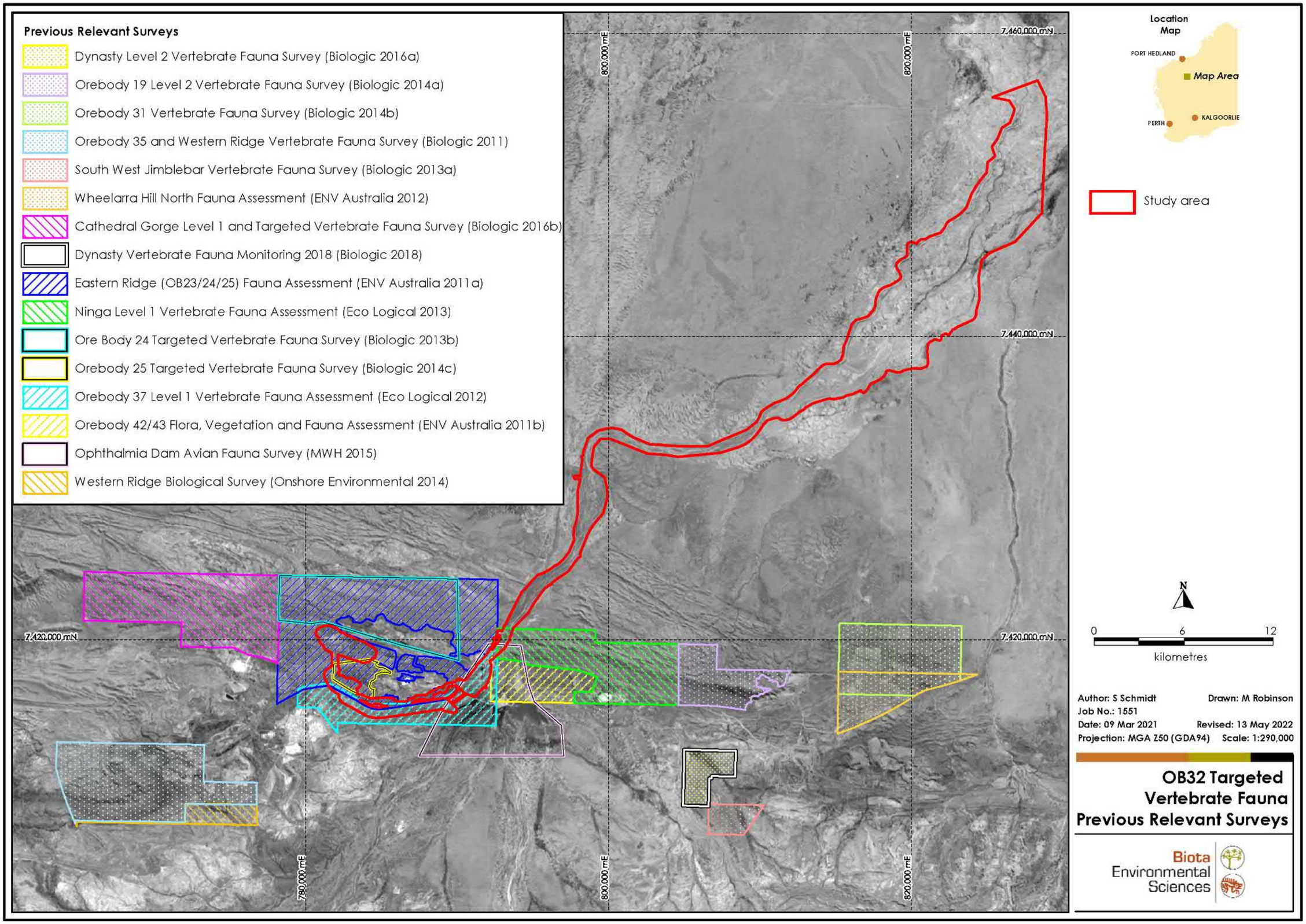

Figure 4.4: Previous relevant surveys undertaken in the locality of the study area.

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5.0 Results and Discussion

5.1 Fauna Habitats

Four fauna landscapes (broad fauna habitats) were identified and mapped on the basis of the approach outlined in Section 3.3.4, in combination with on-ground habitat assessment and consideration of the ecological niches relevant to fauna. These are mapped in Figure 5.1 (with fauna landscape 5 comprising cleared/disturbed areas), and Table 5.1 presents detailed information for each fauna landscape, including dominant vegetation, a representative site picture and the dominant BHP WAIO – prescribed fauna habitat types.

Habitat assessment data and a photo for each sampling and habitat assessment site as required by BHP WAIO's spatial data requirements (SPR-IEN-EMS-015) are presented in Appendix 4, including fauna landscapes for cross-reference.

Based on reviews of aerial imagery and land systems, vegetation, and surface geology mapping, the fauna landscapes identified during the fauna survey are not confined to the study area, extend contiguously beyond the study area, and are common and widespread within the Fortescue plains subregion (van Vreeswyk et al. 2004), compare Figure 5.1 and Section 4.1):

- Fauna landscape 1 (vegetated sandy/stony drainage systems / BHP dominant fauna habitat type Major Drainage Line) broadly corresponds with River land system, comprising almost a third (32.3%) of the study area,
- Fauna landscape 2 (sandy *Triodia* plains / BHP dominant fauna habitat type Sand Plain) mainly comprises Fortescue land system and only limited areas of Divide land system, only representing approximately 5% of the study area but is contiguous with extensive *Triodia* plains outside the study area;
- Fauna landscape 3 (floodplains – open shrubland with patches of *Mulga* / BHP dominant fauna habitat type Drainage Area/ Floodplain) comprises mainly Fortescue (original study area) and Elimunna (additional study area) land systems and reflects over 57% of the study area; and
- Fauna landscape 4 (undulating low hills and ironstone outcrops / BHP dominant fauna habitat type Undulating Low Hills) reflects approximately 1% of the study area, comprising mainly Boolgeeda and Newman with some Rocklea land system areas, all of which extend contiguously to the east and west of the southern part of the study area.

Table 5.1: Fauna habitats identified within the study area including area and dominant characteristics.

Fauna Habitat	Extent (proportion)	Representative photo
Fauna Landscape 1: Vegetated sandy/stony drainage systems Dominant BHP Fauna habitat type: Major Drainage Line Land systems: Fortescue, River, Elimunna, Divide, Fan. Landforms: Major/medium drainage line (main river system including banks and some flood out grass/herb land areas). Fauna habitats: Major/medium drainage line, waterhole (ephemeral pools), wetland, drainage area/floodplain. Substrate: Sand or alluvial rocks. Surface geology: Predominantly alluvial sediment (gravel, sand, silt, clay, locally calcreted). Vegetation: *Acacia* (e.g. *A. citrinoviridis, A. aneura*) and *Melaleuca* woodland and shrubland with scattered trees (e.g. *Eucalyptus camaldulensis*, *Corymbia hamersleyana*) and grasses, sedges and herbs (including small areas of open *Triodia* grassland), *Cenchrus* spp. dominant in some areas.	4,799.8 ha (32.3%)	
Fauna Landscape 2: Sandy *Triodia* plains Dominant BHP Fauna habitat type: Sand Plain Land systems: Fortescue, Adrian, Divide, River, Newman. Landforms: Sandy/stony plains. Fauna habitats: Sandy/stony plains, drainage area/floodplains. Substrate: Sandy clay loam. Surface geology: sand plains with ferruginous pisoliths or pebbles. Vegetation: *Acacia* mixed very open woodland with scattered trees (e.g. *Eucalyptus camaldulensis*, *Corymbia hamersleyana*) and shrubs over *Triodia* grassland.	780.2 ha (5.3%)	

Fauna Habitat	Extent (proportion)	Representative photo
Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga* Dominant BHP Fauna habitat type: Drainage Area/ Floodplain Land systems: Fortescue, River, Adrian, Divide. Landforms: Floodplain (including flood fringe), minor drainage line, sandy/stony plain. Fauna habitats: Drainage area/floodplain, minor drainage line, Mulga woodland, sandy/stony plain, vegetation grove. Substrate: Sandy clay loam. Surface geology: Predominantly alluvium, sand/stony plain. Vegetation: Scattered *Acacia* over shrub steppe and tussock grassland with patches of Mulga woodland - *Acacia aneura* discontinuous in scattered groups.	8,545.3 ha (57.6%)	
Fauna Landscape 4: Undulating low hills and ironstone outcrops Dominant BHP Fauna habitat type: Undulating Low Hills Land systems: Newman, Rocklea, River. Landforms: Ironstone outcrops, footslope, undulating low hills. Fauna habitats: Ironstone outcrops, footslope, undulating low hills, boulders/rockpiles, breakaway, cliff. Substrate: Stony loams or exposed rock. Surface geology: Brockman (banded) iron formation. Vegetation: Scattered eucalypts and *Acacia* over open (hard) *Triodia* hummock grassland with low shrubs, herbs and tussock grasses.	197.2 ha (1.3%)	

Fauna Habitat	Extent (proportion)	Representative photo
Fauna Landscape 5: Cleared/disturbed, including artificial water bodies, roads/tracks, rail etc. Dominant BHP Fauna habitat type: Cleared/ Disturbed Other Fauna habitat types included: artificial wetlands, dam.	526.2 ha (3.5%)	

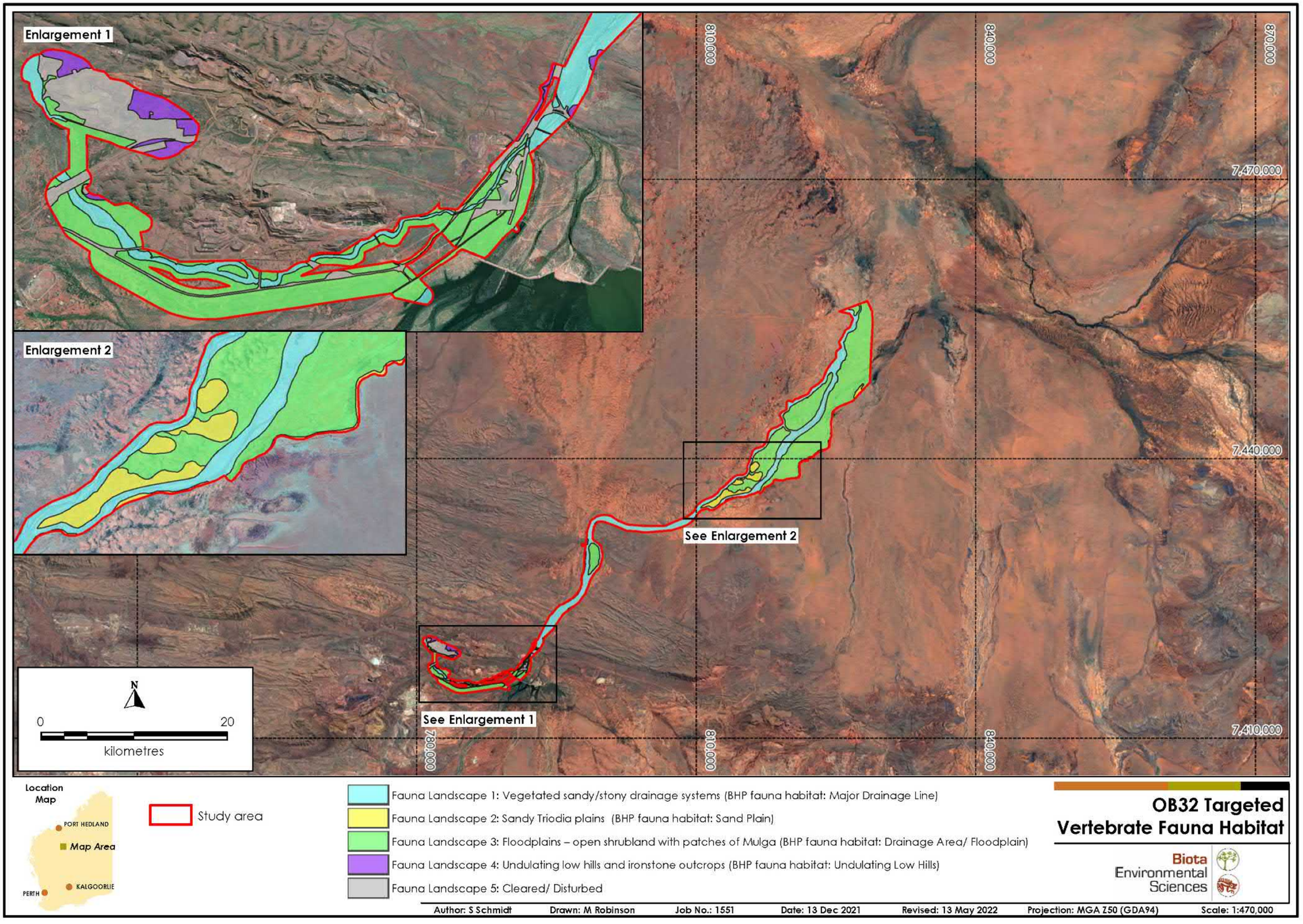

Figure 5.1: Fauna habitats of the study area.

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5.2 Vertebrate Fauna

5.2.1 Vertebrate Fauna Overview

A total of 128 vertebrate species were recorded during the survey. Table 5.2 provides a summary of the number of species recorded from each major vertebrate group. The fauna recorded during the survey represent approximately one third (34%) of the total of 373 species identified from the locality of the study area (Appendix 1 and Section 4.2). This is considered a large proportion given only MNES vertebrate fauna were targeted, no traps were deployed, and limitations such as access constraints (see Table 3.10).

Table 5.2: Vertebrate fauna recorded during the survey and known from the locality.

	Number of Species	
Vertebrate Fauna Group	**This Survey**	**Desktop Study**
Non-volant Mammals	9	34
Bats	11 (inc. 1 not recorded in desktop)	13
Reptiles[4]	20	116
Amphibians	1	8
Birds	87	205
Total	**128**	**376**

5.2.2 Non-volant Mammals

At least nine ground-dwelling mammal species were recorded from the study area, representing 26% of all ground-dwelling mammal species known from the locality (n=34) based on database records and previous surveys (Appendix 1). The species total comprised two kangaroo species (Macropodidae), at least one rodent species (Muridae), Rabbit (*Oryctolagus cuniculus*), Horse (*Equus caballus*), Donkey (*Equus asinus*), Domestic Dog (*Canis familiaris familiaris*), Cat (*Felis catus*), and European Cattle (*Bos taurus*). Numerous rodents were detected on motion cameras but are difficult to identify with confidence based on the images alone, but likely involve at least three species (*Zyzomys argurus* – confirmed, *Pseudomys hermannsburgensis* and **Mus musculus*).

No MNES ground-dwelling mammals were recorded during the survey.

5.2.3 Bats

Eleven bat species from five families were recorded from the study area. These include 10 of the 13 species known from the locality based on database records and previous surveys (77%) and one previously unrecorded species: Pallid long-eared bat (*Nyctophilus daedalus*) (Appendix 1).

One MNES bat species, Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* (Pilbara Form), was recorded during the survey (see Section 5.3.1.1).

5.2.4 Reptiles

Twenty reptile species were recorded from the study area, representing 17% of the 116 species known from the locality based on database records and previous surveys (Appendix 1). These include species from eight of the 11 families known from the locality based on database records and previous surveys, and one species not previously recorded: *Gehyra purpurascens*[5] (Appendix 1).

No MNES reptile species were recorded during the survey.

4 This represents the minimum number of species recorded, as *Gehyra* spp. in the Pilbara have recently undergone extensive taxonomic revision (see Appendix 1)

5 ID confirmed by Paul Doughty, WAM

5.2.5 Amphibians

One amphibian species was recorded from the study area, representing one eighth of all amphibian species known from the locality (n=8) based on database records and previous surveys (Appendix 1).

No MNES amphibian species were recorded during the survey, and none are known from the locality based on the results of the desktop study.

5.2.6 Birds

Eighty-seven bird species from 27 families were recorded from the study area, representing approximately 42% of the 205 species known from the locality based on database records and previous surveys (Appendix 1).

Two MNES bird species were recorded during the survey (see Section 5.3.1); Grey Falcon (*Falco hypoleucos*) and Pacific [Fork-tailed] Swift (*Apus pacificus*).

5.3 MNES Fauna

Table 5.3 provides an overview of the 31 MNES species that were identified in the desktop study (see Section 4.2) with the likelihood of occurrence of each species determined based on existing information, including previous records from the locality and records from the current survey shown in Figure 5.2, and taking into account the habitat assessment and sampling conducted during the field survey. None of these species have previously been recorded within the study area.

Fifteen MNES species were considered 'unlikely to occur' or 'would not occur' in the study area Table 5.3).

The MNES species confirmed as occurring (three species) or that have the potential to occur (three species likely to occur and ten species that may occur) are discussed in detail below (Section 5.3.1 and Section 5.3.2). While these species utilise or are likely to utilise habitats within the study area (Section 5.3.3), none are expected to be restricted to the study area, and the habitats identified are considered common throughout the region (see Section 5.1).

5.3.1 MNES Vertebrates Recorded in the Study Area

Three MNES species were recorded from the study area during the current survey:

- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* Pilbara form; Vulnerable), calls recorded on multiple occasions and from multiple locations;
- Grey Falcon (*Falco hypoleucos*; Vulnerable), one individual observed; and
- Pacific [Fork-tailed] Swift (*Apus pacificus*; Migratory), call recorded from one location.

The locations and details of these records are presented below in Figure 5.2 and Table 5.4, and the species are discussed in more detail in Sections 5.3.1.1 to 5.3.1.3.

No MNES species have previously been recorded within the study area.

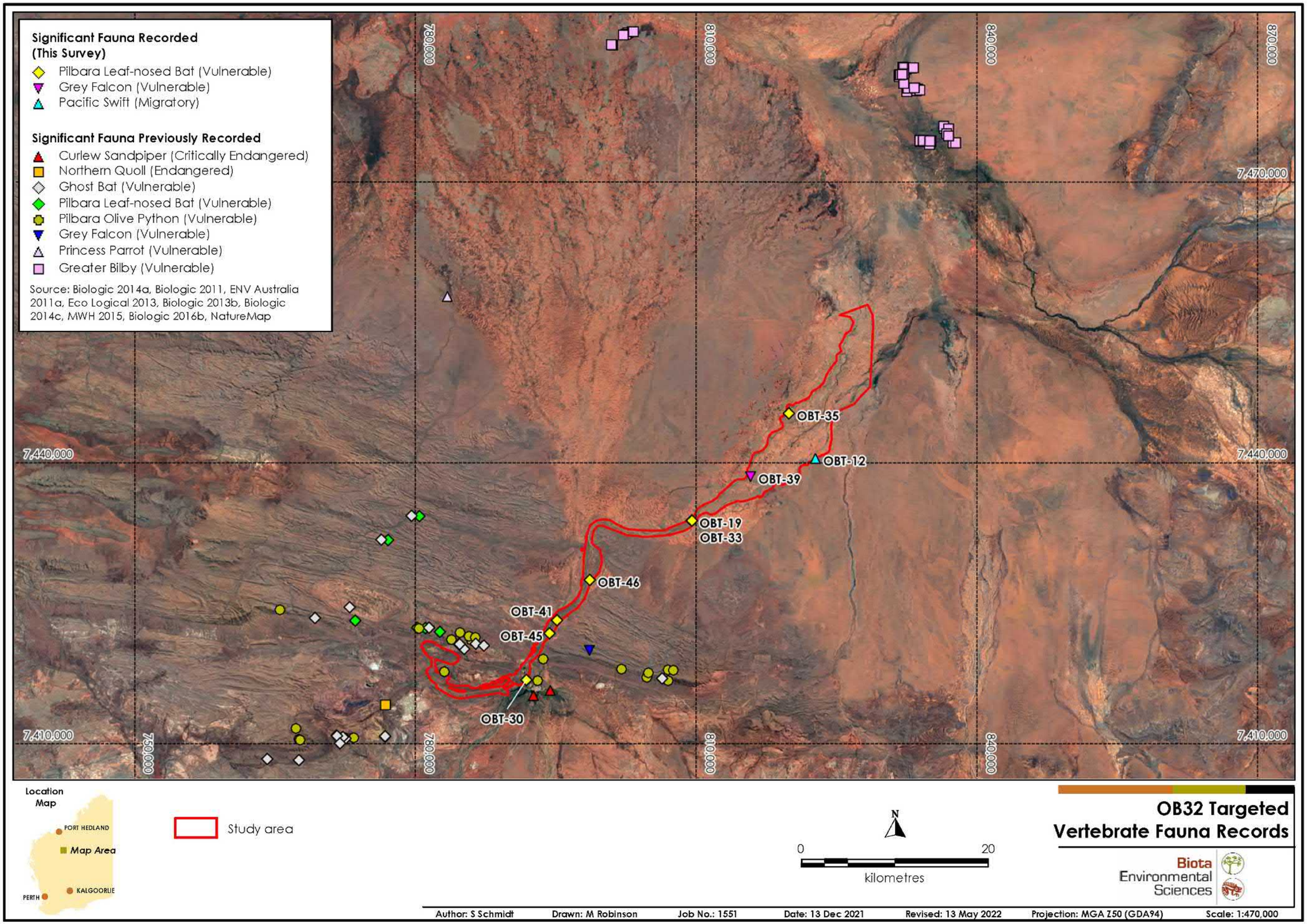

Figure 5.2: MNES fauna species recorded from the study area during current survey and previously from the locality.

Table 5.3: MNES species from the desktop study and their likelihood of occurrence.
(confirmed species, and species likely to occur or may occur highlighted in grey)

Family	Species Name	Common Name	Conservation Status		Preferred Habitat (habitat available in study area **bold**)	Habitat Available in the Study Area	Occurrence in Locality	Likelihood of Occurrence
			State	Common-wealth				
Non-volant mammals								
Dasyuridae	*Dasyurus hallucatus*	Northern Quoll	Endangered	Endangered	Critical habitat: gorges, gullies, free faces, breakaways, boulder piles, incised hills. Supporting habitat: permanent and **semi-permanent water, drainage systems**	Yes (supporting habitat)	The species or species habitat is likely to occur within the locality, including a small part of the study area, and the species/habitat may occur in the remaining parts of the study area (Department of the Environment 2017)). Ground-truthing during the survey confirmed the presence of suitable foraging and dispersal habitat (Fauna Landscape 1) within the study area and the presence of habitat suitable for denning adjacent to the eastern and western boundary of the study area (Newman, Rocklea, Boolgeeda land systems, Figure 5.1), that intersects the study area boundary. However, there are no previous records from within the locality, despite extensive recent previous survey effort in suitable habitat. The nearest records are from approximately 63 km north and 70 km northwest of the study area boundary.	Unlikely to occur
Thylacomyidae	*Macrotis lagotis*	Greater Bilby	Vulnerable	Vulnerable	Typically, **sandy soils covered with spinifex grassland, with an overstorey of low shrubs dominated by Acacia species** but remaining subpopulations occupy three major vegetation types: Open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and **hummock grassland in plains and alluvial areas**.	Yes	Two clusters of multiple recent records within the locality, with the nearest records approx. 19 km north of the study area boundary. While limited habitat exists within the study area, ground-truthing during the survey confirmed extensive critical habitat is present in close proximity (less than 10 km east and less than 20 km north) to the northern part of the study area, contiguous with the area where the species has previously been recorded, and intersecting the eastern study area boundary (Divide land system, Figure 5.1, Figure 5.2).	Likely to occur
Bats								
Rhinonycteridae	*Rhinonicteris aurantia*	Pilbara Leaf-nosed Bat	Vulnerable	Vulnerable	Semi-desert adapted. Critical habitat includes caves or mine adits with stable, very hot and very humid microclimates. Supporting foraging habitat includes ***Triodia* hummock grassland, sparse tree and shrub savannah and riparian vegetation along drainage lines.**	Yes (supporting habitat)	Recorded on multiple occasions and from multiple locations within the study area during the survey (Figure 5.2, Table 5.4). Also recorded from multiple locations within the locality during previous surveys in extensive areas of critical habitat that intersect the study area (i.e. extensive habitat that occurs outside the study area and extends across the study area boundary into the study area, thus is contiguous with habitat inside the study area) (Newman, Rocklea, Boolgeeda Land systems, Figure 5.1). The nearest records are less than 5 km from the study area boundary (Figure 5.2). Extensive supporting habitat is present within the study area (Fauna Landscape 1).	Recorded
Megadermatidae	*Macroderma gigas*	Ghost Bat	Vulnerable	Vulnerable	Range of habitats that provide suitable caves for roost sites, Critical habitat: gorges, gullies, free faces, incised hills. Supporting habitat: **drainage systems, alluvial plains and Floodplains.**	Yes (supporting habitat)	Recorded on multiple occasions and from multiple locations (calls and scats) within the locality during previous surveys in areas of critical habitat that intersect the study area (i.e. extensive habitat that occurs outside the study area and extends across the study area boundary into the study area, thus is contiguous with habitat inside the study area) (Newman, Rocklea, Boolgeeda Land systems, Figure 5.1), with the nearest records less than 5 km from the study area boundary (Figure 5.2). In addition, extensive supporting habitat is present within the study area (Fauna Landscape 1).	Likely to occur
Herpetofauna								
Scincidae	*Liopholis kintorei*	Great Desert Skink	Vulnerable	Vulnerable	Generally **red sand plains** and sand ridges. Mosaic vegetation different ages (regenerating vegetation important), usually consisting of **hummock grasslands with scattered shrubs and trees. Preferred habitat has at least 50% bare ground.**	Yes	No records from the locality, nearest record over 300 km to the northeast of the study area and the species' known distribution does not include the study area locality.	Would not occur
Pythonidae	*Liasis olivaceus barroni*	Pilbara Olive Python	Vulnerable	Vulnerable	Gorges, escarpments, **rocky outcrops** and water holes, shelters in caves, beneath boulders, in **pools of water and occasionally in trees overhanging water and spinifex grasslands.** Associated with **ephemeral or permanent water** but may also be recorded in **rocky habitats some distance from these features**. Known to utilise **manmade**	Yes (supporting habitat)	Recorded on multiple occasions and from multiple locations (during eight previous surveys) within the locality in areas of critical habitat that intersect the study area (i.e. extensive habitat that occurs outside the study area and extends across the study area boundary into the study area, thus is contiguous with habitat inside the study area) (Newman, Rocklea, Boolgeeda Land systems, Figure 5.1), with the nearest record less than 500 m from the study area boundary (Figure 5.2). In addition, extensive supporting habitat is present within the study area (Fauna Landscape 1).	Likely to occur

Family	Species Name	Common Name	Conservation Status		Preferred Habitat (habitat available in study area **bold**)	Habitat Available in the Study Area	Occurrence in Locality	Likelihood of Occurrence
			State	Common-wealth				
					water bodies.			
Birds								
Apodidae	*Apus pacificus*	Pacific [Fork-tailed] Swift	Migratory	Migratory	Entirely aerial when in Australia.	Yes	Recorded in study area during this survey, no previous records from the locality.	Recorded
Charadriidae	*Charadrius dubius*	Little Ringed Plover	Migratory	Migratory	**Sandy or muddy fringes of freshwater wetlands**	Yes	There is limited potentially suitable habitat within the study area and the species is very infrequently recorded in the locality (one record from Ophthalmia Dam, MWH 2015).	Unlikely to occur
	Charadrius veredus	Oriental Plover	Migratory	Migratory	**Sparsely vegetated plains and wetland margins**, also beaches, tidal flats, saltworks and sewage ponds, particularly on passage or for roosting in hot conditions	Yes	Potentially suitable habitat for the species exists in locality, including within the study area in larger drainage line areas and along their margins, and one record exists from the locality.	May occur
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	Endangered	Endangered	**Freshwater wetlands,** preferring **ephemeral wetlands with a mix of shallow water, exposed mud, and dense fringing vegetation**	Yes	Potentially suitable habitat around water bodies within the study area and the wider locality, though the species would only be an occasional visitor. One record approximately 60 km northeast of the study area.	May occur
Scolopacidae	*Limosa limosa*	Black-tailed Godwit	Migratory	Migratory	**Shallow freshwater wetlands**, tidal mudflats and estuaries, preferring muddy substrates.	Yes	Migratory shorebird species. There is very limited suitable habitat within the study area, i.e. small artificial water bodies and the species is very infrequently recorded in the locality - most likely as occasional passage visitors. Previously recorded at Ophthalmia Dam (MWH 2015).	Unlikely to occur
	Calidris pugnax	Ruff	Migratory	Migratory	**Freshwater wetlands**, estuaries, salt works and sewage treatment works	Yes	Migratory shorebird species. There is very limited suitable habitat within the study area, i.e. small artificial water bodies and the species is very infrequently recorded in the locality - most likely as occasional passage visitors. Previously recorded at Ophthalmia Dam (MWH 2015).	Unlikely to occur
	Calidris acuminata	Sharp-tailed Sandpiper	Migratory	Migratory	**Shallow freshwater and estuarine wetlands or wetland margins**; less commonly coastal mudflats	Yes	Migratory shorebird species. Potentially suitable habitat occurs along the drainage lines within the study area when inundated, though habitat would only support small numbers of birds – most likely as occasional passage visitors. Previously recorded at Ophthalmia Dam (MWH 2015)	May occur
	Calidris ferruginea	Curlew Sandpiper	Critically Endangered, Migratory	Critically Endangered, Migratory	Beaches, tidal mudflats of and **shallow inland wetlands, including dams**	Yes	Migratory shorebird species. There is very limited suitable habitat within the study area, i.e. small artificial water bodies and the species is very infrequently recorded in the locality - most likely as occasional passage visitors. Previously recorded at Ophthalmia Dam (MWH 2015).	Unlikely to occur
	Calidris subminuta	Long-toed Stint	Migratory	Migratory	**Freshwater wetlands**, estuaries, salt lakes	Yes	Migratory shorebird species. There is very limited suitable habitat within the study area, i.e. small artificial water bodies and the species is very infrequently recorded in the locality - most likely as occasional passage visitors. Twice previously recorded at Ophthalmia Dam (MWH 2015, NatureMap).	Unlikely to occur
	Calidris ruficollis	Red-necked Stint	Migratory	Migratory	**Shallow waters and exposed margins of a variety of wetland habitats** including estuaries, tidal mudflats, salt lakes, **shallow margins of freshwater wetlands**, sewage treatment works	Yes	Migratory shorebird species. Potentially suitable habitat occurs along the drainage lines within the study area when inundated, though habitat would only support small numbers of birds – most likely as occasional passage visitors.	May occur
	Calidris melanotos	Pectoral Sandpiper	Migratory	Migratory	**Shallow freshwater wetlands**, occasionally estuarine and coastal wetlands.	Yes	Migratory shorebird species. There is very limited suitable habitat within the study area, i.e. shallow freshwater areas, and the species is very infrequently recorded in the locality - most likely as occasional passage visitors. Previously recorded at Ophthalmia Dam (MWH 2015).	Unlikely to occur
	Actitis hypoleucos	Common Sandpiper	Migratory	Migratory	Margins of sheltered coasts, estuaries and **freshwater wetlands.**	Yes	Migratory shorebird species. Potentially suitable habitat occurs along the drainage lines within the study area when inundated, though habitat would only support small numbers of birds – most likely as occasional passage visitors. Previously recorded at Ophthalmia Dam (MWH 2015) and Orebody 42/43 (ENV Australia 2011b).	May occur
	Tringa totanus	Common Redshank	Migratory	Migratory	In Australia, usually recorded from tidal mudflats, **creeks** and estuaries, but uses **wide range of wetland habitats** elsewhere.	Yes	Migratory shorebird species. There is some potentially suitable wetland habitat available in the study area but only one previous record exists from the locality and none of the habitats the species is usually recorded from in Australia is present in the study area.	Unlikely to occur
	Tringa stagnatilis	Marsh Sandpiper	Migratory	Migratory	**Shallow freshwater wetlands**, and less commonly, tidal mudflats	Yes	Migratory shorebird species. Potentially suitable habitat occurs along the drainage lines within the study area when inundated, though habitat would only support small numbers of birds – most likely as occasional passage visitors. Previously recorded at Ophthalmia Dam (MWH 2015)	May occur
	Tringa glareola	Wood Sandpiper	Migratory	Migratory	**Freshwater wetlands** and sewage treatment works	Yes	Migratory shorebird species. Potentially suitable habitat occurs along the drainage lines within the study area when inundated, though habitat would only support small numbers of birds – most likely as occasional passage visitors.	May occur

Family	Species Name	Common Name	Conservation Status		Preferred Habitat (habitat available in study area **bold**)	Habitat Available in the Study Area	Occurrence in Locality	Likelihood of Occurrence
			State	Common-wealth				
							Previously recorded at Ophthalmia Dam (MWH 2015) and Orebody 35/Western Ridge (Biologic 2011).	
	Tringa nebularia	Common Greenshank	Migratory	Migratory	**Shallow wetland habitats** including estuaries, tidal mudflats, salt lakes, **shallow margins of freshwater wetlands**, sewage treatment works	Yes	Migratory shorebird species. Potentially suitable habitat occurs along the drainage lines within the study area when inundated, though habitat would only support small numbers of birds – most likely as occasional passage visitors. Previously recorded at Ophthalmia Dam (MWH 2015) and Orebody 35/Western Ridge (Biologic 2011).	May occur
Laridae	*Gelochelidon [nilotica] macrotarsa*	Australian [Gull-billed] Tern	Migratory	Migratory	Estuaries, tidal mudflats, saltmarshes, saltpans, freshwater lagoons, deltas, **inland lakes, rivers, marshes, swamps, grassland plains**.	Yes	Potentially suitable habitat for the species occurs along the larger drainage lines in the locality, including within the study area, though the species would likely only occur as an occasional visitor.	May occur
	Hydroprogne caspia	Caspian Tern	Migratory	Migratory	Sheltered coastal waters and estuaries, and **larger inland water bodies including lakes and larger rivers.**	Yes	There is limited potentially suitable habitat within the study area and the species is very infrequently recorded in the locality (three records from Ophthalmia Dam).	Unlikely to occur
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis	Migratory	Migratory	**Freshwater wetlands and floodplains**; requires shallow water and mudflats, so is found in **well-vegetated wetland, floodplains**, mangroves and ricefields.	Yes	There is limited potentially suitable habitat within the study area and the species is very infrequently recorded in the locality (few records from Ophthalmia Dam, one from the Fortescue River and one from Newman).	Unlikely to occur
Falconidae	*Falco hypoleucos*	Grey Falcon	Vulnerable	Vulnerable	**Favours lightly wooded and untimbered lowland plains that are crossed by major watercourses lined with taller trees or isolated man-made structures such as communications towers.**	Yes	One individual observed during targeted search on 21/09/2021. One previous record from the locality (Eco Logical 2013), less than 5 km east of the study area boundary.	Recorded
Psittacidae	*Polytelis alexandrae*	Princess Parrot	Priority 4	Vulnerable	**Sandy spinifex plains** and dunes, often with overstorey of Desert Oak or white gums	Yes	There is suitable habitat within the study area and while the species is very infrequently recorded in the locality (one record from Jigalong-Newman Road in 2012), the nomadic nature of this species means that it may occur within the study area on occasion where it would likely forage in the sandy *Triodia* plain and floodplain area during seeding after flooding events.	May occur
	Pezoporus occidentalis	Night Parrot	Critically Endangered	Endangered	**Arid or semi-arid spinifex grasslands with large, established and unburnt hummocks, usually in association with palaeodrainage/drainage areas**, salt lake or **rocky breakaways**. Foraging habitat includes **high productivity grassland areas**, and shrublands of samphire, bluebush and saltbush.	Yes	The occurrence of Night Parrots has recently been confirmed from the vicinity of the Fortescue Marsh (FMG 2021). The precise location has not been disclosed, though it is likely over 40 km from the study area, i.e. not from the locality (the Fortescue Marsh is located over 50 km northwest of the study area). Small areas of potentially suitable roosting habitat are present within the study area, along with potentially suitable spinifex/grassy areas for foraging. In addition, extensive areas of potentially suitable roosting and foraging habitat occur adjacent to the northern and central part of the study area, in some areas contiguously (study area boundary intersects habitat (i.e. extensive habitat that occurs outside the study area and extends across the study area boundary into the study area, thus is contiguous with habitat inside the study area) Divide land system, Figure 5.1).	Unlikely to occur
Hirundinidae	*Hirundo rustica*	Barn Swallow	Migratory	Migratory	**Open areas, usually close to water**.	Yes	Suitable habitat present, however there are no existing records from the locality.	Unlikely to occur
Motacillidae	*Motacilla tschutschensis (flava)*	Eastern Yellow Wagtail	Migratory	Migratory	Coastal marshes, **wetland margins, paddocks** and short grasslands	Yes	Suitable habitat present, however there are no existing records from the locality.	Unlikely to occur
	Motacilla cinerea	Grey Wagtail	Migratory	Migratory	**Margins of watercourses and wetlands, particularly fast- flowing freshwater waterways**.	Yes	Suitable habitat present, however there are no existing records from the locality.	Unlikely to occur

Table 5.4: MNES vertebrate fauna recorded from study area during current survey.

Species	Common name	Site	Latitude	Longitude	Date	Count*
Rhinonicteris aurantia Pilbara Form	Pilbara Leaf-nosed Bat	OBT-19	-23.175578	120.023231	18/04/2021	1
					19/04/2021	3
					20/04/2021	4
					22/04/2021	1
					30/04/2021	1
					01/05/2021	2
					02/05/2021	2
					04/05/2021	3
		OBT-30	-23.332346	119.854191	16/09/2021	1
		OBT-33	-23.175424	120.023640	15/09/2021	7
		OBT-35	-23.070218	120.122180	15/09/2021	1
		OBT-41	-23.274095	119.884937	16/09/2021	1
		OBT-45	-23.287030	119.877529	19/09/2021	2
		OBT-46	-23.234678	119.918274	19/09/2021	1
Falco hypoleucos	Grey Falcon	OBT-39	-23.132006	120.083611	21/09/2021	1
Apus pacificus	Pacific [Fork-tailed] Swift	OBT-12	-23.113031	120.150873	15/09/2021	1

* Except for the Grey Falcon (observation of one individual), count refers to number of detections on recording units rather than number of individuals

5.3.1.1 Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* Pilbara Form)

Vulnerable under the EPBC Act and the BC Act.

Distribution: The Pilbara Leaf-nosed Bat is a sub-population of the Orange Leaf-nosed Bat and is endemic to the Pilbara and Ashburton regions of Western Australia. The Pilbara population is isolated from the main population in the Kimberley, Northern Territory and Queensland by 400 km of unsuitable habitat.

Ecology: The Pilbara Leaf-nosed Bat is semi-desert adapted and has specific roosting requirements, requiring roost sites in caves or mine adits with stable, very hot (28 – 32°C) and very humid (96 – 100 %) microclimates (Churchill 2008). Caves deep enough to create this environment are relatively uncommon in the Pilbara (van Dyck and Strahan 2008), which limits the availability of diurnal roosts for this species. Observed foraging habitat includes *Triodia* hummock grassland, sparse tree and shrub savannah and riparian vegetation along drainage lines (Duncan et al. 1999). The Pilbara Leaf-nosed Bat has a cryptic, high frequency call that has previously imparted low detectability of this species, and as such has potentially resulted in an underestimate of population size. However, McKenzie and Bullen (2009) found that this species is more common than previously recognised (Hancock and Timms 2002).

Likelihood of occurrence: Occurs. This species was recorded in the study area at multiple locations along the Fortescue River, on multiple occasions, and during both survey phases (see Table 5.4, Figure 5.2). The earliest call was recorded at 18:58 on 19/09/2021 at site OBT-45, two minutes after sunset. Biologic previously recorded calls from multiple locations in the locality (Biologic 2013b, Biologic 2016), to the north and west of the western end of the study area. Based on the time of the calls, Biologic (2013b) concluded there may be a roost within 10 km of the three locations closest to the study area, and the earliest recorded call during this study is consistent with this. However, the nearest known roost is located approximately 32 km to the northwest of the western end of the study area. The closest Pilbara Leaf-nosed Bat has previously been recorded was approximately 3.5 km north of the study area boundary (Biologic 2013). In addition, Eco Logical (2013) recorded possible Pilbara Leaf-nosed Bat calls at Ninga (see Table 4.6, Figure 4.4). Previous records occurred in extensive critical habitat with gorges, gullies, caves and rock pools, i.e. habitat suitable for roosting (e.g. Biologic 2016) present outside the study area, which extends into the study area, i.e. intersects the study area boundary (Newman, Rocklea,

Boolgeeda land systems, see Figure 4.1 and Figure 5.1), and extensive supporting habitat is present within the study area (Fauna Landscape 1/Major Drainage Line, see Section 5.3.3, Table 5.3).

5.3.1.2 Grey Falcon (*Falco hypoleucos*)

Vulnerable under the EPBC Act and the BC Act.

Distribution: The Grey Falcon is sparsely distributed across much of arid inland Australia, including the Pilbara.

Ecology: The Grey Falcon occurs mainly on lightly wooded plains and along major watercourses in arid Australia (Johnstone et al. 2013), and breeds in taller trees such as river red gums (*Eucalyptus camaldulensis*), or on isolated man-made structures such as communications towers. It is an active hunter, feeding on birds, reptiles and occasionally large insects.

Likelihood of occurrence: Occurs. A single Grey Falcon was recorded from the study area during the current survey, observed during a targeted search (OBT-39, see Figure 3.3, Figure 5.2, Table 5.4) on 21/09/2021: very close-by, patrolling low over ground, i.e. below height of Mulga grove in open floodplain area (Fauna Landscape 3 (Floodplains – open shrubland with patches of Mulga)/ Drainage Area/ Floodplain), then again flying higher and returning to the same area, patrolling over ground again. In addition, one previous record exists from the locality, less than five kilometres east of the study area boundary (see Table 5.4 and Figure 5.2).

5.3.1.3 Pacific [Fork-tailed] Swift (*Apus pacificus*)

Migratory under the EPBC Act and the BC Act.

Distribution: The Pacific [Fork-tailed] Swift occurs across much of Australia from September to April, particularly in the northern half of the continent. The species is most common closer to the coast but occurs over much of the Pilbara.

Ecology: The species is a non-breeding migrant to Australia and is generally present from September to April. In Australia, it is almost entirely aerial in habits, foraging for flying insects and even sleeping on the wing. The species is highly mobile, often occurring in association with unsettled weather and low pressure systems (Johnstone and Storr 1998).

Likelihood of occurrence: Occurs. Pacific [Fork-tailed] Swift calls were detected on an automated recording unit on 15/09/2021 from site OBT-12 in the north-east of the study area (see Table 5.4 and Figure 5.2). The species has not previously been recorded in the locality but is highly mobile and likely to occur sporadically over the study area from September to April.

5.3.2 Conservation Significant Vertebrates Potentially Occurring in the Study Area

Thirteen MNES vertebrate fauna species that were not recorded during the survey and have not previously been recorded within the study area, but have the potential to occur within the study area, comprise one terrestrial mammal, one bat, one reptile, and ten bird species (Table 5.3). These are discussed below in Sections 5.3.2.1 to 5.3.2.8.

5.3.2.1 Greater Bilby (*Macrotis lagotis*)

Vulnerable under the EPBC Act and the BC Act.

Distribution: The distribution of the Greater Bilby is discontinuous with the species occurring in a number of desert locations between south-west Queensland and the Pilbara.

Ecology: The Greater Bilby is a solitary nocturnal omnivorous species inhabiting deep, often complex burrows. It typically occurs on sandy soils covered with spinifex grassland, with an overstorey of low shrubs dominated by *Acacia* species. Remaining subpopulations occupy three major vegetation types: open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas.

Likelihood of occurrence: Likely to occur. Two clusters of multiple records exist in the locality, with the nearest record approximately 19 km north of the study area boundary (see Figure 5.2). While only limited habitat is present within the study area, the study area boundary intersects extensive areas of critical habitat (Divide land system), to the east of the northern part of the study area, which is contiguous with the area where the species has previously been recorded (Figure 4.1 and Figure 5.1).

5.3.2.2 Ghost Bat (*Macroderma gigas*)

Vulnerable under the EPBC Act and the BC Act.

Distribution: The Ghost Bat occurs in a broad range of habitats, with their distribution being influenced by the availability of suitable caves and mines for roost sites (Churchill 1998). The distribution of the Ghost Bat is fragmented, with each population showing some genetic differentiation (Armstrong and Wilmer 2004, Biota 2004). Populations in the Pilbara bioregion appear to be isolated from those in the Kimberley and Northern Territory. A study by McKenzie and Bullen (2009) found that the Ghost Bat is more common than previously thought.

Ecology: Ghost Bats are efficient predators of small birds, mammals, reptiles and large insects, and they have highly developed echolocation, visual and hearing systems (Churchill 1998). Vocalisations audible to humans are used in their complex social interactions (Churchill 1998). Bats forage over large distances (ranges of ~ 60 ha; (Churchill 1998)), and the size of their foraging area is probably inversely related to the productivity of their landscape. Bats are known to have overlapping ranges (Churchill 1998).

Likelihood of occurrence: Likely to occur. Recorded on multiple occasions and from multiple locations (calls and scats) within the locality during previous surveys in areas of critical habitat habitat suitable for roosting (e.g. Biologic 2016) present outside the study area, which extends into the study area, i.e. intersects the study area boundary (Newman, Rocklea, Boolgeeda land systems, see Figure 4.1 and Figure 5.1). No critical habitat or caves suitable for roosting are present within the study area. However, given this is a highly mobile species, the nearest records are less than five kilometers from the study area boundary (Figure 5.2), and extensive supporting habitat is present within the study area (Fauna Landscape 1 (vegetated major drainage system)/ Major Drainage Line, see Section 5.3.3), the Ghost Bat is likely to utilise the study area to forage and for dispersal).

5.3.2.3 Pilbara Olive Python (*Liasis olivaceus barroni*)

Vulnerable under the EPBC Act and the BC Act.

Distribution: The Pilbara Olive Python has a known distribution that coincides roughly with the Pilbara bioregion (DSEWPaC 2012). It is known from 17 localities in the Pilbara and apparently stable populations occur in four areas: Pannawonica, Millstream, Tom Price and the Burrup Peninsula. At some of these sites, the species occurs in sizeable numbers (DAWE 2020).

Ecology: Preferred habitat for the Pilbara Olive Python includes gorges, escarpments, rocky outcrops and water holes where it may find suitable prey. It seeks shelter in caves, beneath boulders, in pools of water and occasionally in trees overhanging water (Bush and Maryan 2011). It is often associated with ephemeral or permanent water, but may also be recorded in rocky habitats some distance from these features (Biota 2009), demonstrating that the species can have a large range (estimated between 88 ha and 449 ha) (DAWE 2020).

Likelihood of occurrence: Likely to occur. Eight of the previous surveys have recorded this species in the locality with the closest record approximately 500 m outside the current study area boundary (see Figure 5.2, Table 4.6, Appendix 1). In addition, extensive critical habitat with gorges, gullies, caves and rock pools exists in the locality which intersects the boundaries of the study area (i.e. extensive habitat that occurs outside the study area and extends across the study area boundary into the study area, thus is contiguous with habitat inside the study area) (Newman, Rocklea, Boolgeeda land systems, see Figure 4.1 and Figure 5.1) and extensive supporting habitat with freshwater occurs within the study area (Fauna Landscape 1(vegetated major drainage system)/ Major Drainage Line, see Figure 5.1 and Section 5.3.3).

5.3.2.4 Australian Painted Snipe (*Rostratula australis*)

Endangered under the EPBC Act and the BC Act.

Distribution: The Australian Painted Snipe is nomadic, and can occur sporadically across much of Australia, though generally rare.

Ecology: Breeds primarily in temporary wetlands to take advantage of abundant food resources available as waters recede, using a wider range of freshwater wetland habitats outside of breeding (Menkhorst et al. 2017). The species appears to have declined due to habitat degradation and loss from development and livestock (Johnstone and Storr 1998). Primarily crepuscular and nocturnal, spending the day loafing or roosting in sheltered areas.

Likelihood of occurrence: May occur. Potentially suitable habitat around water bodies within the study area and the wider locality, though the species would only be an occasional visitor.

5.3.2.5 Princess Parrot (*Polytelis alexandrae*)

Vulnerable under EPBC Act and listed as Priority 4 species by DBCA.

Distribution: The Princess Parrot is a highly nomadic species confined to arid regions of the Northern Territory, South Australia and Western Australia.

Ecology: The Princess Parrot inhabits sand dunes and sand flats in the arid zone of western and central Australia. It occurs in open savanna woodlands and shrublands. Princess Parrots are often observed in swales between sand dunes, where they feed on a variety of seeds, flowers, fruits and foliage of shrubs and trees.

Likelihood of occurrence: May occur. Recorded on one occasion from the locality, approximately 28 km northwest of the study area (Figure 5.2). The nomadic nature of this species means that it may occur within the study area on occasion, where it would likely forage in the sandy *Triodia* plain (Fauna Landscape 2) and Floodplain (Fauna Landscape 3, Figure 5.1) areas during seeding after flooding events, however it would be difficult to confirm this unless survey timing coincided with this species' occasional presence.

5.3.2.6 Oriental Plover (*Charadrius veredus*)

Migratory under the EPBC Act and the BC Act.

Distribution: In Australia, occurs primarily across the northern half of the continent, with smaller numbers reaching more southern areas. They are mobile in response to conditions, and disperse across inland northern Australia during the wet season (Minton et al. 2013).

Ecology: Non-breeding summer migrant to Australia, occurring primarily from September to April, though the earliest arrivals may return in late August, and occasional birds remain into May (Johnstone and Storr 1998, Broome Bird Observatory unpublished data). Unlike most shorebird species, they are not particularly tied to wetland and coastal habitats while in Australia, foraging on sparsely vegetated open areas, including short-grassed or bare plains, bare wetland margins, and recently burnt areas (Johnstone and Storr 1998). This also includes similar man-made habitats, such as sports fields and airfields. The species will also use tidal mudflats, beaches, sewage ponds and freshwater wetland areas, primarily while on migration or for roosting during the heat of the day (Johnstone and Storr 1998, Menkhorst et al. 2017). They feed primarily on insects and other invertebrates captured on the ground, and appear to do much of their foraging in the early morning, evening and at night (e.g. Piersma and Hassell 2010).

Likelihood of occurrence: May occur. Potentially suitable habitat for the species exists in the study area and the locality in larger drainage line areas and along their margins (Sparsely vegetated plains and wetland margins within Fauna Landscape 1 (vegetated major drainage system)/ Major Drainage Line, see Table 5.3).

5.3.2.7 Australian [Gull-billed] Tern (*Gelochelidon* [*nilotica*] *macrotarsa*)

Migratory under the EPBC Act and the BC Act.

This species is listed as Migratory, however there are two populations of Gull-billed Tern that occur in Australia; a resident population *G.*[*nilotica*] *macrotarsa* and a migratory population *G. nilotica affinis*. Most authorities now recognise the resident Australian population as a distinct species, Australian (Gull-billed) Tern, based on differences in plumage, structure, ecology and genetics (Rogers et al. 2005).

Distribution: In Western Australia, most common in the Kimberley and northern Pilbara coasts, but can occur anywhere where there is suitable habitat and may breed in relatively large numbers on inland wetlands (e.g. salt lakes) when flooded. The migratory species (Common) Gull-billed Tern occurs primarily along the Kimberley and Pilbara coasts, with occasional records further south.

Ecology: The Australian [Gull-billed] Tern uses sheltered coastal and estuarine habitats, as well as a variety of near-coastal and inland wetland habitat types including swamps, floodplains, salt lakes, river pools, claypans and watercourses (Johnstone and Storr 1998). It also forages over dry grassland habitats, including crops. Breeds colonial on inland wetlands, usually on islets in salt lakes or salt marshes (Johnstone and Storr 1998). The migratory species (Common) Gull-billed Tern is a non-breeding migrant to Australia, and is generally more restricted to coastal and estuarine habitats.

Likelihood of occurrence: May occur. Potentially suitable habitat for the species occurs along the larger drainage lines in the locality, including within the study area, though the species would likely only occur as an occasional visitor. The migratory (Common) Gull-billed Tern is unlikely to occur.

5.3.2.8 Migratory shorebird species (Scolopacidae spp.)

Migratory under the EPBC Act and the BC Act.

The following species have been assessed as potentially occurring within the study area:

- Sharp-tailed Sandpiper (*Calidris acuminata*);
- Red-necked Stint (*Calidris ruficollis*);
- Common Sandpiper (*Actitis hypoleucos*);
- Marsh Sandpiper (*Tringa stagnatilis*);
- Wood Sandpiper (*Tringa glareola*); and
- Common Greenshank (*Tringa nebularia*).

Distribution: Migratory shorebirds occur throughout Australia where suitable habitat is presence, with largest numbers in coastal northern Australia.

Ecology: Migratory shorebirds breed primarily in the northern hemisphere and are non-breeding migrants to Australia in the austral summer. They use a variety of wetland habitats, particularly tidal mudflats, estuaries and freshwater wetlands.

Likelihood of occurrence: May occur. Potentially suitable habitat for the species listed above occurs along the drainage lines within the study area when inundated, though habitat would only support small numbers of birds – most likely as occasional passage visitors.

5.3.3 Fauna Habitat of Significance

Based on reviews of aerial imagery and land systems, vegetation, and surface geology mapping, the fauna habitats identified during the fauna survey are not confined to the study area and are common and widespread within the Fortescue plains subregion.

When assessing the value of habitat in the study area, it is informative to consider the critical habitat of individual species of conservation significance. Critical habitat for MNES species equates to "habitat critical to the survival of a species" as recognised for the purposes of the EPBC Act (DotE 2013).

For each MNES species, fauna habitats may be classified as:

1. "critical", equivalent to "habitat critical to the survival of the species" (DotE 2013); this comprises habitat considered to potentially contain roosting, denning or breeding sites, primary foraging areas, or refugia during drought, fire or other stress; or
2. "supporting" – these comprise the remaining habitats of the study area, which may be used on a transitory, dispersing or occasional basis, but do not represent critical habitat.

It is assumed that some proportion of critical habitat must be maintained across the species' range to ensure the persistence of the species in the region. Supporting habitats may be used for less regular foraging or on a transitory, dispersing, or occasional basis, but do not represent critical habitat.

Six MNES species were confirmed as recorded or likely to occur in the study area (Section 5.3). Based on desktop and field survey results, these species may utilise the fauna landscapes as presented in Table 5.5.

Table 5.5: Probable MNES species habitat utilisation.

MNES Species	Habitat			
	Fauna Landscape 1: Vegetated sandy/stony drainage systems (BHP: Major Drainage Line)	**Fauna Landscape 2: Sandy *Triodia* plains (BHP: Sand Plain)**	**Fauna Landscape 3: Floodplains – shrubland with patches of Mulga (BHP: Drainage Area/ Floodplain)**	**Fauna Landscape 4: Undulating low hills and Ironstone outcrops (BHP: Undulating Low Hills)**
Greater Bilby	Foraging & dispersal	Denning & foraging	Foraging & dispersal	–
Pilbara Leaf-nosed Bat	Foraging & dispersal	–	–	Roosting & foraging#
Ghost Bat	Foraging & dispersal	–	–	Roosting & foraging#
Pilbara Olive Python	Foraging & dispersal	–	–	Sheltering & foraging#
Pacific [Fork-tailed] Swift *	–	–	–	–
Grey Falcon	Nesting & foraging	Foraging	Foraging	–

Orange cells indicate critical habitat; yellow cells indicate supporting habitat.

* Entirely aerial when in Australia

contiguous areas to this Fauna Landscape (Boolgeeda, Rocklea, Newman land systems area) outside the study area, are considered critical habitat as it typically includes relevant features (e.g. caves, see above), however no such features were observed within the small areas of this Fauna Landscape occurring within the boundaries of the study area, therefore it is only considered to be supporting habitat inside the study area.

The extent of identified critical habitat within the study area is limited for all three mammals and the Pilbara Olive Python, and all fauna landscapes identified as being utilised or having the potential to be utilised by MNES species within the study area are not restricted to the study area or locality, and occur contiguously with the same habitat types outside of the study area.

6.0 Glossary

BC Act	State *Biodiversity Conservation Act 2016.*
Biota	Biota Environmental Sciences.
Significant	A species listed under the BC Act and/or the Federal EPBC Act and/or as a DBCA Priority species.
DBCA	Department of Biodiversity, Conservation and Attractions formerly Department of Parks and Wildlife, Department of Environment and Conservation (DEC), and Department of Conservation and Land Management (CALM).
EPA	Environmental Protection Authority of Western Australia.
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
IBRA	Interim Biogeographic Regionalisation for Australia.
Landform	A geomorphological unit that is largely defined by its surface form and location in the landscape.
MNES species	Species that are listed as Matters of National Environmental Significance under the EPBC Act.
Opportunistic record	Recorded by non-systematic sampling methods.
SM2Bat, SM4Bat	SongMeter 2 or 4 ultrasonic bat call recorder.
SM4Mini	SongMeter 4 mini ultrasonic or acoustic recording unit.
sp. (plural: spp.)	Abbreviation of "species".
Study area	OB32 Surplus Water Homestead Creek Wetting Front study area boundary
Locality	Area included in the desktop study, i.e. 40 km radius of study area
WAM	Western Australian Museum.

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Appendix 1

Vertebrate Fauna Recorded and Potentially Occurring

Non-volant Mammals

Family/Species	Common Name	This survey	Conservation status		Databases			Previous surveys															
			BC Act	EPBC Act	NatureMap	EPBC	ALA	Dynasty Level 2 (Biologic 2016a)	Orebody 19 Level 2 (Biologic 2014a)	Orebody 31 Level 2 (Biologic 2014b)	Orebody 35 Level 2 (Biologic 2011)	South West Jimblebar (Biologic 2013a)	Wheelarra Hill North (ENV Australia 2012)	Cathedral Gorge Level 1/Targeted (Biologic 2016b)	Dynasty Vertebrate Fauna Monitoring 2018 (Biologic 2018)	Eastern Ridge Level 1 (ENV Australia 2011a)	Ninga Level 1 (Eco Logical 2013)	Orebody 24 Targeted (Biologic 2013b)	Orebody 25 Targeted (Biologic 2014c)	Orebody 37 Level 1 (Eco Logical 2012)	Orebody 42/43 Level 1 (ENV Australia 2011b)	Ophthalmia Dam Avian Fauna (MWH 2015)	Western Ridge Level 1 (Onshore Environmental 2014)
Tachyglossidae																							
Tachyglossus aculeatus	Short-beaked Echidna				•				•		•			•			•	•					
Dasyuridae																							
Dasycercus blythi	Brush-tailed Mulgara, Ampurta		P4		•			•	•	•		•			•		•	•					
Dasykaluta rosamondae	Kaluta				•		•	•	•			•	•		•								
Dasyurus hallucatus	Northern Quoll		EN	EN		•																	
Ningaui timealeyi	Pilbara Ningaui				•		•		•														
Planigale sp. (1)	Planigale sp. 1/sp. 2				•		•				•		•										
Pseudantechinus roryi	Rory's Pseudantechinus				•																		•
Pseudantechinus woolleyae (2)	Woolley's Pseudantechinus				•		•		•		•												
Sminthopsis crassicaudata	Fat-tailed Dunnart				•				•														
Sminthopsis longicaudata	Long-tailed Dunnart		P4		•		•																
Sminthopsis macroura	Stripe-faced Dunnart				•		•		•		•	•							•				
Sminthopsis ooldea	Ooldea Dunnart				•		•			•													
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart				•		•	•	•	•		•	•										
Thylacomyidae																							
Macrotis lagotis	Greater Bilby, Dalgyte		VU	VU	•	•																	
Phalangeridae																							
Trichosurus vulpecula hypoleucus (3)	Koomal, Common Brushtail Possum				•																		
Macropodidae																							
Lagorchestes conspicillatus leichardti	Spectacled Hare-wallaby		P4		•																		
Osphranter robustus (4)	Euro, Biggada	•			•		•		•	•	•		•	•	•		•	•	•	•	•		•
Osphranter rufus (4)	Red Kangaroo, Marlu	•			•		•				•	•	•			•		•			•		•
Petrogale rothschildi	Rothschild's Rock-wallaby				•		•		•		•			•			•	•		•			
Muridae																							
Leggadina lakedownensis	Short-tailed Mouse		P4		•		•																
Mus musculus	House Mouse	?			•	•	•		•	•		•	•										
Notomys alexis	Spinifex Hopping-mouse				•		•	•	•			•			•			•		•			
Pseudomys chapmani	Western Pebble-mound Mouse		P4		•		•		•		•		•	•		•	•	•					
Pseudomys desertor	Desert Mouse				•		•	•	•	•		•			•								
Pseudomys hermannsburgensis	Sandy Inland Mouse	?			•		•	•	•	•	•	•	•		•								
Zyzomys argurus	Common Rock-rat	•			•		•		•	•	•		•	•				•					•
Leporidae																							
Oryctolagus cuniculus	Rabbit	•			•	•	•			•	•						•			•			
Canidae																							
Canis familiaris familiaris (5)	Dog	•				•	•					•	•				•			•			•
Canis familiaris dingo (5)	Dingo								•	•	•	•		•					•	•	•		
Vulpes vulpes	Red Fox					•																	
Felidae																							
Felis catus	Cat	•			•	•			•		•	•	•	•	•				•	•	•		•

Family/Species	Common Name	This survey	Conservation status		Databases			Previous surveys															
			BC Act	EPBC Act	NatureMap	EPBC	ALA	Dynasty Level 2 (Biologic 2016a)	Orebody 19 Level 2 (Biologic 2014a)	Orebody 31 Level 2 (Biologic 2014b)	Orebody 35 Level 2 (Biologic 2011)	South West Jimblebar (Biologic 2013a)	Wheelarra Hill North (ENV Australia 2012)	Cathedral Gorge Level 1/Targeted (Biologic 2016b)	Dynasty Vertebrate Fauna Monitoring 2018 (Biologic 2018)	Eastern Ridge Level 1 (ENV Australia 2011a)	Ninga Level 1 (Eco Logical 2013)	Orebody 24 Targeted (Biologic 2013b)	Orebody 25 Targeted (Biologic 2014c)	Orebody 37 Level 1 (Eco Logical 2012)	Orebody 42/43 Level 1 (ENV Australia 2011b)	Ophthalmia Dam Avian Fauna (MWH 2015)	Western Ridge Level 1 (Onshore Environmental 2014)
Equidae																							
Equus asinus	Donkey	•			•	•				•	•												
Equus caballus	Horse	•			•	•					•	•									•		
Camelidae																							
Camelus dromedarius	Dromedary, Camel				•	•		•		•		•	•				•						
Bovidae																							
Bos taurus	European Cattle	•			•					•	•	•	•	•	•		•			•	•		•

(1) Planigales in the Pilbara considered to comprise two undescribed species, "sp. 1" and "sp. 2". Formerly listed as *P. maculata* and/or *P. ingrami*.
(2) formerly included within *P. macdonnellensis*, some old previous records listed as such.
(3) Pilbara population formerly included within listed northern subspecies *arnhemincus*, now shown to be genetically aligned with non-listed south-western subspecies.
(4) Red Kangaroo *Osphranter rufus* and Euro *Osphranter robustus* both formerly included within the genus Macropus.
(5) Previously included within *C. lupus* as *C. lupus dingo* and *C. lupus familiaris*, some previous records listed as such.
Note: Records of *Petrogale lateralis lateralis* from 1975 not included – considered erroneous as species restricted Cape Range, offshore Pilbara islands and isoloated outcrops in the Wheatbelt.

Bats

Family/Species	Common Name	This survey	Conservation status		Databases			Previous surveys															
			BC Act	EPBC Act	NatureMap	EPBC	ALA	Dynasty Level 2 (Biologic 2016a)	Orebody 19 Level 2 (Biologic 2014a)	Orebody 31 Level 2 (Biologic 2014b)	Orebody 35 Level 2 (Biologic 2011)	South West Jimblebar (Biologic 2013a)	Wheelarra Hill North (ENV Australia 2012)	Cathedral Gorge Level 1/Targeted (Biologic 2016b)	Dynasty Vertebrate Fauna Monitoring 2018 (Biologic 2018)	Eastern Ridge Level 1 (ENV Australia 2011a)	Ninga Level 1 (Eco Logical 2013)	Orebody 24 Targeted (Biologic 2013b)	Orebody 25 Targeted (Biologic 2014c)	Orebody 37 Level 1 (Eco Logical 2012)	Orebody 42/43 Level 1 (ENV Australia 2011b)	Ophthalmia Dam Avian Fauna (MWH 2015)	Western Ridge Level 1 (Onshore Environmental 2014)
Rhinonycteridae																							
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	•	VU	VU	•	•								•			Uncon-firmed	•					
Megadermatidae																							
Macroderma gigas	Ghost Bat		VU	VU	•	•	•		•		•			•									
Emballonuridae																							
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat	•			•			•		•	•	•	•		•	•	Uncon-firmed	•	•	•	•		
Taphozous georgianus	Common Sheath-tailed Bat	•			•		•	•	•	•	•		•	•	•	•	•	•	•				•
Taphozous hilli	Hill's Sheath-tailed Bat				•		•	•	•	•	•				•								•
Molossidae																							
Austronomus australis (1)	White-striped Free-tailed Bat	•														•			•	•			•
Chaerephon jobensis	Greater Northern Free-tailed Bat	•			•		•	•	•	•		•	•	•	•	•		•	•	•	•		•
Ozimops lumsdenae (2)	Northern Free-tailed Bat	•					•			•	•	•	•		•	•		•	•	•	•		•
Vespertilionidae																							
Chalinolobus gouldii	Gould's Wattled Bat	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•
Nyctophilus daedalus	Pallid Long-eared Bat	•																					
Nyctophilus geoffroyi	Lesser Long-eared Bat	•			•			•		•	•	•	•	•	•			•	•				
Scotorepens balstoni	Inland Broad-nosed Bat				•										•								
Scotorepens greyii	Little Broad-nosed Bat	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•
Vespadelus finlaysoni	Finlayson's Cave-bat	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•

(1) White-striped Free-tailed Bat (*Austronomus australis*) previously included in genus Tadarida.
(2) Northern Free-tailed Bat (*Ozimops lumsdenae*) previously *Mormopterus beccarii* and *Mormopterus lumsdenae*.
Note: Record of *Taphozous australis* not included – considered an error as species restricted to coastal QLD; Eco Logical (2013) state Pilbara Leaf-nosed Bat/Yellow-bellied Sheath-tailed Bat call IDs not certain.

Amphibians

Family/Species	Common Name	This survey	Conservation status		Databases			Previous surveys															
			BC Act	EPBC Act	NatureMap	EPBC	ALA	Dynasty Level 2 (Biologic 2016a)	Orebody 19 Level 2 (Biologic 2014a)	Orebody 31 Level 2 (Biologic 2014b)	Orebody 35 Level 2 (Biologic 2011)	South West Jimblebar (Biologic 2013a)	Wheelarra Hill North (ENV Australia 2012)	Cathedral Gorge Level 1/Targeted (Biologic 2016b)	Dynasty Vertebrate Fauna Monitoring 2018 (Biologic 2018)	Eastern Ridge Level 1 (ENV Australia 2011a)	Ninga Level 1 (Eco Logical 2013)	Orebody 24 Targeted (Biologic 2013b)	Orebody 25 Targeted (Biologic 2014c)	Orebody 37 Level 1 (Eco Logical 2012)	Orebody 42/43 Level 1 (ENV Australia 2011b)	Ophthalmia Dam Avian Fauna (MWH 2015)	Western Ridge Level 1 (Onshore Environmental 2014)
Pelodryadidae																							
Cyclorana maini	Sheep Frog				•		•	•			•	•	•		•	•							
Cyclorana occidentalis (1)	Western water-holding Frog				•								•										
Litoria rubella	Little Red Tree Frog	•			•		•		•		•	•			•	•	•	•		•			
Limnodynastidae																							
Neobatrachus kunapalari	Kunapalari Frog				•																		
Notaden nichollsi	Desert Spadefoot				•		•																
Platyplectrum spenceri	Centralian Burrowing Frog				•		•	•							•								
Myobatrachidae																							
Pseudophryne douglasi	Gorgre Toadlet				•																		
Uperoleia saxatilis (2)	Pilbara Toadlet				•		•								•								

(1) formerly included within *C. platycephala*, some previous records listed as such.
(2) previously included within *U. russelli*, some previous records may be listed as such.

Reptiles

Family/Species	Common Name	This survey	Conservation status		Databases			Previous surveys															
			BC Act	EPBC Act	NatureMap	EPBC	ALA	Dynasty Level 2 (Biologic 2016a)	Orebody 19 Level 2 (Biologic 2014a)	Orebody 31 Level 2 (Biologic 2014b)	Orebody 35 Level 2 (Biologic 2011)	South West Jimblebar (Biologic 2013a)	Wheelarra Hill North (ENV Australia 2012)	Cathedral Gorge Level 1/Targeted (Biologic 2016b)	Dynasty Vertebrate Fauna Monitoring 2018 (Biologic 2018)	Eastern Ridge Level 1 (ENV Australia 2011a)	Ninga Level 1 (Eco Logical 2013)	Orebody 24 Targeted (Biologic 2013b)	Orebody 25 Targeted (Biologic 2014c)	Orebody 37 Level 1 (Eco Logical 2012)	Orebody 42/43 Level 1 (ENV Australia 2011b)	Ophthalmia Dam Avian Fauna (MWH 2015)	Western Ridge Level 1 (Onshore Environmental 2014)
Cheluidae																							
Chelodina steindachneri	Flat-shelled Turtle	•			•		•					•											
Carphodactylidae																							
Nephrurus cinctus (1)	Northern Banded Knob-tailed Gecko				•		•																
Diplodactylidae																							
Diplodactylus bilybara (2)	Western Fat-tailed Gecko						•																
Diplodactylus conspicillatus (2)	Variable Fat-tailed Gecko	•			•		•		•	•	•	•	•										
Diplodactylus laevis (2)	Desert Fat-tailed Gecko						•																
Diplodactylus mitchelli					•		•																
Diplodactylus pulcher					•		•																
Diplodactylus savagei	Southern Pilbara Beak-faced Gecko				•		•		•		•								•				
Lucasium woodwardi					•		•		•	•	•	•	•		•								
Lucasium wombeyi					•		•		•	•			•				•						
Oedura fimbria (3)	Western Marbled Velvet Gecko				•		•		•	•	•		•	•			•						
Rhynchoedura ornata	Western Beaked Gecko	•			•		•	•			•	•	•										
Strophurus elderi					•		•	•					•										
Strophurus jeanae					•					•		•	•										
Strophurus wellingtonae					•		•	•	•	•	•	•	•										
Gekkonidae																							
Gehyra micra (4)	Small Pilbara Spotted Rock Gehyra						•																
Gehyra pilbara (4)					•		•						•										
Gehyra punctata (4)					•		•	•	•	•	•	•	•				•		•				•
Gehyra purpurascens (5)		•																					
Gehyra variegata (5)		•			•		•	•	•	•	•	•	•			•			•	•	•		•
Heteronotia binoei	Bynoe's Gecko	•			•		•		•		•		•				•						
Heteronotia planiceps					•		•																
Heteronotia spelea	Pilbara Cave Gecko				•		•		•	•	•		•										
Pygopodidae																							
Delma butleri (6)					•		•	•	•		•	•	•										
Delma elegans					•		•		•		•		•										
Delma nasuta					•		•	•	•				•		•								
Delma pax					•		•	•	•	•	•							•		•			
Delma tincta					•		•						•										
Lialis burtonis					•		•	•		•	•	•					•						
Pygopus nigriceps					•		•				•												
Agamidae																							
Ctenophorus caudicinctus	Ring-tailed Dragon	•			•		•	•	•	•	•	•	•	•		•	•	•	•	•	•		•
Ctenophorus isolepis gularis	Central Military Dragon				•		•																
Ctenophorus isolepis isolepis	Central Military Dragon	•			•		•	•		•	•	•	•	•	•	•	•	•	•	•	•		•
Ctenophorus nuchalis	Central Netted Dragon				•		•					•			•					•			

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Ctenophorus reticulatus	Western Netted Dragon				•		•					•	•										
Diporiphora amphiboluroides (7)	Mulga Dragon				•		•					•			•								
Diporiphora valens	Southern Pilbara Tree Dragon				•								•										
Gowidon longirostris (8)	Long-nosed Dragon	•			•		•			•	•	•	•	•	•	•	•	•		•	•		
Lophognathus horneri^ (9)	Northern Tree Dragon						•	•															
Moloch horridus	Thorny Devil				•		•																
Pogona minor					•		•	•	•		•	•	•		•								
Tympanocryptis fortescuensis (10)	Hamersley Pebble-mimic Dragon				•																		
Tympanocryptis diabolicus (10)	Hamersley Pebble-mimic Dragon						•																
Scincidae																							
Carlia munda					•		•			•	•					•		•		•			
Carlia triacantha					•		•	•		•	•	•	•			•				•			
Cryptoblepharus buchananii (11)					•		•	•							•								
Cryptoblepharus ustulatus (11)					•		•		•		•			•			•	•					
Ctenotus ariadnae					•		•	•	•			•											
Ctenotus duricola					•		•		•	•	•	•	•										•
Ctenotus grandis					•			•				•	•										
Ctenotus hanloni					•		•																
Ctenotus helenae					•		•		•	•	•	•	•										•
Ctenotus leonhardii					•		•				•												
Ctenotus pallasotus	Western Pilbara Lined Ctenotus						•																
Ctenotus pantherinus^	Leopard Ctenotus				•		•	•	•	•	•	•	•		•	•		•		•			
Ctenotus rubicundus					•		•		•														
Ctenotus rutilans					•		•		•				•					•					
Ctenotus saxatilis	Rock Ctenotus	•			•			•	•	•	•		•	•		•	•	•			•		
Ctenotus schomburgkii					•						•		•										
Ctenotus serventyi																•		•					
Ctenotus uber					•								•										
Ctenotus uber johnstonei			P2		•			•				•			•								
Ctenotus uber uber					•		•			•													
Cyclodomorphus melanops	Slender Blue-tongue				•		•	•	•	•			•				•						
Egernia cygnitos	Western Pilbara Spiny-tailed Skink				•		•		•	•													
Egernia depressa	Southern Pygmy Spiny-tailed Skink				•		•	•			•	•				•							
Egernia formosa					•		•				•			•				•					
Eremiascincus richardsonii	Broad-banded Sand Swimmer	•			•		•	•															
Lerista bipes					•		•			•													
Lerista flammicauda					•								•										
Lerista jacksoni													•										
Lerista macropisthopus remota^			P2		•																		
Lerista muelleri					•		•		•		•		•										
Lerista neander					•		•	•	•	•	•	•								•			•

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Lerista timida					•		•	•		•		•	•											
Lerista zietzi					•		•		•		•		•				•							
Liopholis kintorei	Great Desert Skink		VU	VU		•																		
Liopholis striata^	Night Skink				•																			
Menetia greyii					•		•		•	•	•		•							•				
Menetia surda					•		•				•				•									
Morethia ruficauda exquisita		•			•		•		•	•	•					•	•	•						
Proablepharus reginae																•								
Tiliqua multifasciata	Central Blue-tongue				•		•	•	•	•	•	•	•	•	•									
Varanidae																								
Varanus acanthurus	Spiny-tailed Goanna	•			•		•		•	•	•	•	•					•						
Varanus brevicauda	Short-tailed Pygmy Goanna				•		•				•	•	•											•
Varanus bushi	Pilbara Mulga Goanna				•		•																	
Varanus caudolineatus					•		•	•			•	•	•											
Varanus eremius	Pygmy Desert Goanna				•		•			•			•											
Varanus giganteus	Perentie	•			•			•	•		•	•	•	•			•	•						
Varanus gilleni	Pygmy Mulga Goanna				•																			
Varanus gouldii	Bungarra or Sand Goanna	•			•		•			•		•	•		•									
Varanus hamersleyensis	Southern Pilbara Rock Goanna						•																	
Varanus panoptes rubidus	Yellow-spotted Monitor	•			•		•	•		•	•	•	•											
Varanus pilbarensis	Northern Pilbara Rock Goanna				•		•		•										•					
Varanus tristis	Racehorse Goanna						•	•	•	•	•								•					
Typhlopidae																								
Anilios ammodytes (12)													•											
Anilios ganei (12)			P1				•		•		•													
Anilios grypus (12)							•		•		•		•											
Anilios hamatus (12)							•		•	•	•													
Anilios waitii (12)									•															
Pythonidae																								
Antaresia perthensis	Pygmy Python				•		•		•		•	•	•											
Antaresia childreni (13)	Children's Python				•		•				•													
Aspidites melanocephalus	Black-headed Python	•			•		•				•													
Liasis olivaceus barroni	Pilbara Olive Python		VU	VU	•	•	•		•		•			•		•	•	•	•			•		
Elapidae																								
Acanthophis wellsi	Pilbara Death Adder				•		•																	
Brachyurophis approximans		•			•		•			•	•	•	•		•									
Demansia psammophis	Yellow-faced Whipsnake	•			•		•		•	•			•											
Demansia rufescens	Rufous Whipsnake				•		•		•		•													
Furina ornata	Moon Snake				•		•		•		•													
Pseudechis australis	Mulga Snake	•			•		•		•		•						•	•						
Pseudonaja modesta	Ringed Brown Snake				•		•		•	•	•	•												

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Pseudonaja mengdeni (14)	Western Brown Snake				•		•	•	•	•		•	•										
Suta fasciata	Rosen's Snake				•		•						•										
Suta gaikhorstorum (15)					•		•				•												
Suta punctata	Spotted Snake				•		•			•		•			•								
Vermicella snelli					•		•						•										

(1) *previously a subspecies of Nephrurus wheeleri;*
(2) *Diplodactylus conspicillatus (sensu stricto), D. bilybara and D. laevis all previously included within D. conspicillatus (sensu lato).*
Older records of D. conspicillatus may be referrable to any of these species, though D. conspicillatus and D. laevis most likely in locality based on distributions.
(3) *Oedura fimbria previously included within O. marmoratus.*
(4) *Gehyra punctata complex: G. punctata* split into several species in 2018 (Doughty et al. 2018), and specimens previously recorded from the study area locality as *G. punctata* may be referrable to any of *G. punctata, G. fenestrula* or *G. micra.*
(5) *Gehyra variegata complex:* G. variegate split into several species in 2018, and *G. purpurescens* and *G. montium* were re-described (Kealley et al. 2018).
Specimens previously recorded from the study area locality as *G. variegata* may be any of *G. variegata*, *G. crypta*, *G. montium, G. incognita* or *G. purpurescens*.
(6) *Delma butleri* is synonymous with *D. haroldi.*
(7) *Diporiphora amphiboluroides* previously placed in its own genus as *Caimanops amphiboluroides.*
(8) *Gowidon longirostris* formerly both *Amphibolurus longirostris* and *Lophognathus longirostris.*
(9) *Lophognathus horneri* previously included within *L. gilberti* or *Amphibolurus gilberti.*
(10) *Tympanocryptis cephalus* split into several species, records from study area locality most likely referrable to *T. fortescuensis*, but some may also involve *T. diabolicus*.
(11) *Cryptoblepharus buchananii* and *C. ustulatus* both previously included within *C. plagiocephalus*, some old records listed as such.
(12) Blind snakes *Anilios* spp. previously *Ramphotyphlops* spp..
(13) Stimson's Python (*Antaresia stimsoni*) now included within Children's Python (*Antaresia children)*.
(14) Western Brown Snake/Gwardar (*Pseudonaja mengdeni*) previously included within Northern Brown Snake (*P. nuchalis*).
(15) *Parasuta monachus* in the Pilbara region re-described as *Suta gaikhorstorum.*

Note: *Ctenotus saxatilis* listed as *C. inornatus* in one previous report; *Christinus marmoratus* and *Ctenophorus maculatus* records excluded as considered erroneous (far outside known distribution).

^ Indicates species for which BHP WAIO internal nomenclature currently differs/species not currently included in BHP WAIO internal species list.

Avifauna

Family/Species	Common Name	This survey	Conservation status		Databases			Previous surveys															
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Casuariidae																							
Dromaius novaehollandiae	Emu				•		•													•			
Phasianidae																							
Coturnix pectoralis	Stubble Quail			MA	•		•						•										
*Coturnix ypsilophora^*	Brown Quail	•			•		•																
Anseranidae																							
Anseranas semipalmata	Magpie Goose			MA	•		•																
Anatidae																							
Dendrocygna eytoni	Plumed Whistling Duck				•		•															•	
Dendrocygna arcuata	Wandering Whistling Duck			MA	•		•															•	
Cygnus atratus	Black Swan	•			•		•				•									•	•	•	
Stictonetta naevosa	Freckled Duck				•		•															•	
*Tadorna tadornoides^*	Australian Shelduck				•		•				•									•	•	•	
Malacorhynchus membranaceus	Pink-eared Duck				•		•															•	
Chenonetta jubata	Australian Wood Duck				•		•													•		•	
*Spatula rhynchotis^*	Australasian Shoveler				•		•																
Anas superciliosa	Pacific Black Duck	•			•		•				•									•	•	•	
Anas gracilis	Grey Teal	•			•		•				•									•		•	
Aythya australis	Hardhead	•			•		•				•									•		•	
*Biziura lobata^*	Musk Duck			MA	•		•																
Podargidae																							
Podargus strigoides	Tawny Frogmouth				•		•				•		•					•					
Eurostopodidae																							
Eurostopodus argus	Spotted Nightjar	•		MA	•		•	•			•	•	•	•								•	
Aegothelidae																							
Aegotheles cristatus	Australian Owlet-nightjar	•			•		•		•	•			•					•				•	•
Apodidae																							
Apus pacificus	Pacific [Fork-tailed] Swift (1)	•	MI	MI; MA		•																	
Otididae																							
Ardeotis australis	Australian Bustard	•			•		•	•		•	•	•	•			•			•	•	•	•	•
Cuculidae																							
Centropus phasianinus	Pheasant Coucal				•		•													•		•	
Chrysococcyx basalis	Horsfield's Bronze Cuckoo	•					•					•										•	
Chrysococcyx osculans	Black-eared Cuckoo			MA		•	•						•			•	•						
Cacomantis pallidus	Pallid Cuckoo	•		MA	•		•						•	•		•	•					•	•
Columbidae																							
Columba livia	Feral Pigeon (Rock Dove)					•				•													
Phaps chalcoptera	Common Bronzewing	•			•		•	•	•	•	•	•	•	•				•				•	•
Ocyphaps lophotes	Crested Pigeon	•			•		•	•	•		•	•	•	•	•	•	•	•		•	•	•	•
*Geophaps plumifera^*	Spinifex Pigeon	•			•		•		•	•	•	•	•	•		•	•	•	•	•	•	•	•

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Geopelia cuneata	Diamond Dove	•			•		•	•	•	•		•	•	•				•	•	•	•	•	
Geopelia placida^	Peaceful Dove	•			•		•		•		•						•				•	•	
Geopelia humeralis	Bar-shouldered Dove				•		•																
Rallidae																							
Gallirallus philippensis^	Buff-banded Rail				•		•																
Porzana pusilla	Baillon's Crake			MA	•		•																
Porzana tabuensis	Spotless Crake			MA	•		•															•	
Porphyrio melanotus^	Australasian Swamphen			MA			•														•	•	
Gallinula tenebrosa^	Dusky Moorhen						•																
Tribonyx ventralis	Black-tailed Nativehen				•		•					•								•			
Fulica atra	Eurasian Coot	•			•		•				•									•	•	•	
Podicipedidae																							
Tachybaptus novaehollandiae	Australasian Grebe	•			•		•				•										•	•	
Poliocephalus poliocephalus	Hoary-headed Grebe				•		•														•	•	
Podiceps cristatus	Great Crested Grebe	•			•		•													•	•	•	
Turnicidae																							
Turnix velox	Little Buttonquail	•			•		•		•	•		•	•		•	•	•			•			•
Burhinidae																							
Burhinus grallarius	Bush Stone-curlew				•		•					•											
Recurvirostridae																							
Himantopus leucocephalus	Pied Stilt (2)			MA	•		•				•											•	
Cladorhynchus leucocephalus	Banded Stilt				•		•																
Recurvirostra novaehollandiae	Red-necked Avocet			MA	•		•																
Charadriidae																							
Vanellus tricolor	Banded Lapwing				•		•																
Vanellus miles	Masked Lapwing						•																
Erythrogonys cinctus	Red-kneed Dotterel				•		•															•	
Charadrius dubius	Little Ringed Plover		MI	MI; MA																		•	
Charadrius ruficapillus	Red-capped Plover			MA	•		•				•											•	
Charadrius veredus	Oriental Plover		MI	MI; MA		•	•																
Elseyornis melanops	Black-fronted Dotterel	•			•		•				•	•									•	•	
Rostratulidae																							
Rostratula australis	Australian Painted Snipe (3)		EN	EN		•																	
Scolopacidae																							
Limosa limosa	Black-tailed Godwit		MI	MI; MA																		•	
Calidris pugnax^ (4)	Ruff		MI	MI; MA																		•	
Calidris acuminata	Sharp-tailed Sandpiper		MI	MI; MA	•	•	•															•	
Calidris ferruginea	Curlew Sandpiper		CR; MI	CR; MI; MA	•	•	•															•	
Calidris subminuta	Long-toed Stint		MI	MI; MA	•		•															•	
Calidris ruficollis	Red-necked Stint		MI	MI; MA	•		•																

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Calidris melanotos	Pectoral Sandpiper		MI	MI; MA	•	•	•															•	
Actitis hypoleucos	Common Sandpiper		MI	MI; MA	•	•	•														•	•	
Tringa totanus	Common Redshank		MI	MI; MA	•																		
Tringa stagnatilis	Marsh Sandpiper		MI	MI; MA	•		•															•	
Tringa glareola	Wood Sandpiper		MI	MI; MA	•		•				•											•	
Tringa nebularia	Common Greenshank		MI	MI; MA	•		•				•											•	
Glareolidae																							
Stiltia isabella	Australian Pratincole			MA	•		•															•	
Laridae																							
Chroicocephalus novaehollandiae^	Silver Gull			MA	•		•														•	•	
Gelochelidon [nilotica] *macrotarsa*^	Australian [Gull-billed] Tern (5)		MI	MI; MA	•		•																
Hydroprogne caspia	Caspian Tern		MI	MI	•		•																
Chlilonias hybrida^	Whiskered Tern			MA			•															•	
Ciconiidae																							
Ephippiorhynchus asiaticus	Black-necked Stork				•		•					•											
Phalacrocoracidae																							
Microcarbo melanoleucos^	Little Pied Cormorant	•			•		•													•	•	•	
Phalacrocorax sulcirostris	Little Black Cormorant	•			•		•													•	•	•	
Phalacrocorax varius	Australian Pied Cormorant	•			•		•													•			
Phalacrocorax carbo	Great Cormorant	•			•		•													•			
Anhingidae																							
Anhinga novaehollandiae	Australasian Darter	•			•		•													•	•	•	
Threskiornithidae																							
Threskiornis molucca	Australian White Ibis	•		MA			•														•	•	
Threskiornis spinicollis	Straw-necked Ibis	•		MA	•		•														•	•	
Plegadis falcinellus	Glossy Ibis		MI	MI; MA	•		•															•	
Platalea regia	Royal Spoonbill				•		•										•					•	
Platalea flavipes	Yellow-billed Spoonbill				•		•														•	•	
Ardeidae																							
Nycticorax caledonicus	Nankeen Night Heron	•		MA	•		•															•	
Bubulcus coromandus^	Eastern Cattle Egret (6)			MA	•	•	•																
Ardea pacifica	White-necked Heron	•			•		•	•				•									•	•	
Ardea alba^	Great Egret (7)	•		MA	•	•	•				•										•	•	
Ardea intermedia	Intermediate Egret			MA	•		•															•	
Egretta novaehollandiae^	White-faced Heron	•			•		•				•										•	•	
Egretta garzetta^	Little Egret	•		MA	•		•															•	
Pelecanidae																							
Pelecanus conspicillatus	Australian Pelican	•		MA	•		•										•				•	•	
Accipitridae																							
Elanus caeruleus axillaris	Black-shouldered Kite				•		•		•	•				•			•				•		

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*Lophoictinia isura^*	Square-tailed Kite				•		•													•			
Hamirostra melanosternon	Black-breasted Buzzard	•			•		•		•	•			•								•	•	•
Hieraaetus morphnoides	Little Eagle				•		•									•				•	•		
Aquila audax	Wedge-tailed Eagle	•			•		•		•		•	•	•					•					•
Accipiter fasciatus	Brown Goshawk	•		MA	•		•	•	•		•	•						•			•		
Accipiter cirrocephalus	Collared Sparrowhawk				•		•		•			•										•	
Circus approximans	Swamp Harrier			MA	•		•																
Circus assimilis	Spotted Harrier				•		•		•				•										•
Milvus migrans	Black Kite	•			•		•		•					•			•			•			
Haliastur sphenurus	Whistling Kite	•		MA	•		•		•	•	•	•	•	•		•	•	•		•	•	•	•
Haliaeetus leucogaster	White-bellied Sea Eagle			MA	•		•															•	
Tytonidae																							
Tyto javanica	Eastern Barn Owl (8)						•		•		•												
Strigidae																							
Ninox connivens	Barking Owl	•			•		•															•	
Ninox boobook	Australian Boobook (9)	•		MA			•			•	•		•	•				•	•		•	•	
Alcedinidae																							
Dacelo leachii occidentalis	Blue-winged Kookaburra	•			•		•							•		•		•		•	•	•	
Todiramphus sanctus	Sacred Kingfisher	•		MA	•		•					•					•			•	•	•	
Todiramphus pyrrhopygius	Red-backed Kingfisher	•			•		•		•	•			•	•		•	•					•	
Meropidae																							
Merops ornatus	Rainbow Bee-eater	•		MA	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Falconidae																							
Falco cenchroides	Nankeen Kestrel	•		MA	•		•		•	•	•	•	•	•	•	•	•	•		•	•	•	•
Falco longipennis	Australian Hobby	•			•		•		•			•	•			•		•				•	
Falco berigora	Brown Falcon	•			•		•	•	•	•	•	•	•	•	•	•	•	•				•	
Falco hypoleucos	Grey Falcon	•	VU	VU		•											•						
Falco subniger	Black Falcon						•															•	
Falco peregrinus	Peregrine Falcon		OS		•		•				•							•					
Cacatuidae																							
Nymphicus hollandicus	Cockatiel	•			•		•	•				•	•			•	•		•	•	•	•	•
*Eolophus roseicapilla^*	Galah	•			•		•	•		•	•	•	•	•	•	•	•	•	•	•		•	
Cacatua sanguinea	Little Corella	•			•		•	•							•	•	•	•		•	•	•	•
Psittaculidae																							
*Polytelis alexandrae^*	Princess Parrot		P4	VU	•	•	•																
*Psephotus varius^*	Mulga Parrot						•			•	•							•					
*Barnardius zonarius^*	Australian Ringneck	•					•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•
Pezoporus occidentalis	Night Parrot		CR	EN		•																	
Neopsephotus bourkii	Bourke's Parrot				•		•	•															
*Neophema elegans^*	Elegant Parrot										•												

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Melopsittacus undulatus	Budgerigar	•			•		•		•			•	•	•		•			•	•		•	
Ptilonorhychidae																							
Chlamydera guttata^	Western Bowerbird (10)				•		•	•	•	•	•	•	•	•		•		•		•			
Climacteridae																							
Climacteris melanurus	Black-tailed Treecreeper	•					•																
Maluridae																							
Malurus splendens	Splendid Fairywren				•		•				•				•							•	
Malurus leucopterus	White-winged Fairywren	•			•		•	•	•		•	•	•			•				•	•	•	
Malurus assimilis^	Purple-backed Fairywren	•			•		•	•	•	•	•	•	•	•		•		•	•	•	•	•	•
Stipiturus ruficeps	Rufous-crowned Emu-wren				•		•																
Amytornis whitei	Rufous Grasswren (11)				•		•		•	•	•		•	•				•					
Meliphagidae																							
Epthianura tricolor	Crimson Chat	•			•		•		•		•	•			•			•		•			
Epthianura aurifrons	Orange Chat				•		•																
Conopophila whitei	Grey Honeyeater				•		•															•	
Certhionyx variegatus	Pied Honeyeater				•		•															•	
Sugomel niger	Black Honeyeater						•						•			•							
Lichmera indistincta	Brown Honeyeater	•			•		•		•		•		•	•		•				•	•	•	
Melithreptus gularis laetior	Black-chinned Honeyeater	•					•		•											•		•	
Purnella albifrons	White-fronted Honeyeater				•		•				•												
Gavicalis virescens	Singing Honeyeater	•			•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•
Ptilotula keartlandi	Grey-headed Honeyeater	•					•		•		•		•	•		•	•	•	•		•	•	
Ptilotula penicillata	White-plumed Honeyeater	•					•		•		•	•	•	•	•	•	•		•	•	•	•	
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	•			•		•	•	•		•	•	•	•			•		•		•	•	•
Manorina flavigula	Yellow-throated Miner	•			•		•	•	•	•	•		•	•	•	•	•	•	•	•	•		•
Pardalotidae																							
Pardalotus rubricatus	Red-browed Pardalote	•			•		•		•	•	•		•									•	•
Pardalotus striatus	Striated Pardalote				•		•		•		•			•									
Acanthizidae																							
Smicrornis brevirostris	Weebill	•			•		•	•	•	•	•		•	•		•	•	•	•	•	•	•	•
Pyrrholaemus brunneus	Redthroat				•		•			•	•										•	•	
Gerygone fusca	Western Gerygone	•			•		•	•	•		•					•							
Gerygone fusca mungi	Western Gerygone				•		•										•				•		
Acanthiza apicalis	Inland Thornbill				•		•			•	•		•									•	
Acanthiza uropygialis	Chestnut-rumped Thornbill				•		•	•		•	•	•				•						•	•
Acanthiza chrysorrhoa	Yellow-rumped Thornbill				•		•										•						
Acanthiza robustirostris	Slaty-backed Thornbill				•		•			•												•	
Aphelocephala leucopsis	Southern Whiteface				•		•																
Aphelocephala nigricincta^	Banded Whiteface				•		•																
Pomatostomidae																							

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Pomatostomus temporalis rubeculus	Grey-crowned Babbler	•					•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	
Pomatostomus superciliosus	White-browed Babbler				•		•				•				•			•			•	•	•
Psophodidae																							
Psophodes occidentalis	Chiming Wedgebill				•		•																
Cinclosomatidae																							
*Cinclosoma marginatum^*	Western Quail-thrush (12)				•		•																
Artamidae																							
Artamus leucorynchus	White-breasted Woodswallow	•					•																
Artamus personatus	Masked Woodswallow	•			•		•		•			•			•					•		•	
Artamus superciliosus	White-browed Woodswallow				•		•													•			
Artamus cinereus	Black-faced Woodswallow	•			•		•	•	•	•	•	•	•	•	•	•		•			•	•	•
Artamus minor	Little Woodswallow				•		•		•	•	•		•	•			•	•	•				
*Gymnorhina tibicen^*	Australian Magpie	•			•		•	•	•		•		•	•	•	•	•	•					
Cracticus torquatus	Grey Butcherbird	•			•		•	•			•	•	•			•			•				
Cracticus nigrogularis	Pied Butcherbird	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Campephagidae																							
Coracina maxima	Ground Cuckooshrike				•		•				•	•						•					
Coracina novaehollandiae	Black-faced Cuckooshrike	•		MA	•		•	•	•	•	•	•	•					•			•	•	•
Coracina novaehollandiae subpallida	Black-faced Cuckooshrike			MA										•	•					•			
Lalage tricolor	White-winged Triller				•		•		•		•	•	•	•	•							•	
Neosittidae																							
Daphoenositta chrysoptera	Varied Sittella						•				•												
Oreoicidae																							
Oreoica gutturalis	Crested Bellbird	•			•		•	•	•		•	•	•	•	•	•	•				•	•	•
Pachycephalidae																							
Pachycephala rufiventris	Rufous Whistler	•					•	•	•	•	•	•	•	•		•	•			•	•	•	•
Colluricincla harmonica	Grey Shrikethrush	•			•		•		•		•		•	•		•	•	•	•	•	•	•	•
Rhipiduridae																							
Rhipidura leucophrys	Willie Wagtail	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Rhipidura albiscapa	Grey Fantail				•		•				•												
Rhipidura albiscapa albicauda	Grey Fantail				•		•																
Monarchidae																							
Grallina cyanoleuca	Magpie-lark	•		MA	•		•	•	•		•	•		•	•	•	•	•	•	•	•	•	•
Corvidae																							
*Corvus coronoides^*	Australian Raven																	•					
Corvus bennetti	Little Crow				•		•											•					
Corvus orru cecilae	Torresian Crow	•			•		•	•	•	•	•	•	•			•	•				•	•	•
Petroicidae																							
Melanodryas cucullata	Hooded Robin				•		•		•		•	•	•			•							•
Petroica goodenovii	Red-capped Robin				•		•	•	•		•	•			•			•			•	•	

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Alaudidae																							
Mirafra javanica	Horsfield's Bush Lark				•		•													•			
Hirundinidae																							
Cheramoeca leucosterna	White-backed Swallow				•		•															•	
Hirundo rustica	Barn Swallow		MI	MI		•																	
Hirundo neoxena	Welcome Swallow			MA	•		•															•	
Petrochelidon ariel	Fairy Martin				•		•		•		•									•	•	•	
Petrochelidon nigricans	Tree Martin			MA	•		•	•			•			•						•	•	•	
Acrocephalidae																							
Acrocephalus australis	Australian Reed Warbler	•			•		•				•										•	•	
Locustellidae																							
Poodytes carteri^	Spinifexbird	•			•		•		•			•	•	•			•	•	•	•		•	•
Poodytes gramineus^	Little Grassbird				•		•															•	
Cincloramphus cruralis	Brown Songlark						•					•			•	•				•		•	
Cincloramphus mathewsi	Rufous Songlark						•	•	•			•	•	•					•			•	
Dicaeidae																							
Dicaeum hirundinaceum	Mistletoebird				•		•		•		•								•			•	
Estrildidae																							
Emblema pictum	Painted Finch	•			•		•		•	•	•		•	•		•	•	•	•		•		•
Neochmia ruficauda	Star Finch				•		•				•											•	
Taeniopygia guttata^	Zebra Finch	•					•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Motacillidae																							
Motacilla tschutschensis^	Eastern Yellow Wagtail (13)		MI	MI; MA		•																	
Motacilla cinerea	Grey Wagtail		MI	MI; MA		•																	
Anthus australis	Australian Pipit (14)	•		MA	•		•	•	•		•		•								•	•	

(1) Fork-tailed Swift (*A. pacificus* sensu lato) split into four species, Pacific Swift (*A. pacificus* sensu stricto) now taxon occurring in Australia.
(2) Pied Stilt *Himantopus leucocephalus* previously included within Black-winged Stilt (*H. himantopus*).
(3) Australian Painted Snipe (*Rostratula australis*) formerly included within [Greater] Painted Snipe (*R. benghalensis*).
(4) Previously placed in the genus Philomachus.
(5) Australian subspecies *macrotarsa* of Gull-billed Tern now considered a separate species Australian Tern (or Australian Gull-billed Tern) *Gelochelidon macrotarsa*.
(6) Previously included within Cattle Egret (*Ardea ibis* or *Bubulcus ibis*).
(7) At times has been considered a distinct species, Eastern Great Egret *Ardea modesta*.
(8) Previously included within Barn Owl *Tyto alba*.
(9) Previously included within Southern Boobook.
(10) Previously included as a subspecies of Spotted Bowerbird *P. maculatus*.
(11) Rufous Grasswren (*Amytornis whitei*) previously considered a subspecies of Striated Grasswren (*A. striatus*).
(12) Western Quail-thrush (*Cinclosoma marginatum*) previously considered a subspecies of Chestnut-breasted Quail-thrush (*C. castaneothorax*).
(13) Eastern Yellow Wagtail (*Motacilla tschutschensis*) previously considered a subspecies of (Western) Yellow Wagtail (*M. flava*).
(14) Australian Pipit (*Anthus australis*) previously included within Australasian Pipit (*A. novaeseelandiae*) and prior to that Richard's Pipit (*A. richardi*).

Note: Records of Dusky Woodswallow (*Artamus cyanopterus*), Grey-fronted Honeyeater (*Ptilotula plumula*), and Copperback Quail-thrush (*Cinclosoma clarum*) removed as these records are well outside usual range for these species, records have not been well-documented, and likely confusion species do regularly occur. Garganey (*Anas querquedula*) indicated in appendix table of Biologic 2013a considered an error as not mentioned nor discussed anywhere else in report, such as results or significant fauna section.

^ Indicates species for which BHP WAIO internal nomenclature currently differs/species not currently included in BHP WAIO internal species list.

Appendix 2

Threatened Fauna Statutory Framework – Western Australia

Commonwealth *EPBC Act 1999*

Fauna species of national environmental significance are listed under the Commonwealth *EPBC Act*, and may be classified as 'critically endangered', 'endangered', 'vulnerable' or 'lower risk', which are consistent with IUCN categories.

Critically Endangered (CR): a taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Endangered (EN): a taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

Vulnerable (VU): a taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

Lower Risk (LR): a taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. **Conservation Dependent (CD).** Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation program targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
2. **Near Threatened (NT).** Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
3. **Least Concern (LC).** Taxa which do not qualify for Conservation Dependent or Near Threatened.

Migratory species (MI) are also protected under the *EPBC Act* as species of national environmental significance. Migratory species are those animals that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations. The list of migratory species consists of those species listed under the following international conventions:

1. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention);
2. China-Australia Migratory Bird Agreement (CAMBA);
3. Japan-Australia Migratory Bird Agreement (JAMBA); and,
4. Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Marine species (MA) are also protected under the *EPBC Act*, and are listed to ensure the long-term conservation of the species. Marine species include all Australian sea snakes, seals, crocodiles, dugongs, marine turtles, seahorses and seabirds that naturally occur in the Commonwealth marine area.

Western Australian *Biodiversity Conservation Act 2016*

The Wildlife Conservation (Specially Protected Fauna) Notice 2018 has been transitioned under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the Biodiversity Conservation Act 2016:

Threatened Species

- **Critically Endangered (CR):** Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines.
- **Endangered (EN):** Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines".
- **Vulnerable (VU):** Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines".

Extinct Species

- **Extinct Species (EX):** Species where "there is no reasonable doubt that the last member of the species has died"
- **Extinct in the wild (EW):** Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form"

Specially Protected Species

- **Migratory (MI):** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth. Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program
- **Species of special conservation interest (conservation dependent fauna) (CD):** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
- **Other specially protected fauna (OS):** Fauna otherwise in need of special protection to ensure their conservation

Department of Biodiversity, Conservation and Attractions Priority Listing

The DBCA maintains a list of Priority species that have not been assigned statutory protection under the *Biodiversity Conservation Act 2016*. Species on this list are considered to be of conservation priority because there is insufficient information to make an assessment of their conservation status or they are considered to be rare but not threatened and are in need of monitoring. Under this list, species are classified according to four Priority categories:

Priority 1: Poorly known species
Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

Priority 2: Poorly known species
Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

Priority 3: Poorly known species
Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

Priority 4: Rare, Near Threatened and other species in need of monitoring
(a) Rare. Species 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 species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix 3

Fauna Licence

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

FAUNA TAKING (BIOLOGICAL ASSESSMENT) LICENCE

Regulation 27, Biodiversity Conservation Regulations 2018

Licence Number: BA27000388

Licence Holder: Dr Sylvie Schmidt
Biota Environmental Sciences
Level 1 / 228 Carr Place
Leederville WA 6007

Date of Issue: 01/04/2021

Date Valid From: 01/04/2021
Date of Expiry: 31/03/2022

LICENSED ACTIVITIES

Subject to the terms and conditions on this licence, the licence holder may –

1. Take and disturb fauna for fauna survey for BHP using remote sensing cameras, ultrasonic bat detectors, acoustic call recorders, and visual observations (Aural survey, spotlighting, secondary signs, habitat assessment) to inform future environmental assessments and approvals.

LOCATIONS

1. OB32 Surplus Water survey area northeast of existing Eastern Ridge BHP Operations (Newman) (Pilbara Region).

AUTHORISED PERSONS

The following persons or persons of the specified class may assist in carrying out the licensed activities:

1. Michael Greenham

CONDITIONS

1. Fauna must not be taken on CALM land, (as defined in the Conservation and Land Management Regulations 2002*),* unless authorised by a written notice of a lawful authority issued under regulations 4 and 8 of the Conservation and Land Management Regulations 2002.
2. If persons, other than the licence holder, are authorised to carry out/assist in carrying out the activities under the licence, the licence holder must ensure those persons have read and understand the licence terms and conditions.
3. The written authorisation of the person in possession or occupation of the land accessed and upon which fauna is taken, as required under regulation 101(2) and referred to in “Additional information” below, must:
   a) state location details (including lot or location number, street/road, suburb and local government authority);
   b) state land owner or occupier name, and contact phone number;
   c) specify the time period that the authorisation is valid for;
   d) be signed and dated; and
   e) be attached to this licence at all times.

4. This licence, and any written authorisation or lawful authority which authorises the take of fauna on specified locations must be carried at all times while conducting licensed activities and be produced on demand by a wildlife officer.
5. If a species of fauna listed as a threatened species under Section 19 of the *Biodiversity Conservation Act 2016* is inadvertently captured, that species is to be released immediately at the point of capture. If the fauna is injured or deceased, the licence holder shall contact the DBCA Wildlife Licensing Section (wildlifelicensing@dbca.wa.gov.au) for advice on treatment or disposal. Details of any capture of threatened fauna must be included in the "Return of Fauna Taken."
6. The licence holder must not:
   a) release any fauna in any area where it does not naturally occur;
   b) transfer fauna to any other person or authority (other than the Western Australian Museum) unless approved in writing by the CEO; or
   c) dispose of the remains of fauna in any manner likely to interfere the natural or present day distribution of the species.
7. The licence holder must not take and remove more than ten specimens of any one protected species of fauna from any location less than 20km apart. Where exceptional circumstances make it necessary to take a larger number of specimens from a particular location in order to obtain adequate statistical data, the collector must proceed with circumspection and justify their actions to the Director General in advance.
8. All holotypes and syntypes and a half share of paratypes of species or subspecies permitted to be permanently taken under this licence must be donated to the Western Australian Museum. Duplicates (one pair in each case) of any species collected, which represents a significant extension of geographic range must be offered to the Western Australian Museum.
9. All specimens and material retained under the authority of this licence must be offered to the Western Australian Museum for loan, for inclusion in its collection, or on request be made available to other persons involved in relevant scientific studies.
10. The licence holder must create, compile and maintain records and information as required in a DBCA approved "Return of Fauna Taken" of all fauna taking activities as they occur.
11. A DBCA approved "Return of Fauna Taken" must be completed in full (including nil taking details) and submitted to DBCA Wildlife Licensing Section (wildlifelicensing@dbca.wa.gov.au) prior to the end of each annual period of the licence (from the valid from date) (refer to "Additional Information" section below).

Norman Press
LICENSING OFFICER
WILDLIFE PROTECTION BRANCH

Delegate of CEO

ADDITIONAL INFORMATION

1. It is an offence to take any species of fauna listed as a threatened species under Section 19 of the *Biodiversity Conservation Act 2016* unless the person is authorised under Section 40. The penalty ranges between $300 000 and $500 000; Section 150 Biodiversity Conservation Act 2016.

2. Regulation 82 empowers the CEO to add, substitute or delete a term or condition of a licence or to correct errors. Such power may be exercised on application of a licence holder or by the CEO's own initiative. If an amendment to a licence term or condition is required, please contact the CEO or the Licensing Section on wildlifelicensing@dbca.wa.gov.au in the first instance. The licence holder, if adversely affected by a condition imposed in this licence, may apply to the State Administrative Tribunal for review of the decision of the CEO to impose that condition on a licence: regulation 89(2) Biodiversity Conservation Regulations 2018.

3. A person must not contravene a condition of a licence. The penalty for an offence involving the contravention of a condition of a licence is a fine of $10 000: regulation 84 of the Biodiversity Conservation Regulations 2018.

4. It is an offence for persons authorised by this licence to enter land that is not in their possession or under their control without first having the *prior* written authorisation of the current owner or occupier of the land to:

   a) enter the land; and

   b) carry out the activity authorised by this licence.

   The penalty for this offence is a fine of $5 000: regulation 101(2) of the Biodiversity Conservation Regulations 2018.

5. The licence holder must be able to produce for inspection upon request any information or records required by regulation 85(2) of the Biodiversity Conservation Regulations 2018 Penalty $10 000. It is an offence to knowingly include false or misleading information or make statements in records: regulation 85(3) of the Biodiversity Conservation Regulations 2018 Penalty $10 000. It is an offence to include any information or make any statement in a return that the licence holder knows to be false or misleading in a material particular: regulation 86 (2) of the Biodiversity Conservation Regulations 2018 Penalty $10 000.

6. The approved DBCA "Return of Fauna Taken" data file can be downloaded from the DBCA webpage (https://www.dpaw.wa.gov.au/plants-and-animals/licences-and-authorities).

7. The issuing of a licence under the Biodiversity Conservation Regulations 2018 does not constitute an animal ethics approval or a licence to use animals for scientific purposes as required under the *Animal Welfare Act 2002,* Animal Welfare (Scientific Purposes) Regulations 2003. It is the responsibility of a licence applicant / licence holder to ensure that they comply with the requirements of all applicable legislation. Enquiries relating to the Animal Welfare Act licences and animal ethics approvals are to be directed to the Department of Primary Industries and Regional Development (https://www.agric.wa.gov.au/animalwelfare).

8. Threatened fauna can only be taken under a *Biodiversity Conservation Act 2016* Section 40 authorisation, Occurrences of threatened species must be reported to the CEO. For more information please see https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals.

9. Any interaction involving Nationally Listed Threatened Fauna that may be invasive and/or harmful to the fauna may require approval from the Commonwealth Department of the Environment and Energy http://www.environment.gov.au/about-us/business-us/permits-assessments-licences. Interaction with such species is controlled by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and Environment Protection and Biodiversity Conservation Regulations 2000 as well as the *Biodiversity Conservation Act 2016* and Biodiversity Conservation Regulations 2018.

GOVERNMENT OF WESTERN AUSTRALIA

Department of **Biodiversity, Conservation and Attractions**

AUTHORISATION TO TAKE OR DISTURB THREATENED SPECIES

Section 40 of the Biodiversity Conservation Act 2016

AUTHORISATION DETAILS

Authorisation type: Fauna

Authorisation number: TFA 2021-0022

Authorisation duration: From date signed by Minister's delegate, below, until 31 March 2022.

AUTHORISATION HOLDER

Sylvie Schmidt

Biota Environmental Sciences

Level 1/228 Carr Place

Leederville WA 6007

AREA TO WHICH THIS AUTHORISATION APPLIES

Homestead Creek and surrounds, ~3 to 65 km north-east of Newman (Pilbara Region).

AUTHORISED ACTIVITY

Purpose of taking/disturbance:

Two-phase targeted, matter of national environmental significance, fauna survey to inform environmental impact assessments associated with potential future surplus water discharge and /or pipeline construction, upstream of the existing Eastern Ridge BHP Operations.

Threatened species authorised to be taken/disturbed (including conservation status):

Night parrot, *Pezoporus occidentalis* (Critically Endangered)

Northern quoll, *Dasyurus hallucatus* (Endangered)

Bilby, *Macrotis lagotis* (Vulnerable)

Quantity of threatened species authorised to be taken/disturbed:

Any number of individual animals of the above listed threatened fauna species may potentially be observed and/or disturbed by the survey activities.

Authorised taking/disturbance methodology:

Disturb night parrots during deployment and collection of acoustic call recorders in night parrot nesting and roosting habitat.

Disturb northern quolls and bilbies by deployment of remote sensor cameras. Cameras will be baited with a mixture of peanut butter, rolled oats, bacon and truffle oil for scent. Bait will be inaccessible for long term camera monitoring, except for a small amount during baiting (initial set-up) and rebaiting 2-3 months later. A small bolus of bait will be used for short-term camera monitoring (up to five nights) to investigate fresh signs of activity.

..... (Delegate's initials)

ADDITIONAL AUTHORISED PERSONS

Michael Greenham

Additional personnel who are suitably qualified and experienced in the authorised activities working under the direction of the authorisation holder.

Field assistants assisting with the authorised activities working under the direct supervision of the authorisation holder or suitably qualified and experienced named additional authorised person.

CONDITIONS

1. The written authorisation of the person in possession or occupation of the land accessed and upon which threatened fauna is taken or disturbed must:
   a) state location details (including lot or location number, street/road, suburb and local government authority);
   b) state land owner or occupier name, and contact phone number;
   c) specify the time period that the authorisation is valid for;
   d) be signed and dated; and
   e) be attached to this Authorisation to take or disturb threatened species at all times.
2. This Authorisation to take or disturb threatened species, and any other written authorisation or lawful authority which authorises the take or disturbance of fauna on specified locations for the authorised activities must be carried at all times while conducting authorised activities and be produced on demand by a wildlife officer.
3. Named additional authorised persons who are not suitably qualified and experienced in the authorised activities, and volunteer field assistants assisting with the authorised activities, must be working under direct supervision of experienced and competent named authorised persons.
4. Any inadvertently captured species of non-target threatened fauna or non-threatened fauna (threatened fauna as defined in *Biodiversity Conservation Act 2016* Section 19) is to be released immediately at the point of capture. Details of such fauna must be included in the fauna taking return as required under this authorisation.
5. The authorisation holder, unless specified in the authorised activities, must not:
   a) release any threatened fauna in any area where it does not naturally occur;
   b) transfer threatened fauna to any other person or authority (other than the Western Australian Museum) unless the fauna is injured or abandoned fauna (condition 6); or
   c) dispose of the remains of threatened fauna in any manner likely to confuse the natural or present-day distribution of the species.
6. All threatened fauna injuries, unexpected deaths, unplanned euthanasia, and abandoned young or eggs, must be reported by the authorisation holder to the DBCA Wildlife Licensing Section (wildlifelicensing@dbca.wa.gov.au) to notify of the incident and for advice on treatment or disposal. All deceased threatened fauna must be offered to the Western Australian Museum.
7. The authorisation holder must create, compile and maintain records and information as required in a DBCA approved "Return of Fauna Taken/Disturbed" of all fauna taking activities as they occur.
8. A DBCA approved "Return of Fauna Taken/Disturbed" must be completed in full (including nil taking details) and submitted to DBCA Wildlife Licensing Section (wildlifelicensing@dbca.wa.gov.au) prior to the end of the authorisation duration and, if the authorisation duration is greater than 12 months, prior to the end of each annual period of the authorisation (from the date signed by the Minister's delegate) (refer to "Additional Information" section below). Where a licence to take or disturb fauna is issued in conjunction with this

..... (Delegate's initials)

Authorisation to take or disturb threatened species, a combined "Return of Fauna Taken/Disturbed" may be completed and submitted.

9. A written report detailing the undertaken authorised activities, outcome, unintended incidents, injuries and mortalities of threatened fauna, implemented monitoring, mitigation and management, and explaining the records and information as required in a DBCA approved "Return of Fauna Taken/Disturbed" must be submitted, in addition to a "Return of Fauna Taken/Disturbed" to DBCA Wildlife Licensing Section (wildlifelicensing@dbca.wa.gov.au).

ADDITIONAL INFORMATION

1. Before undertaking the Authorised Activity, permission must be obtained from: (a) the owner or occupier of private land; or (b) the Department or Authority controlling Crown land, on which the Threatened Fauna occur. This includes obtaining the written endorsement from Department of Biodiversity, Conservation and Attractions (DBCA) if the authorised activity is proposed for land managed by DBCA.
2. This Authorisation to take or disturb threatened species does not constitute lawful authority issued under regulations 4 and 8 of the *Conservation and Land Management Regulations 2002*. Contact the applicable Department District Officer for further information.
3. The approved DBCA "Return of Fauna Taken/Disturbed" data file can be downloaded from the DBCA webpage (https://www.dpaw.wa.gov.au/plants-and-animals/licences-and-authorities).
4. Any interaction involving nationally listed threatened fauna that may be harmful to the fauna and/or invasive may require approval from the Commonwealth Department of the Environment and Energy (http://www.environment.gov.au/biodiversity/threatened/permits). Interaction with such species is controlled by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and *Environment Protection and Biodiversity Conservation Regulations 2000*.
5. It is the responsibility of the authorisation holder to ensure that they comply with the requirements of all applicable legislation.
6. An Authorisation to take or disturb threatened species does not constitute an animal ethics approval or a licence to use animals for scientific purposes as required under the *Animal Welfare Act 2002, Animal Welfare (Scientific Purposes) Regulations 2003*. Enquiries relating to the Animal Welfare Act licences and animal ethics approvals are to be directed to the Western Australian Department of Primary Industries and Regional Development (https://www.agric.wa.gov.au/animalwelfare).

Margaret Byrne

Dr Margaret Byrne

Executive Director of Biodiversity and Conservation Science

AS DELEGATE OF THE MINISTER

DATE: 19/3/2021

Appendix 4

Habitat Assessment

Habitat Assessment

Site ID	Latitude (°S)	Longitude (°E)	(Dominant) BHP Fauna Habitat Type	(Dominant) Landform	Aspect	Slope	Soil Type	Soil Availability	Amount of Outcropping	Outcropping Rock Type	Rock Size	Vegetation Litter Cover	Hollow Bearing Trees	Time Since Last Fire	Disturbances	Mapped Fauna Habitat	Picture
OBT-01	-23.338132	119.771645	Drainage Area/ Floodplain	Major Drainage Line	East	Flat	Sandy Clay Loam	Evenly Spread	Negligible	Other	Pebbles (5-10cm)	Few Small Patches	-	Old (6+ yr)	Road/ Access Track	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-02	-23.342298	119.779872	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Silty Clay Loam	Scarce	Negligible	Other	Negligible	Few Small Patches	-	Old (6+ yr)	Weed Invasion	Fauna Landscape 5: Cleared/ disturbed, incl. artificial water bodies	
OBT-03	-23.345315	119.834481	Wetland	Major Drainage Line	Flat	Flat	Silty Clay Loam	Few Large Patches	Negligible	Other	Negligible	Few Large Patches	-	Old (6+ yr)	Road/ Access Track	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-04	-23.296451	119.869111	Major Drainage Line	Major Drainage Line	North	Flat	Silty Clay Loam	Many Large Patches	Negligible	Other	Gravel (1-4cm)	Few Small Patches	-	Old (6+ yr)	Road/ Access Track	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-05*	-23.31264	119.853056	Ironstone Outcrops	Hillslope	East	Moderate	Silty Clay Loam	Few Small Patches	Limited Outcropping	BIF	Small Rocks (11-20cm)	Scarce	-	Old (6+ yr)	Mining Exploration	Fauna Landscape 4: Undulating low hills and ironstone outcrops	
OBT-06	-23.147743	120.053969	Drainage Area/ Floodplain	Sand Plain	Flat	Flat	Sandy Loam	Many Small Patches	Negligible	None Discernible	Negligible	Few Small Patches	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 2: Sandy *Triodia* plains	

Site ID	Latitude (°S)	Longitude (°E)	(Dominant) BHP Fauna Habitat Type	(Dominant) Landform	Aspect	Slope	Soil Type	Soil Availability	Amount of Outcropping	Outcropping Rock Type	Rock Size	Vegetation Litter Cover	Hollow Bearing Trees	Time Since Last Fire	Disturbances	Mapped Fauna Habitat	Picture
OBT-07	-23.231492	119.911081	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Silty Clay Loam	Many Small Patches	Negligible	Other	Gravel (1-4cm)	Scarce	-	Old (6+ yr)	Road/ Access Track	Fauna Landscape 2: Sandy *Triodia* plains	
OBT-08	-23.231753	119.913262	Major Drainage Line	Major Drainage Line	North	Flat	Silty Clay Loam	Many Large Patches	Negligible	Other	Pebbles (5-10cm)	Few Small Patches	-	Old (6+ yr)	Road/ Access Track	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-09	-23.292195	119.869974	Major Drainage Line	Major Drainage Line	North	Flat	Silty Clay Loam	Many Large Patches	Negligible	Other	Pebbles (5-10cm)	Few Small Patches	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-10	-22.971747	120.180457	Waterhole	Medium Drainage Line	North	Flat	Sandy Clay Loam	Evenly Spread	Negligible	None Discernible	Negligible	Scarce	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-11	-22.984534	120.199764	Stony Plain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Other	Gravel (1-4cm)	Few Small Patches	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	
OBT-12	-23.113031	120.150873	Sand Plain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam Sandy	Many Small Patches	Negligible	None Discernible	Negligible	Few Small Patches	-	Old (6+ yr)	Cattle Grazing, Road/ Access Track	Fauna Landscape 2: Sandy *Triodia* plains	

Site ID	Latitude (°S)	Longitude (°E)	(Dominant) BHP Fauna Habitat Type	(Dominant) Landform	Aspect	Slope	Soil Type	Soil Availability	Amount of Outcropping	Outcropping Rock Type	Rock Size	Vegetation Litter Cover	Hollow Bearing Trees	Time Since Last Fire	Disturbances	Mapped Fauna Habitat	Picture
OBT-13	-23.144069	120.095013	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	None Discernible	Negligible	Many Small Patches	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 2: Sandy *Triodia* plains	
OBT-14	-23.185724	119.994566	Drainage Area/ Floodplain	Stony Plain	Flat	Flat	Silty Clay Loam	Many Small Patches	Negligible	Other	Gravel (1-4cm)	Scarce	-	Old (6+ yr)	None Discernible	Fauna Landscape 2: Sandy *Triodia* plains	
OBT-15	-23.31846	119.852903	Artificial Wetlands	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Evenly Spread	Negligible	Other	Small Rocks (11-20cm)	Scarce	-	Old (6+ yr)	Road/ Access Track	Fauna Landscape 5: Cleared/ disturbed, incl. artificial water bodies	
OBT-16	-23.314707	119.85827	Waterhole	Major Drainage Line	North	Flat	Silty Clay Loam	Many Large Patches	Limited Outcropping	Other	Gravel (1-4cm)	Many Large Patches	-	Old (6+ yr)	Weed Invasion	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-17	-23.205927	119.912388	Waterhole	Major Drainage Line	North	Flat	Silty Clay Loam	Many Large Patches	Negligible	Other	Small Rocks (11-20cm)	Few Small Patches	-	Old (6+ yr)	Cattle Grazing, Weed Invasion	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-18	-23.178288	119.925449	Waterhole	Major Drainage Line	East	Flat	Clayey Sand	Many Large Patches	Negligible	Other	Gravel (1-4cm)	Few Small Patches	-	Old (6+ yr)	Road/ Access Track	Fauna Landscape 1: Vegetated sandy/stony drainage systems	

Site ID	Latitude (°S)	Longitude (°E)	(Dominant) BHP Fauna Habitat Type	(Dominant) Landform	Aspect	Slope	Soil Type	Soil Availability	Amount of Outcropping	Outcropping Rock Type	Rock Size	Vegetation Litter Cover	Hollow Bearing Trees	Time Since Last Fire	Disturbances	Mapped Fauna Habitat	Picture
OBT-19	-23.175578	120.023231	Major Drainage Line	Major Drainage Line	East	Flat	Sandy Clay Loam	Many Large Patches	Negligible	Other	Pebbles (5-10cm)	Few Small Patches	-	Old (6+ yr)	Road/ Access Track	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-20	-23.33152	119.854486	Major Drainage Line	Major Drainage Line	Flat	Flat	Clay Loam	Scarce	Negligible	None Discernible	Negligible	Many Large Patches	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-21	-23.205004	119.914499	Ironstone Outcrops	Major Drainage Line	East	Flat	Silty Clay Loam	Few Small Patches	Limited Outcropping	Other	Pebbles (5-10cm)	Scarce	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 4: Undulating low hills and ironstone outcrops	
OBT-22	-23.293214	119.870559	Major Drainage Line	Major Drainage Line	North	Flat	Silty Clay Loam	Many Large Patches	Negligible	Other	Pebbles (5-10cm)	Few Small Patches	-	Old (6+ yr)	Road/ Access Track	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-23	-23.29834	119.869652	Minor Drainage Line	Major Drainage Line	South	Low	Clay Loam	Few Small Patches	Minor Outcropping	Other	Small Rocks (11-20cm)	Many Small Patches	-	Moderate (3 to 5 yr)	Cattle Grazing	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-24*	-23.311041	119.873674	Hillcrest/ Hillslope	Ironstone Outcrops	Flat	Flat	Silty Clay Loam	Few Small Patches	Major Outcropping	BIF	Gravel (1-4cm)	Scarce	-	Old (6+ yr)	Mining Exploration	Fauna Landscape 4: Undulating low hills and ironstone outcrops	

Site ID	Latitude (°S)	Longitude (°E)	(Dominant) BHP Fauna Habitat Type	(Dominant) Landform	Aspect	Slope	Soil Type	Soil Availability	Amount of Outcropping	Outcropping Rock Type	Rock Size	Vegetation Litter Cover	Hollow Bearing Trees	Time Since Last Fire	Disturbances	Mapped Fauna Habitat	Picture
OBT-25	-23.302065	119.859509	Ironstone Outcrops	Undulating Low Hills	South	Moderate	Silty Clay Loam	Few Small Patches	Minor Outcropping	BIF	Large Rocks (21-60cm)	Scarce	-	Old (6+ yr)	Road/ Access Track	Fauna Landscape 4: Undulating low hills and ironstone outcrops	
OBT-26	-23.315084	119.858566	Ironstone Outcrops	Major Drainage Line	West	Moderate	Silty Clay Loam	Scarce	Minor Outcropping	BIF	Small Rocks (11-20cm)	Scarce	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 4: Undulating low hills and ironstone outcrops	
OBT-27	-23.338439	119.771158	Major Drainage Line	Major Drainage Line	East	Flat	Silty Clay Loam	Many Small Patches	Negligible	Other	Pebbles (5-10cm)	Few Small Patches	-	Old (6+ yr)	Weed Invasion	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-28	-23.263899	119.890714	Major Drainage Line	Major Drainage Line	North	Flat	Silty Clay Loam	Few Large Patches	Negligible	Other	Gravel (1-4cm)	Few Small Patches	-	Moderate (3 to 5 yr)	Cattle Grazing, Weed Invasion	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-29	-23.264945	119.897982	Major Drainage Line	Major Drainage Line	North	Flat	Sandy Clay Loam	Few Large Patches	Negligible	Other	Pebbles (5-10cm)	Many Small Patches	-	Moderate (3 to 5 yr)	Cattle Grazing	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-30	-23.332346	119.854191	Wetland	Wetland	East	Flat	Clay Loam	Few Small Patches	Negligible	None Discernible	Negligible	Evenly Spread	0	Old (6+ yr)	Cattle Grazing, Road/ Access Track	Fauna Landscape 1: Vegetated sandy/stony drainage systems	

Site ID	Latitude (°S)	Longitude (°E)	(Dominant) BHP Fauna Habitat Type	(Dominant) Landform	Aspect	Slope	Soil Type	Soil Availability	Amount of Outcropping	Outcropping Rock Type	Rock Size	Vegetation Lifter Cover	Hollow Bearing Trees	Time Since Last Fire	Disturbances	Mapped Fauna Habitat	Picture
OBT-31	-23.297792	119.869398	Drainage Area/ Floodplain	Drainage Area/ Floodplain	South	Flat	Clay Loam Sandy	Many Large Patches	Negligible	None Discernible	Negligible	Many Small Patches	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-32	-23.20707	119.912658	Drainage Area/ Floodplain	Drainage Area/ Floodplain	East	Flat	Sandy Clay Loam	Few Small Patches	Negligible	None Discernible	Negligible	Few Small Patches	-	Old (6+ yr)	Road/ Access Track	Fauna Landscape 2: Sandy *Triodia* plains	
OBT-33	-23.175424	120.02364	Major Drainage Line	Major Drainage Line	North/ East	Low	Loamy Sand	Evenly Spread	Negligible	None Discernible	Small Rocks (11-20cm)	Few Small Patches	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-34	-23.113465	120.087417	Drainage Area/ Floodplain	Drainage Area/ Floodplain	East	Flat	Sandy Clay Loam	Many Large Patches	Negligible	None Discernible	Pebbles (5-10cm)	Few Small Patches	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-35	-23.070218	120.12218	Drainage Area/ Floodplain	Drainage Area/ Floodplain	West	Flat	Clay Loam Sandy	Many Large Patches	Negligible	None Discernible	Gravel (1-4cm)	Many Small Patches	-	Old (6+ yr)	Cattle Grazing, Weed Invasion	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-36	-23.097244	120.162297	Drainage Area/ Floodplain	Drainage Area/ Floodplain	North	Flat	Silty Clay Loam	Many Small Patches	Negligible	None Discernible	Negligible	Scarce	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	

Site ID	Latitude (°S)	Longitude (°E)	(Dominant) BHP Fauna Habitat Type	(Dominant) Landform	Aspect	Slope	Soil Type	Soil Availability	Amount of Outcropping	Outcropping Rock Type	Rock Size	Vegetation Litter Cover	Hollow Bearing Trees	Time Since Last Fire	Disturbances	Mapped Fauna Habitat	Picture
OBT-37	-23.095603	120.157623	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	None Discernible	Negligible	Scarce	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	
OBT-38	-23.130989	120.082272	Major Drainage Line	Major Drainage Line	North	Flat	Sandy Clay Loam	Evenly Spread	Negligible	None Discernible	Gravel (1-4cm)	Scarce	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-39	-23.132006	120.083611	Drainage Area/ Floodplain	Drainage Area/ Floodplain	East	Flat	Sandy Clay Loam	Few Large Patches	Negligible	None Discernible	Negligible	Few Small Patches	-	Old (6+ yr)	Cattle Grazing, Weed invasion	Fauna Landscape 2: Sandy *Triodia* plains	
OBT-40	-23.165354	120.040044	Drainage Area/ Floodplain	Drainage Area/ Floodplain	West	Low	Sandy Clay Loam	Many Small Patches	Negligible	None Discernible	Negligible	Many Small Patches	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 2: Sandy *Triodia* plains	
OBT-41	-23.274095	119.884937	Drainage Area/ Floodplain	Drainage Area/ Floodplain	North	Flat	Clay Loam	Many Large Patches	Negligible	None Discernible	Pebbles (5-10cm)	Many Small Patches	-	Old (6+ yr)	Cattle Grazing, Weed invasion	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-42	-22.965125	120.193949	Drainage Area/ Floodplain	Drainage Area/ Floodplain	West	Flat	Sandy Clay Loam	Many Large Patches	Negligible	None Discernible	Gravel (1-4cm)	Few Small Patches	-	Old (6+ yr)	Cattle Grazing, Weed invasion	Fauna Landscape 1: Vegetated sandy/stony drainage systems	

Site ID	Latitude (°S)	Longitude (°E)	(Dominant) BHP Fauna Habitat Type	(Dominant) Landform	Aspect	Slope	Soil Type	Soil Availability	Amount of Outcropping	Outcropping Rock Type	Rock Size	Vegetation Litter Cover	Hollow Bearing Trees	Time Since Last Fire	Disturbances	Mapped Fauna Habitat	Picture
OBT-43	-23.199909	119.92021	Boulders/ Rockpiles	Ironstone Outcrops	West	Low	Clay Loam	Few Large Patches	Minor Outcropping	BIF	Large Rocks (21-60cm)	Scarce	-	Old (6+ yr)	Cattle Grazing, Road/ Access Track	Fauna Landscape 4: Undulating low hills and ironstone outcrops	
OBT-44	-23.237156	119.913699	Major Drainage Line	Major Drainage Line	North	Low	Sandy Clay Loam	Many Large Patches	Negligible	None Discernible	Gravel (1-4cm)	Many Small Patches	-	Old (6+ yr)	Cattle Grazing, Weed Invasion	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-45	-23.28703	119.877529	Waterhole	Major Drainage Line	North	Flat	Sandy Clay Loam	Many Large Patches	Negligible	None Discernible	Gravel (1-4cm)	Few Small Patches	-	Old (6+ yr)	Cattle Grazing	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-46	-23.234678	119.918274	Waterhole	Drainage Area/ Floodplain	West	Flat	Sandy Clay Loam	Many Large Patches	Negligible	None Discernible	Gravel (1-4cm)	Many Small Patches	-	Old (6+ yr)	Cattle Grazing, Weed Invasion	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-47	-23.201328	119.919059	Waterhole	Major Drainage Line	North	Flat	Sandy Clay Loam	Evenly Spread	Limited Outcropping	Other	Pebbles (5-10cm)	Few Small Patches	-	Old (6+ yr)	Cattle Grazing, Road/ Access Track	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-48	-23.309991	119.768145	Hillcrest/Hillslope	Ironstone Outcrops	South	Low	Clay Loam	Few Small Patches	Limited Outcropping	Other	Gravel (1-4cm)	Scarce	-	Old (6+ yr)	Mining Exploration, Road/ Access Track	Fauna Landscape 5: Cleared/ disturbed, incl. artificial water bodies	

Site ID	Latitude (°S)	Longitude (°E)	(Dominant) BHP Fauna Habitat Type	(Dominant) Landform	Aspect	Slope	Soil Type	Soil Availability	Amount of Outcropping	Outcropping Rock Type	Rock Size	Vegetation Litter Cover	Hollow Bearing Trees	Time Since Last Fire	Disturbances	Mapped Fauna Habitat	Picture
OBT-49	-23.312633	119.766945	Drainage Area/ Floodplain	Drainage Area/ Floodplain	South	Flat	Clay Loam	Few Large Patches	Negligible	Other	Gravel (1-4cm)	Few Large Patches	-	Old (6+ yr)	Mining Exploration, Road/ Access Track, Weed Invasion	Fauna Landscape 5: Cleared/ disturbed, incl. artificial water bodies	
OBT-50	-23.315014	119.769596	Undulating Low Hills	Undulating Low Hills	South	Low	Clay Loam	Few Small Patches	Limited Outcropping	Other	Gravel (1-4cm)	Scarce	-	Old (6+ yr)	Mining Exploration, Road/ Access Track	Fauna Landscape 5: Cleared/ disturbed, incl. artificial water bodies	
OBT-51	-23.343016	119.773167	Drainage Area/ Floodplain	Drainage Area/ Floodplain	South	Flat	Clay Loam	Few Large Patches	Negligible	Other	Gravel (1-4cm)	Few Large Patches	-	Old (6+ yr)	Mining Exploration, Road/ Access Track, Weed Invasion	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	
OBT-52	-23.310816	119.750602	Medium Drainage Line	Medium Drainage Line	South	Low	Clay Loam	Scarce	Negligible	Other	Pebbles (5-10cm)	Few Small Patches	-	Old (6+ yr)	Weed Invasion	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	
OBT-53	-23.313154	119.758615	Drainage Area/ Floodplain	Drainage Area/Flood plain	South	Flat	Clay Loam	Many Large Patches	Negligible	Other	Gravel (1-4cm)	Few Large Patches	-	Old (6+ yr)	Mining Exploration, Road/ Access Track, Weed Invasion	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	
OBT-54	-23.340151	119.826183	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	None Discernible	Negligible	Scarce	-	Old (6+ yr)	Mining Exploration, Road/ Access Track, Weed Invasion	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	

Site ID	Latitude (°S)	Longitude (°E)	(Dominant) BHP Fauna Habitat Type	(Dominant) Landform	Aspect	Slope	Soil Type	Soil Availability	Amount of Outcropping	Outcropping Rock Type	Rock Size	Vegetation Lifter Cover	Hollow Bearing Trees	Time Since Last Fire	Disturbances	Mapped Fauna Habitat	Picture
OBT-55	-23.342728	119.809105	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Scarce	Negligible	None Discernible	Negligible	Scarce	-	Old (6+ yr)	Mining Exploration, Road/ Access Track, Weed Invasion	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	
OBT-56	-23.346214	119.784686	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Silty Clay Loam	Many Large Patches	Negligible	Other	Gravel (1-4cm)	Scarce	-	Old (6+ yr)	Mining Exploration, Road/ Access Track, Weed Invasion	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	
OBT-57	-23.337997	119.765655	Dam	Drainage Area/ Floodplain	Flat	Flat	Silty Clay Loam	Few Large Patches	Negligible	Other	Gravel (1-4cm)	Scarce	-	Old (6+ yr)	Road/ Access Track, Weed Invasion	Fauna Landscape 5: Cleared/ disturbed, incl. artificial water bodies	
OBT-58	-23.335969	119.761136	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Many Small Patches	Negligible	None Discernible	Negligible	Scarce	-	Old (6+ yr)	Mining Exploration, Road/ Access Track, Weed Invasion	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	
OBT-59	-23.345965	119.828652	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Silty Clay Loam	Few Large Patches	Negligible	Other	Gravel (1-4cm)	Few Large Patches	-	Old (6+ yr)	Road/ Access Track, Weed Invasion	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	
OBT-60	-23.346860	119.832157	Drainage Area/ Floodplain	Major Drainage Line	Flat	Flat	Silty Clay Loam	Few Large Patches	Negligible	Other	Gravel (1-4cm)	Evenly Spread	-	Old (6+ yr)	Cattle Grazing, Weed Invasion	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	

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OBT-61	-23.344741	119.832828	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Silty Clay Loam	Many Small Patches	Negligible	Other	Gravel (1-4cm)	Few Small Patches	-	Old (6+ yr)	Cattle Grazing, Weed Invasion	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	
OBT-62	-23.342529	119.826564	Drainage Area/ Floodplain	Drainage Area/ Floodplain	East	Flat	Clay Loam	Many Large Patches	Negligible	None Discernible	Negligible	Few Small Patches	-	Old (6+ yr)	Road/ Access Track, Rubbish/ Litter, Weed Invasion	Fauna Landscape 3: Floodplains – open shrubland with patches of *Mulga*	
OBT-63	-23.334057	119.767017	Drainage Area/ Floodplain	Minor Drainage Line	North/ East	Low	Clay Loam	Few Small Patches	Negligible	Other	Gravel (1-4cm)	Few Small Patches	-	Old (6+ yr)	Cattle Grazing, Weed Invasion	Fauna Landscape 1: Vegetated sandy/stony drainage systems	
OBT-64	-23.327776	119.757799	Major Drainage Line	Major Drainage Line	North/ East	Flat	Sandy Clay Loam	Many Large Patches	Negligible	Other	Pebbles (5-10cm)	Many Small Patches	-	Old (6+ yr)	Cattle Grazing, Weed Invasion	Fauna Landscape 1: Vegetated sandy/stony drainage systems	

* outside study area (camera system equipment)
Note: As per BHP data requirements each site characteristic can only have one value, therefore all values here reflect the characteristic at the location given, however the range of values would differ for the area searched/covered by sampling techniques used;
Hollow bearing trees not counted as not relevant for target species.