Biota Environmental Sciences

Nifty Copper Mine Targeted Fauna Assessment

Prepared for Cyprium Metals Ltd

November 2021

Biota Environmental Sciences

ABN 49 092 687 119
Level 1, 228 Carr Place
Leederville Western Australia 6007
Ph: (08) 9328 1900 Fax: (08) 9328 6138

Project No.: 1596

Prepared by: N. Beerkens, R. de Vos

Document Quality Checking History

Version:	Rev 0	Peer review:	D. Kamien, J. Graff
	Rev 0	Director review:	G. Humphreys
	Rev 0	Format review:	G. Humphreys

Approved for issue: G. Humphreys

This report has been designed for double-sided printing. Hard copies supplied by Biota are printed on recycled paper.

This page is intentionally left blank.

Nifty Targeted Fauna Assessment

Contents

Tables

Figures

Plates

1.0 Executive Summary

1.1 Background

Cyprium Metals Ltd (Cyprium) has recently acquired the Nifty Copper Mine (Nifty), located in the Great Sandy Desert, approximately 350 km southeast of Port Hedland. Cyprium intends to alter the mine layout which will require clearing of approximately 300 ha of native vegetation within a 559 ha area, and Cyprium will seek a Native Vegetation Clearing Permit (NVCP) under the *Environmental Protection Act 1986*.

To inform and support the NVCP application, Biota Environmental Sciences (Biota) was commissioned to undertake a targeted fauna survey, comprising desktop study, fauna habitat description, targeted searches, and an assessment of likelihood of occurrence of significant fauna.

1.2 Methodology

Study objectives included:

1. completion of a desktop study reviewing relevant literature, databases, and past survey reports from the locality to identify known features of conservation significance and compile a predicted faunal assemblage;
2. identification and mapping of fauna habitats, with a particular focus on their relevance to significant fauna species identified during the desktop study;
3. targeted field surveys for significant fauna species identified during the desktop study; and
4. reporting on survey findings, including the mapping of habitats, field results and an assessment of the likelihood of significant fauna occurring in the survey area.

For the purposes of this work, the 'survey area' was defined by the 559 ha area which will contain the smaller area of proposed vegetation clearing. The 'study area' encompassed a 40 km buffer around the survey area. The field survey was conducted over two deployments from 10 to 16 June 2021, and from 6th to 8th July 2021. Field survey methodology employed was in accordance with relevant Environmental Protection Authority policy and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) guidance.

Targeted searches focused on the Bilby (*Macrotis lagotis*), Northern Marsupial Mole (*Notoryctes caurinus*), Brush-tailed Mulgara (*Dasycercus blythi*), Great Desert Skink (*Liopholis kintorei*), Ghost Bat (*Macroderma gigas)* and Night Parrot (*Pezoporus occidentalis*) as the key significant fauna species of potential relevance to the survey.

1.3 Results and Conservation Significance

The desktop study returned a total of 346 species of vertebrate fauna previously recorded within the study area. Of these, 29 species are listed as significant (Threatened or Priority fauna).

During the field survey, 67 species of vertebrate fauna were recorded, including seven terrestrial mammal species (three native, three introduced and one naturalized exotic species), eight bat species, 37 bird species, 14 reptile species and one amphibian species.

Two fauna species of significance were recorded from the survey area:

- Bilby, *Macrotis lagotis*; Vulnerable under the State *Biodiversity Conservation Act 2016* (BC Act) and the EPBC Act. Bilby tracks were observed in the survey area.
- Northern Marsupial Mole, *Notoryctes caurinus*; Department of Biodiversity, Conservation and Attractions (DBCA) Priority 4. Evidence of marsupial mole tunneling was observed on two sand dunes within the survey area.

Ten species of significance were considered 'likely to occur' or 'may occur' within the survey area based on previous regional records and field assessment of the habitats present (Table 1.1).

Sand dunes and sandplains are considered to represent the habitat of highest faunal value in the survey area, although their attributes are typical of similar habitat types in the wider locality. These habitats are relevant to significant fauna species occurring or potentially occurring within the survey area (i.e. Bilby, Northern Marsupial Mole and Brush-tailed Mulgara), in that they represent core habitat critical to their survival.

Table 1.1: Significant fauna that were assessed as "likely to occur" or "may occur".

Species	Common Name	Significance*	
		State	Federal
Likely to occur			
Dasycercus blythi	Brush-tailed Mulgara	P4	-
Falco peregrinus	Peregrine Falcon	OS	-
Apus pacificus	Pacific Swift	MI	MI/MA
Gelochelidon [nilotica] macrotarsa	[Australian] Gull-billed Tern	MI	MI/MA
May occur			
Macroderma gigas	Ghost Bat	VU	VU
Falco hypoleucos	Grey Falcon	VU	VU
Charadrius veredus	Oriental Plover	MI	MI/MA
Glareola maldivarum	Oriental Pratincole	MI	MI
Rostratula australis	Australian Painted Snipe	EN	EN
Chlidonias leucopterus	White-winged Tern	MI	MI/MA

* CR = Critically Endangered; EN = Endangered; VU = Vulnerable; OS = Other Specially Protected fauna; MI = Migratory; MA = Marine; P1 = Priority 1; P4 = Priority 4.

2.0 Introduction

2.1 Project Background

Cyprium Metals Ltd (Cyprium) has recently acquired the Nifty Copper Mine (Nifty), located in the Great Sandy Desert, approximately 350 km southeast of Port Hedland (Figure 2.1). Cyprium plans to alter the mine layout to allow for more efficient operations. The layout changes will require clearing of approximately 300 ha of native vegetation within a 559 ha area, and Cyprium will seek a Native Vegetation Clearing Permit (NVCP) under the *Environmental Protection Act 1986*.

To inform and support the NVCP application, Biota Environmental Sciences (Biota) was commissioned to undertake a targeted fauna survey, comprising desktop study, fauna habitat description, targeted searches, and an assessment of likelihood of significant fauna. For the purposes of this work, the 'survey area' is defined by the 559 ha area which will contain vegetation clearing (Figure 2.1). The desktop study encompassed a 40 km buffer around the survey area comprising the overall 'study area' for the scope (Figure 2.1).

2.2 Scope of Works and Objectives

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

Specific objectives included:

1. completion of a desktop study;
2. identification and mapping of fauna habitats, with focus on relevance to significant fauna species identified during the desktop study;
3. targeted field surveys for significant fauna species identified during the desktop study; and
4. reporting on survey findings, including an assessment of the likelihood of significant fauna occurrence in the survey area.

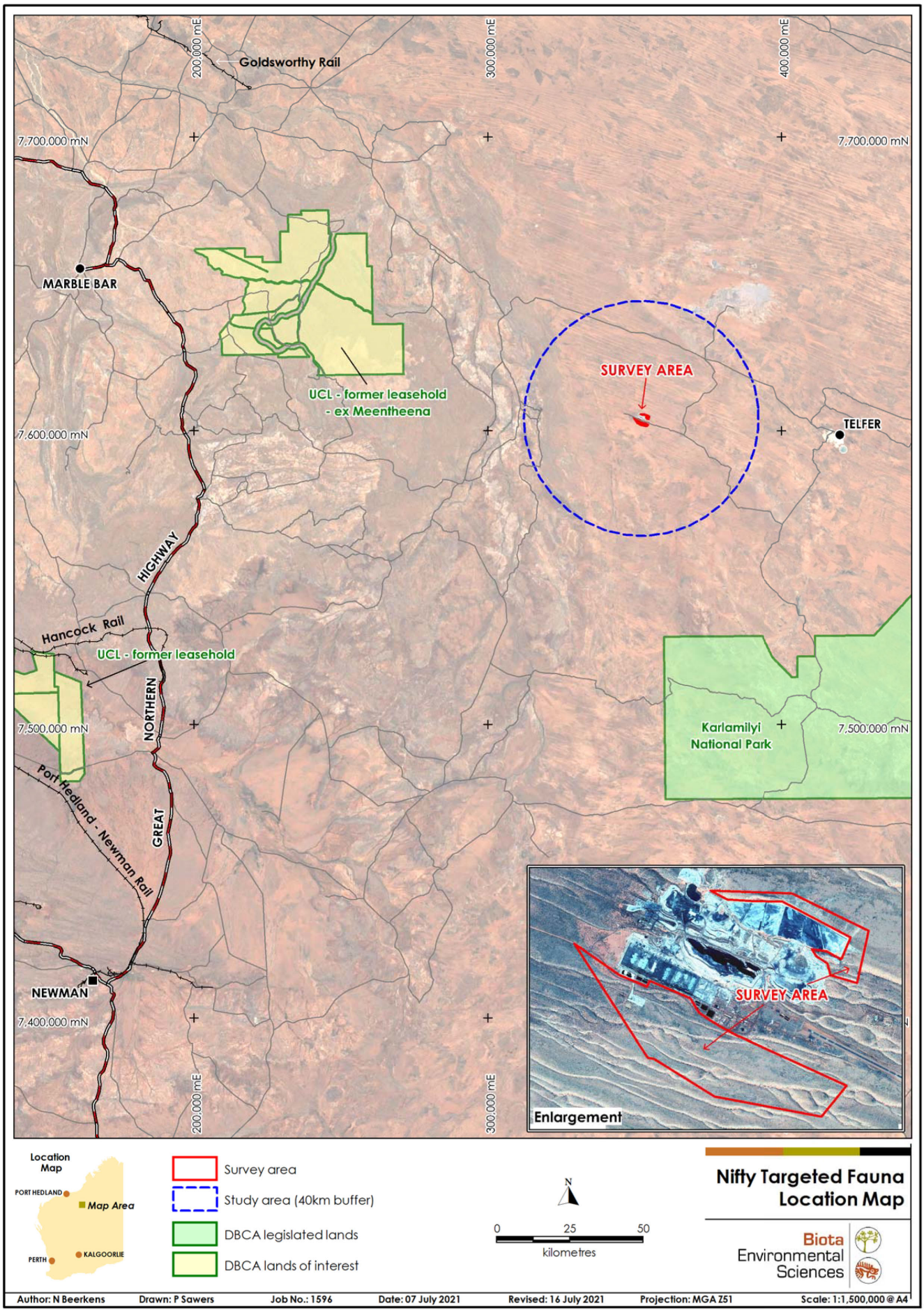

Figure 2.1: Study area and survey area locality.

3.0 Methods

3.1 Desktop Study

A desktop study was undertaken to identify features of significance known from the study area, including significant fauna potentially occurring. The desktop study was also used to assess the level of biological survey work that had been completed previously in the study area, informing the design of the survey.

The desktop study incorporated the results of database searches (Section 3.1.1) and review of regional information and previous biological surveys in the vicinity (Section 3.1.2).

3.1.1 Database Searches

The following databases were searched for records of fauna of significance previously recorded from, or potentially occurring in, the study area:

- NatureMap database: a joint project of the Department of Biodiversity Conservation and Attractions (DBCA) and the Western Australian Museum (WAM). This database represents the most comprehensive source of information on the distribution of Western Australia's fauna, comprising records from the Fauna Survey Returns database, the WA Threatened Fauna Database, the WAM Specimen databases, and the BirdLife Australia Atlas.
- The Federal EPBC Act Protected Matters search tool.
- The Atlas of Living Australia (ALA) database; supported by NCRIS (National Collaborative Research Infrastructure for Australia) and hosted by CSIRO.
- Biota's internal databases were searched for records from obtained by the company across the Great Sandy Desert.

All database searches were confined to the study area using an approximate central point of the survey area (21.65923°S; 121.57221°E) to return records from a 40 km buffer.

3.1.2 Literature Review

The literature review comprised:

- a summary of the Interim Biogeographic Regionalisation for Australia (IBRA) region and subregion (DSEWPaC 2012); and
- a review of relevant biological surveys previously completed in the locality, within 40 km of the survey area)

Literature review results were used to inform the likelihood assessments of species of significance occurring in the survey area, and to determine potential habitats and methods for targeting these.

3.1.3 Assessment of Likelihood of Occurrence

Results from the literature review and database searches were used to compile a list of terrestrial fauna species of conservation significance that had previously been recorded from the locality. The likelihood that each taxon would occur in the study area was then assessed 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; and
- preferred habitats.

Habitats were defined according to vegetation units, landforms apparent on aerial imagery, and considering 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: Likelihood ranking guide for species that may occur in the survey area.

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

3.2 Field Survey

3.2.1 Timing and Personnel

The fauna survey was completed in two phases, from 10 to 16 June 2021, and 5 to 8 July 2021 (Table 3.2). For three of these days (14 to 16 June 2021), two acoustic recorders and two motion cameras remained active without zoologists onsite. These units were collected by Mr Craig Timms of Cyprium on 16 June 2021.

Table 3.2: Fauna survey team qualifications and experience.

Name	Position at Biota	Survey Role	Qualification	Years of Experience
Nathan Beerkens	Zoologist	Fauna team lead	BSc. Hons	5
Joshua Keen	Zoologist	Fauna team member	BSc. Hons	5

The fauna survey was undertaken under "Fauna Taking (Biological Assessment) Licence" No. BA27000448, issued to Nathan Beerkens (Appendix 1).

3.2.2 Weather and Climate

Weather observations were obtained from the Bureau of Meteorology Telfer Aero weather station (station 013030). Temperatures remained moderate during the survey, with maximum temperatures ranging from 24.4°C to 30.0°C, while minimum temperatures ranged from 7.4°C to 21.8°C (Table 3.3). No rain fell during the survey.

Table 3.3: Daily meteorological observations for the survey area during the survey.

Date	Maximum Temperature (°C)	Minimum Temperature (°C)	Rainfall (mm)
10/06/21	29.0	14.6	0
11/06/21	28.0	11.3	0
12/06/21	29.6	12.2	0
13/06/21	26.3	21.8	0
14/06/21	25.9	17.6	0
15/06/21	26.7	15.5	0
16/06/21	30.0	15.4	0
06/07/21	25.5	7.9	0
07/07/21	24.4	7.4	0
08/07/21	25.2	13.0	0

Long-term climate data (temperature and rainfall: 1974 - 2021) and the June 2020 to July 2021 climate data were also obtained from the Bureau of Meteorology weather station at Telfer Aero (No. 013030). Figure 3.1 charts the average monthly minimum and maximum temperature and total rainfall for the year preceding the survey, in comparison with long-term averages. Rainfall data was not available for the months of October to January in the preceding year. Precipitation for the six months preceding the survey was below average, while the temperatures were typical.

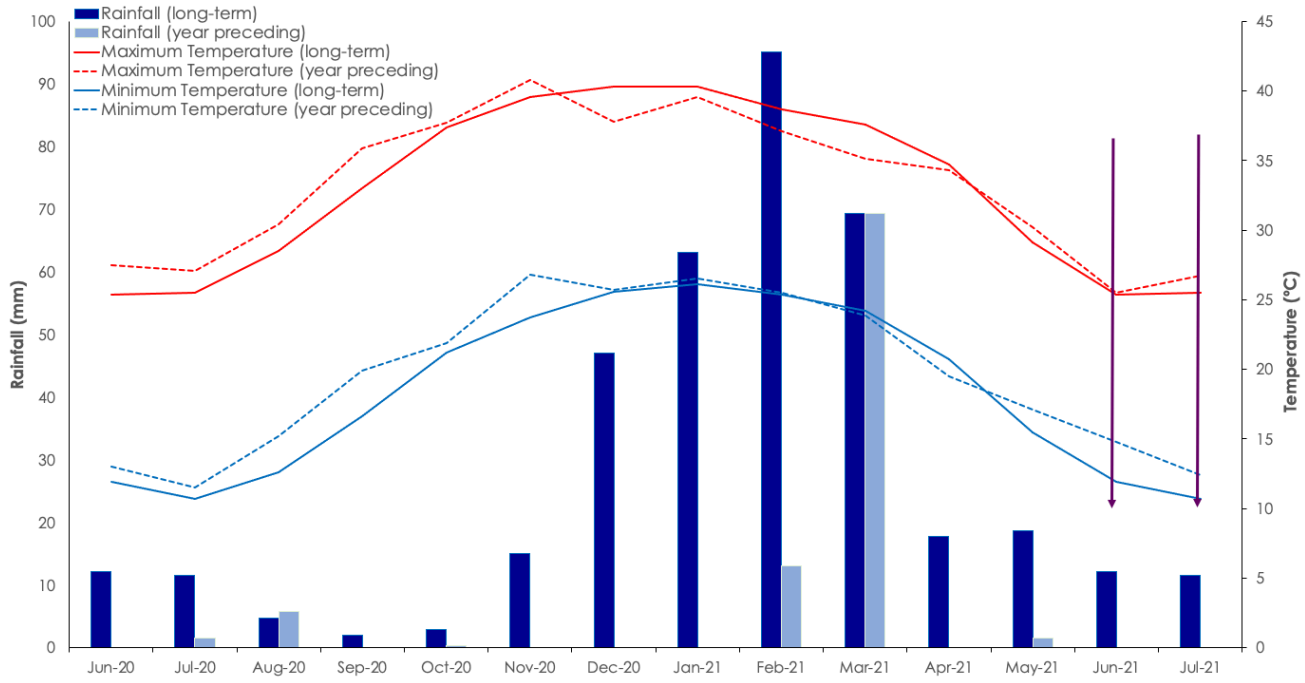

Figure 3.1: Monthly weather data for the year preceding the survey and long-term climate averages recorded at Telfer Aero.
(Data obtained from Bureau of Meteorology; arrows indicate survey period).

3.3 Targeted Terrestrial Fauna Survey

3.3.1 Survey Design

A targeted survey was undertaken to verify the desktop study, further determine the occurrence of threatened species and delineate habitat characteristics. This consisted of non-systematic opportunistic and targeted searching (Sections 3.3.2 to 3.3.6).

An initial on-ground assessment of the survey area was undertaken to identify potentially suitable sites for threatened fauna species returned from the desktop study. These were selected based on factors such as recent fire, location of temporary or permanent water bodies and presence of core habitat. Targeted searches were then undertaken in areas of habitat deemed suitable for significant fauna.

Table 3.4 summarises targeted fauna and methods utilised. Locations of sampling sites are provided in Figure 3.2. All fauna species encountered within the survey area during the field survey were recorded.

The survey methodology was developed with reference to the following policy documents:

- Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020);
- Environmental Factor Guideline – Terrestrial Fauna (EPA 2016);
- Survey Guidelines for Threatened Birds (DSEWPaC 2010);
- Survey Guidelines for Threatened Mammals (DSEWPaC 2011a);
- Survey Guidelines for Threatened Reptiles (DSEWPaC 2011b);
- Species specific survey guidelines, including but not limited to:
    - EPBC Act referral guideline for the endangered Northern Quoll (*Dasyurus hallucatus)* (DotEE 2016*);*
    - The conservation and management of the Bilby (*Macrotis lagotis*) in the Pilbara (DBCA 2018);
    - Interim guideline for preliminary surveys of Night Parrot (*Pezoporus occidentalis*) in Western Australia (DBCA 2017a).

Table 3.4: Targeted fauna and search methods utilised.

	Significance^		Foot & Vehicle Traverses		Passive Recording				
Species	**State**	**Federal**	**Bilby Survey/ Diurnal Search**	**Nocturnal Search**	**Motion Cameras**	**Ultrasonic Sound Recorders**	**Audible Sound Recorders**	**Marsupial Mole Trenching**	**Opportunistic**
Mammals									
Northern Quoll *Dasyurus hallucatus*	EN	EN	X	X	X				
Bilby *Macrotis lagotis*	VU	VU	X	X	X				
Ghost Bat *Macroderma gigas*	VU	VU				X			
Brush-tailed Mulgara, Ampurta *Dasycercus blythi*	P4	–	X		X				
Western Pebble-mound Mouse *Pseudomys chapmani*	P4	–	X						
Northern Marsupial Mole *Notoryctes caurinus*	P4	–						X	
Pilbara Leaf-nosed Bat *Rhinonicteris aurantia*	P4	–				X			
Birds									
Night Parrot *Pezoporus occidentalis*	CR	CR					X		
Australian Painted Snipe *Rostratula australis*	EN	EN							X
Grey Falcon *Falco hypoleucos*	VU	VU							X
Pacific Swift• *Apus pacificus*	MI	MI/MA							X
Peregrine Falcon *Falco peregrinus*	OS	–							X
Princess Parrot *Polytelis alexandrae*	P4	VU							X
Oriental Plover• *Charadrius veredus*	MI	MI/MA							X
Oriental Pratincole• *Glareola maldivarum*	MI	MI							X
Gull-billed Tern *Gelochelidon nilotica*	MI	MI/MA							X
Reptiles									
Pilbara Olive Python *Liasis olivaceus barroni*	VU	VU		X					X
Great Desert Skink *Liopholis kintorei*	VU	VU	X		X				X

^ CR = Critically Endangered, EN = Endangered, VU = Vulnerable, MI = Migratory, MA = Marine, OS = Other Specially Protected fauna, P4 = Priority 4

• indicates species for which the field surveys were not conducted at the optimum time of year. .

3.3.2 Bilby Survey

A targeted Bilby survey was undertaken using a combination of transect searches and 2 ha sign plot surveys to search for secondary evidence of the Bilby (DBCA 2017b). Both methods employed to search for the Bilby sign (tracks, scats, diggings or burrows) were also considered suitable for detecting evidence of several other significant species with similar habitat preferences (Table 3.4).

3.3.2.1 Sign Plot Surveys

Sign plots aim to record sign evidence of Bilbies and other animals (tracks, scats, diggings and/or burrows). Four 2 ha (200 m x 100 m) sign plots were systematically searched by a team of two zoologists for 20 minutes (a total of 40 person minutes for each plot) (Table 3.5). Plot locations were selected prior to the field survey based on aerial imagery, to encompass areas of potential Bilby habitat. In the interests of standardisation and development of best practice survey techniques for the Bilby in WA, a standardised data sheet for the 2 ha sign plot surveys (available from the DBCA) was used to record data.

Table 3.5: Location and effort of 2 ha sign plots within the survey area.

Site	Latitude	Longitude	Date	Duration (mins)	No. of Observers	Effort (mins)
NIF01BP	-21.5712	121.5712	11/06/2021	20	2	40
NIF02BP	-21.6593	121.5959	13/06/2021	20	2	40
NIF03BP	-21.6763	121.5817	07/07/2021	20	2	40
NIF04BP	-21.6783	121.5705	08/07/2021	20	2	40
					Total	**160**

3.3.2.2 Diurnal Transect Searches

Unbounded linear foot traverses were undertaken across the entire survey area to search for sign evidence of the Bilby, and other significant species (tracks, scats, diggings and/or burrows) (Table 3.4). Records of non-significant species were also collected during these traverses. All transects were undertaken by a single observer, covering a total linear distance of 95 km (Figure 3.2).

3.3.2.3 Nocturnal Search

A nocturnal road spotting search (spotting animals from the car) was conducted to sample for species that are not readily trapped or seen during the day, including nocturnal birds and some snakes, and to opportunistically search for Bilby. The nocturnal search covered a 25 km linear distance and was conducted for 2.5 hours on 12 June 2021 (Figure 3.2).

3.3.3 Motion-sensitive Cameras

Infrared motion cameras were deployed at locations where they were considered likely to record significant fauna. Two motion cameras were placed outside a reptile burrow system to determine whether it was inhabited by the listed Great Desert Skink (*Liopholis kintorei*). Details of motion cameras and trap effort are provided in Table 3.6, and locations shown in Figure 3.2. Images were analysed by Nathan Beerkens of Biota, and all species observed in images were recorded.

Table 3.6: Location of motion cameras deployed within the survey and contextual areas.

Site	Latitude	Longitude	Landform	Deployment Date	Effort (nights)
NIF01M	-21.6698	121.5678	Low rocky rise; crest	10/06/2021	2
NIF02M	-21.6651	121.5557	Cleared/Degraded; adjacent to pooled water in burrow pit	10/06/2021	3
NIF03M	-21.6743	121.5751	Sandplain; along vehicle track adjacent to old Bilby tracks	12/06/2021	1
NIF04M	-21.6724	121.5739	Sandplain; targeted at reptile burrow system	13/06/2021	3
NIF05M	-21.6724	121.5739	Sandplain; targeted at reptile burrow system	13/06/2021	3
NIF06M	-21.6777	121.5756	Sand dune; dune crest	06/07/2021	2
				Total Effort:	**14**

3.3.4 Ultrasonic Bat Call Recorders

Sampling was conducted within the survey area to target all potentially occurring bat species. Echolocation calls were recorded using SM Mini SongMeters, which detect and record ultrasonic echolocation calls emitted during bat flight. This included determination of the occurrence of the significant Ghost Bat (*Macroderma gigas*) and Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*). The units were programmed to record triggered calls from 30 minutes before sunset until 30 minutes after sunrise. Bat sampling was undertaken at one site; the only point in the survey area which contained pooled water, an attractant to bats (Table 3.7; Figure 3.2).

Bat echolocation call analysis was conducted by Dan Kamien of Biota using Kaleidoscope Pro software (version 5.1.1), and following methods recommended by the Australasian Bat Society (2006) in conjunction with available reference data (Churchill 2008, McKenzie and Bullen 2009). Only sequences containing good quality search phase calls were considered for identification.

Table 3.7: Location of ultrasonic bat call recorders deployed within survey area.

Site	Latitude	Longitude	Fauna Habitat	Deployment Date	Retrieval Date	Effort (nights)
NIF01BAT	-21.6651	121.5559	Cleared/Degraded – borrow pit with pooled water	10/06/2021	13/06/2021	3
				Total Effort:	**Total Effort:**	**3**

3.3.5 Audible Sound Recorders

SongMeter4 (SM4) audible sound recorders were set to record in the audible frequency range and deployed at three locations within the survey area targeting Night Parrots (Table 3.8; Figure 3.2). The units were programmed to record continuously each night from one hour before sunset until one hour after sunrise. Methodology was in accordance with the interim guidelines for Night Parrot surveys (DBCA 2017a).

Audio files were analysed by John Graff of Biota using SongScope software (version 4.1.5), with a recogniser built using Night Parrot calls recorded in Western Australia[1]. Potential matches were then assessed manually by visually inspecting the spectrogram and listening to the recordings.

Table 3.8: Location of audible sound recorders deployed within the survey and contextual areas.

Site	Latitude	Longitude	Fauna Habitat	Deployment Date	Retrieval Date	Effort (nights)
NIF01A	-21.6651	121.5558	Sandplain; with spinifex	10/06/2021	16/06/2021	6
NIF02A	-21.6563	121.5953	Cleared/Degraded; adjacent to pooled water in burrow pit, surrounded by spinifex sandplain	10/06/2021	16/06/2021	6
NIF03A	-21.6754	121.5854	Sandplain; with spinifex	06/07/2021	08/07/2021	2
				Total Effort:	**Total Effort:**	**14**

3.3.6 Marsupial Mole Trenching

Trenches were excavated in dunes to search for backfilled tunnels that indicate presence of marsupial moles (Benshemesh and Schulz 2009). Trenching was conducted at eleven locations within the survey area (Table 3.9; Figure 3.2). Trenches were back-filled upon completion.

Table 3.9: Location of Marsupial Mole Trenches dug within the survey area.

Site	Latitude	Longitude	Date	Landform
NIF01MM	-21.6682	121.5557	11/06/2021	Dune crest
NIF02MM	-21.6678	121.5558	11/06/2021	Dune slope
NIF03MM	-21.6589	121.5944	12/06/2021	Dune crest
NIF04MM	-21.6590	121.5945	12/06/2021	Dune crest

[1] Night Parrot calls are available at https://nightparrot.com.au/index.php/resources/night-parrot-calls

Site	Latitude	Longitude	Date	Landform
NIF05MM	-21.6791	121.5842	07/07/2021	Dune crest
NIF06MM	-21.6790	121.5855	07/07/2021	Dune crest
NIF07MM	-21.6798	121.5847	07/07/2021	Dune slope
NIF08MM	-21.6821	121.5905	07/07/2021	Dune slope
NIF09MM	-21.6797	121.5849	07/07/2021	Dune crest
NIF10MM	-21.6753	121.5854	08/07/2021	Dune crest
NIF11MM	-21.6754	121.5854	08/07/2021	Dune crest

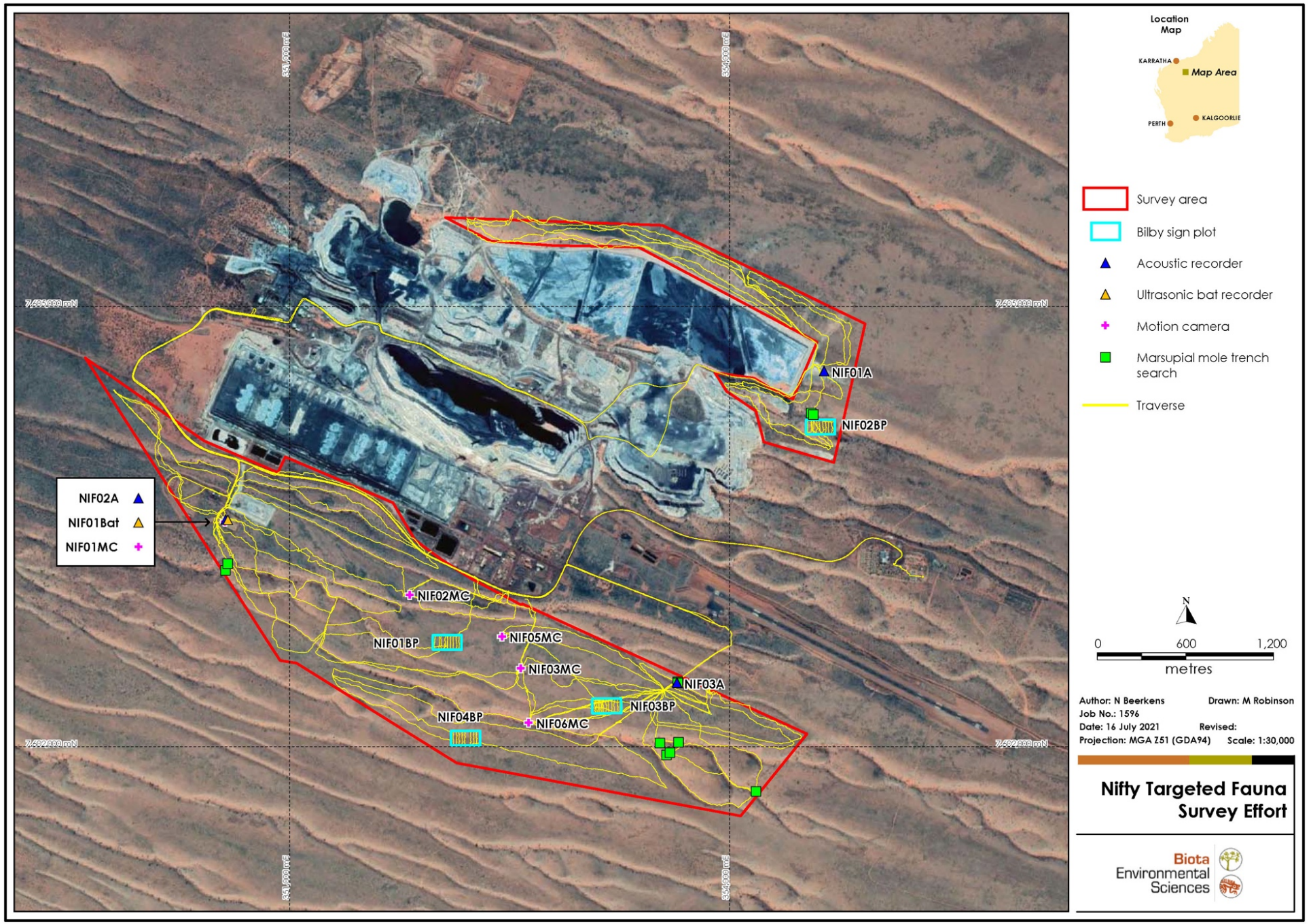

Figure 3.2: Survey effort across the survey area.

3.3.7 Fauna Habitat Mapping

Fauna habitat mapping was undertaken using a functional, ecological perspective on fauna use of the landscape (Biota 2013). Broad fauna habitat areas were mapped in the field using a combination of foot traverses, and vehicle traverses on the existing road. Habitats were described and mapped based on a combination of landform, substrate and vegetation, and grouped into areas that would be likely to offer a range of ecological niches to different suites of species.

It should be noted that a particular defined habitat cannot be used to map the distribution of any one species, as many species utilise a range of ecological niches for specific activities such as foraging, commuting, breeding and nesting, and may use only a subset of the niches available in any mapped habitat type. The resultant habitat map may therefore be viewed as a guide to delineate areas that may be of differing ecological importance to the fauna species utilising the survey and contextual areas.

The quality of fauna habitat was also considered according to the criteria defined in Table 3.10.

Table 3.10: Criteria used to assess fauna habitat quality.

Habitat Quality	Criteria
Excellent	Minimal to no modification of habitat from intense/frequent fires, trampling/grazing by introduced herbivores or weed invasion.
Good	Some habitat modification from intense/frequent fires, trampling/grazing by introduced herbivores and/or weed invasion.
Poor	Habitat mostly or completely modified by intense/frequent fires, trampling by introduced herbivores, invasion of weeds and/or clearing.

3.3.8 Fauna Nomenclature

As per the EPA Terrestrial Fauna Technical Guidance (2020), species nomenclature for mammals, reptiles and amphibians follows that of the WAM fauna taxonomic checklist, which was last revised in June 2021. Species nomenclature for birds follows that of the International Ornithological Congress (IOC) World Bird List.

3.4 Survey Limitations

The results outlined within this report should be considered in the context of the following limitations outlined in Table 3.11.

Table 3.11: Potential constraints and limitations of the biological survey.

Potential Constraint	Statement of Limitations
1. Availability of contextual information at a regional and local scale	• Reports from previous fauna surveys at Nifty were provided to us, and Biota has extensive recent survey information at a regional level, within the Great Sandy Desert. • Regional and local level contextual information is not considered to be a limiting factor for this study.
2. Competency/ experience of the team carrying out the survey, including experience in the bioregion surveyed	• Field personnel were suitably qualified to identify the targeted fauna species, having conducted multiple recent targeted surveys within the Great Sandy Desert bioregion. • Competency and experience were not considered to be limitations.
3. Appropriate area fully surveyed (effort and extent)	• The survey area was surveyed thoroughly by foot traverses. • Survey effort targeted at detecting the presence of the Bilby was in accordance with that recommended by DBCA (2017b). • Survey effort and extent for the survey was not considered to be a limitation.

Potential Constraint	Statement of Limitations
4. Access restrictions within the survey area	• The survey sites were located close to tracks which were in good condition. All parts of the survey area were accessible by either vehicle or foot. • Access was not considered to be a limitation.
5. Survey timing, rainfall, season of survey	• Rainfall data in the preceding year from to 14 October 2020 – 16 February 2021 was not available from Telfer Aero, and so was taken from Marble Bar, located 196 km to the west-northwest. • Between surveys, on the 21 June 2021, Nifty recorded a significant rainfall event (Nifty management, pers. comms) that was not recorded in the Telfer Aero records. During the second survey component, the sand dunes were very damp, with the water likely removing evidence of pre-rain Northern Marsupial Mole burrows. However, evidence of Northern Marsupial Moles had already been recorded at two sites in similar habitat area during the first survey, so this is not considered to have limited the assessment. • The survey was conducted in winter, when reptiles are less likely to be active, and therefore more likely to be unreported during surveys. However, the only reptile targeted in this survey, the Great Desert Skink, can be searched for year-round, as it creates visible burrow systems with latrines. • As such, despite the issues noted above, survey timing, rainfall and seasonality are not considered to be limitations.
6. Disturbance that may have affected the results of survey such as fire, flood or clearing	• The survey area had been affected by recent fires. Fire may have affected fauna abundance, species distributions and presence within the survey area. • Drill line and track disturbance in the survey area was minimal and was not limiting to the results of the assessment, therefore disturbance was not considered to be a limitation for the study.

This page is intentionally left blank.

4.0 Results

4.1 Desktop Study

4.1.1 IBRA Bioregions and Subregions

The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 89 bioregions and 419 subregions within Australia (DSEWPaC 2012). The survey area intersects two bioregions: Central Kimberley and Ord Victoria Plains (see Figure 2.1).

The survey area intersects the GSD2- Mackay subregion of the Great Sandy Desert bioregion. The Mackay subregion covers 18,636,695 ha, and is described as follows:

> *"The Mackay subregion comprises the "tropical inland 'red-centre' desert, and includes the 'Percival' and 'Auld' palaeoriver systems". Mainly tree steppe grading to shrub steppe in south; comprising open hummock grassland of Triodia pungens and Triodia schinzii with scattered trees of Owenia reticulata and bloodwood (Corymbia spp.), and shrubs of Acacia spp., Grevillea wickhamii and G. refracta, on Quaternary red longitudinal sand dune fields. The climate is arid tropical with summer rainfall, and monsoonal influences are apparent in the northwestern sector of this region"* (Kendrick 2003).

4.1.2 Soil-Landscape Systems

Soil-landscape systems are composed of repeating patterns of topography, soils and vegetation, which are described as a series of soil or land units (Tille 2006). The survey area encompasses a single soil unit; the Little Sandy System (16851). The survey area represents 0.65 % of the area covered by this unit within the study area (Table 4.1; Figure 4.1).

4.1.3 Geology

Mapping of the surface geological units in the locality was prepared based on data from Geoscience Australia (2008). Three surface geological units were mapped within the survey area; Qd (70 % of survey area), Nsaw (29 %), and Czl (1 %;) (Table 4.2 and Figure 4.2).

4.1.4 Pre-European Vegetation

Broad-scale vegetation mapping for the locality has been prepared at the 1:1,000,000 scale based on the work of J.S. Beard the Pilbara (Beard 1975) and the Great Sandy Desert (Beard 1968). The survey area includes one of Beard's vegetation associations; Great Sandy Desert 134 (Table 4.3 and Figure 4.3). The survey area represents 0.7 % of the area covered by this vegetation association within the study area.

4.1.5 Conservation Estate

No conservation estate is present within the study area. The closest, Karlamilyi National Park, is located 72 km to the south (Figure 2.1).

Table 4.1: Description of land systems within the survey area and study area.
Data from DPIRD 2018; only those units intersecting the survey area are listed.

Land System		Description	Extent in Survey Area		Extent in Study Area (ha)	Extent in Survey Area as a Proportion of Occurrence in the Study Area
			Area (ha)	Proportion		
Little Sandy System	156Ls	Sandplains with linear and reticulate dunes supporting shrubby hard and soft spinifex grasslands.	559	100%	85,725	0.65%

Table 4.2: Description of geological units within the survey area and study area.
Data from Geoscience Australia 2008; only those units intersecting the survey area are listed.

Geological Unit	Description	Extent in Survey Area		Extent in Study Area (ha)	Extent in Survey Area as a Proportion of Occurrence in the Study Area
		Area (ha)	Proportion		
Qd	Dunes: Sandplain with dunes and swales; may include numerous interdune claypans; residual and aeolian sand with minor silt and clay; aeolian red quartz sand, clay and silt, in places gypsiferous; yellow hummocky sand.	391	70%	281,397	0.14%
Nsaw	Quartzite, shale, siltstone, psammite: Quartzite, dark grey shale, siltstone, arenaceous schist and sheared sandstone	162	29%	234	69.23%
Czl	Ferruginous duricrust: Pisolitic, nodular or vuggy ferruginous laterite; some lateritic soils; ferricrete; magnesite; ferruginous and siliceous duricrusts and reworked products, calcrete, kaolinised rock, gossan; residual ferruginous saprolite.	6	1%	952	0.63%

Table 4.3: Description and extent of Beard's vegetation units within the survey area and study area.
Data from (Beard 1975) and (Beard 1968); only those units intersecting the survey area are listed.

Geological Unit	Description	Extent in Survey Area		Extent in Study Area (ha)	Extent in Survey Area as a Proportion of Occurrence in the Study Area
		Area (ha)	Proportion		
Great Sandy Desert 134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex on sandhills / Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills	559	100%	76,806	0.73%

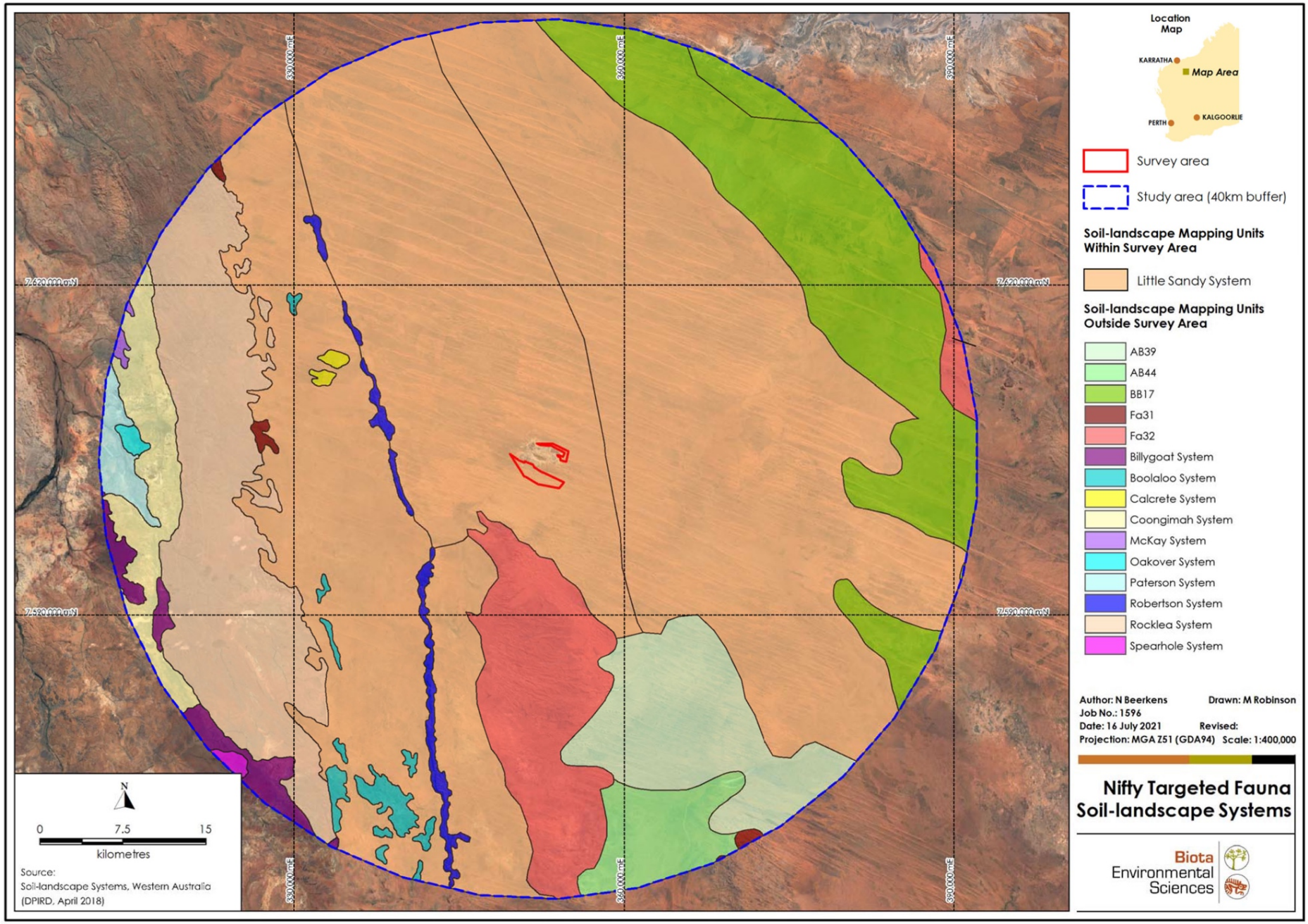

Figure 4.1: Soil-landscape systems of the study area.

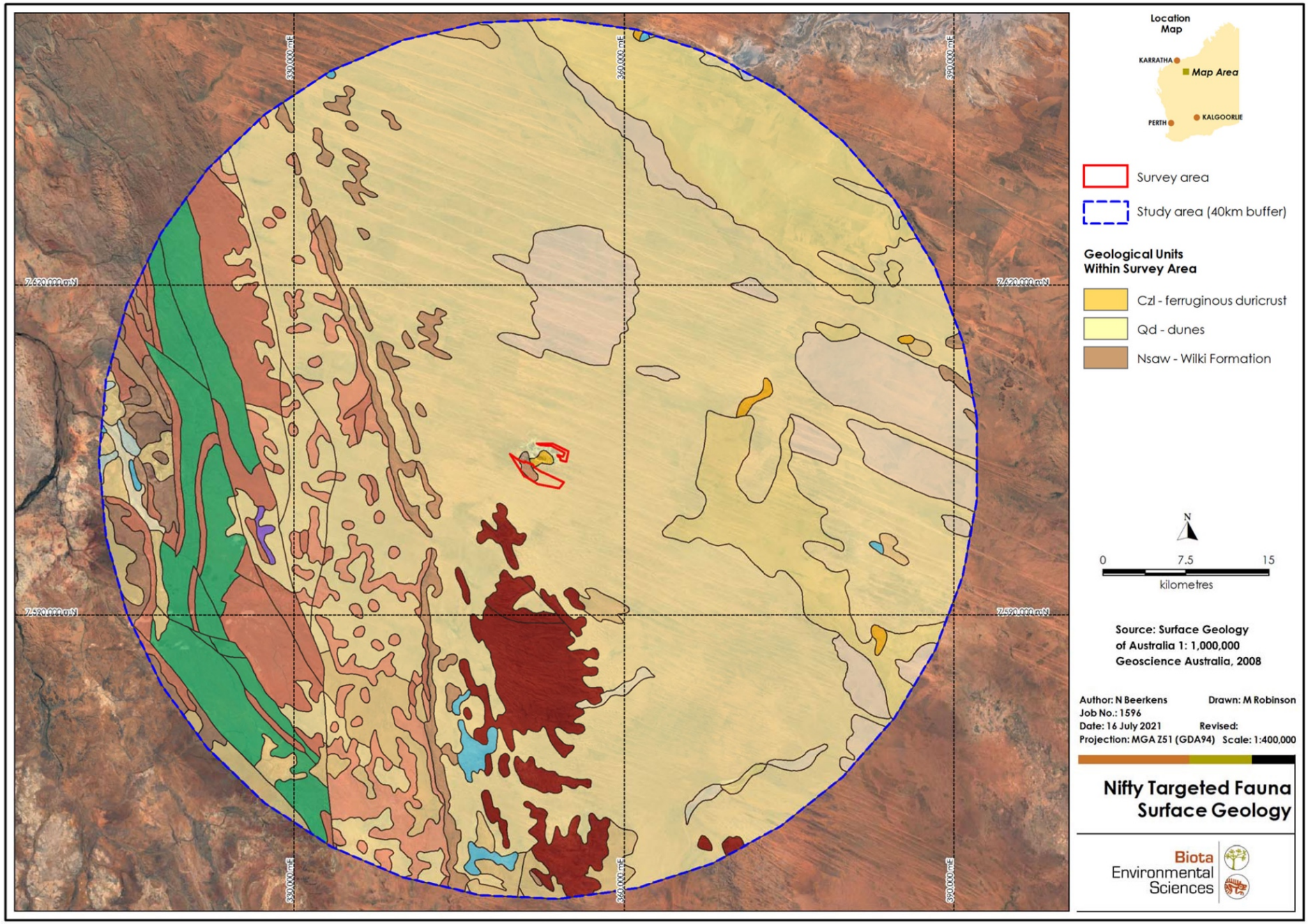

Figure 4.2: Geological units of the study area.

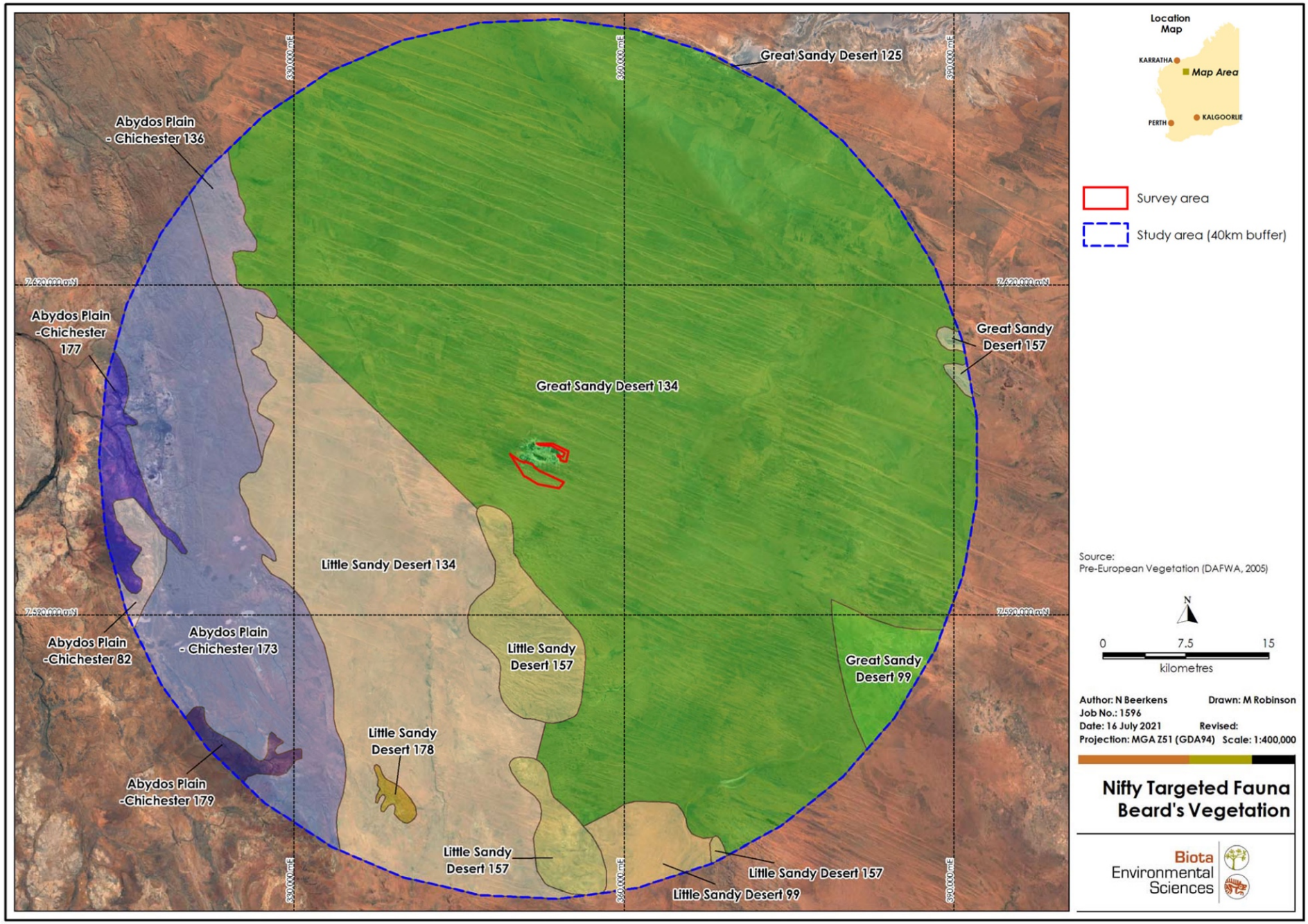

Figure 4.3: Beard's vegetation mapping for the study area.

4.1.6 Previous Fauna Surveys in the Locality

Fauna surveys targeting vertebrate fauna within the locality summarised in Table 4.4.

Table 4.4: Previous relevant surveys conducted in the study area locality.

Report/Survey	Description	Dates of Survey	Location Relative to Nifty
Vertebrate fauna of the Nifty Mine Site, Great Sandy Desert, with comments on the impacts of mining and rehabilitation (Read 1998)	Multi-phase Level 2 vertebrate survey.	April 1994, October 1995, March 1996, November 1996	Nifty Copper Mine
Targeted Rare Fauna Search for Proposed Tailings Storage Facility at Nifty Copper Operations (MBS 2004)	Targeted survey Mulgara, Bilby, Northern Marsupial Mole)	13 - 15 July 2004	Nifty Copper Mine
Vegetation Survey and Targeted Rare Flora and Fauna Search of the Waste Rock Dump, Airstrip and Heap Leach Pad Extension Areas, Nifty Copper Operations, Western Australia (MBS 2006)	Targeted fauna survey, vegetation survey, and Declared Rare Flora search.	23 - 28 October 2005	Nifty Copper Mine
Birla Nifty Copper Operations Fauna Monitoring Program Report (Ecological Horizons 2013)	Monitoring survey	November 2011, March 2012, September 2012, March 2013	Nifty Copper Mine
Asian Renewable Energy Hub Terrestrial Fauna and SRE Fauna Survey (Biota 2018)	Desktop study and Level 2 terrestrial fauna survey and short-range endemic invertebrate survey	Phase 1: 24 August - 5 September 2017. Phase 2: 13 - 21 March 2018	~ 150 km Northwest
Woodie Woodie Mine: Level 1 Vertebrate Fauna Survey 2018 (Western Wildlife 2019a)	Desktop study and Level 1 fauna survey	5 - 14 June 2018	34 km West
Woodie Woodie Mine: Targeted Northern Quoll Survey (Western Wildlife 2019b)	Desktop study and targeted Northern Quoll survey.	5 - 14 June 2018	34 km West
Winu Project Fauna Assessment (Biota 2020)	Desktop study and detailed vertebrate fauna survey, including a targeted Bilby survey, and short-range endemic invertebrate survey.	Phase 1: 12 - 20 May 2019. Phase 2: 18 - 35 September 2019	~ 150 km Northwest

4.1.7 Fauna Known from the Locality

4.1.7.1 Potential Fauna Assemblage

Database and literature searches yielded a total of 346 vertebrate species with the potential to occur in the survey area (Table 4.5). The assemblage comprised 47 mammals (including ten introduced species), 172 birds, 117 reptiles, and ten amphibians.

A total of 29 bird species with a 'Marine' listing under the EPBC Act that were returned by the database searches are considered erroneous listings, as the species nominated do not use marine habitats and for the most part are very common bush birds (Garnett 2013). Additionally, Marine-listed species are only relevant to Commonwealth marine areas. As such, Marine-listed species are not considered further in this report.

Table 4.5: Overview of vertebrate fauna species with potential to occur in the survey area.

Fauna Group	Status	No. of Species	No. of Significant Species
Ground-dwelling mammals	Native	24	5
	Introduced	10 (inc. 1 naturalised exotic)	0
Bats	Native	13	2
Birds	Native	172	20*
Reptiles	Native	117	2
Amphibians	Native	10	0
*excluding listed Marine species	**Total:**	**346**	**29***

4.1.7.2 Likelihood of Occurrence of Significant Fauna

Prior to the survey, the desktop study returned an initial total of 29 species of significant terrestrial fauna (Table 4.5; Appendix 2). Appendix 3 summarises the likelihood of occurrence of the 29 significant species that were considered. Prior to undertaking the field survey, eight of the 29 species were considered likely to occur, 10 species were classified as may occur, and 10 species were considered unlikely to occur, and one species would not occur (Appendix 3). These preliminary (pre-survey) likelihood assessments were used to ensure field methodologies were appropriate to those significant fauna with a higher likelihood of occurrence.

4.2 Fauna Results

4.2.1 Fauna Habitats

The fauna habitats defined for the survey area aligned broadly with the landforms present, with further delineation of some isolated habitats that may support distinct fauna assemblages. Five habitat types were identified (including cleared areas). Habitat types are described in Table 4.6 and mapped in Figure 4.4. Sandplains and sand dunes dominated the survey area, together comprising 92.1 %.

A summary of each habitat in relation to faunal diversity is provided below, while specific examples of significant species utilising these habitats are discussed in more detail in Section 5.0.

- Sand dunes (SD): species with preference for deep soils are typically associated with this habitat type. This includes several significant species, including Northern Marsupial Mole (*Notoryctes caurinus*) and Bilby (*Macrotis lagotis*). Other species associated with this habitat type include the Spinifex Hopping-mouse (*Notomys alexis*) and the introduced Cat (*Felis catus*), whose tracks were common along dune crests.
- Sandplain (SP): species with preference for sandy, flat soils and spinifex are typically associated with this habitat type. This includes several significant species, such as the Brush-tailed Mulgara (*Dasycercus blythi*), Bilby and Great Desert Skink (*Liopholis kintorei*).
- Low rocky rise (LR): species with preferences for shale substrates without caves or large boulders are associated with this habitat type. This includes the gecko *Gehyra micra*.

- Revegetation (RV): the compacted soil and lack of understory renders this habitat less suitable to significant species such as Brush-tailed Mulgara or Bilby. Bird species, such as honeyeaters are likely to utilise this habitat.
- Cleared/degraded areas (CD): in dry conditions, few species would utilise these habitats. Those that may utilise it include the Australasian Pipit (*Anthus novaeseelandiae*) and Nankeen Kestrel (*Falco cenchroides*). Following rain, pooled water in borrow pits may be visited by many species, including nomadic and migratory birds, and the widespread frog *Litoria rubella*.

Table 4.6: Fauna habitats of the survey area.

Habitat	Description (Including Condition of Habitat)	Area (ha) and Proportion of Survey Area	Example Photograph
SD – Sand dune	Tall longitudinal sand dunes. Open *Eucalyptus/Corymbia* sp. over scattered *Acacia* spp. and *Eremophila* sp. shrubs, over *Triodia* sp. open hummock grassland and very open tussock grassland. **Condition**: Excellent	66.7 (11.9%)	
SP - Sandplain	Open sandplains dominated by scattered *Acacia* spp. and *Eremophila* sp. shrubs, over *Triodia* sp. open hummock grassland **Condition**: Excellent in south, with large areas recently burnt. Good to Poor in north; with some areas impacted by leaching from tailings dam.	448.2 (80.2%)	

Habitat	Description (Including Condition of Habitat)	Area (ha) and Proportion of Survey Area	Example Photograph
LR – Low rocky rises	Exposed shale rises, comprising *Acacia* sp. Open shrubland, *over Triodia* sp. Open hummock grassland and *Ptilotus* sp. scattered low shrubs. **Condition**: Excellent	7.9 (1.4%)	
CD – Cleared/disturbed area	Land subjected to historical clearing. This includes borrow pits which may be occasionally inundated by rains and represent a water source for fauna. **Condition**: Poor.	28.9 (5.2%)	

Habitat	Description (Including Condition of Habitat)	Area (ha) and Proportion of Survey Area	Example Photograph
RV - Revegetation	Sandplain habitat which has been subjected to historical clearing and revegetation. Consists of *Acacia* sp. Tall open shrubland, with minimal groundcover on heavily compacted soils. Condition: Poor	7.1 (1.3%)	

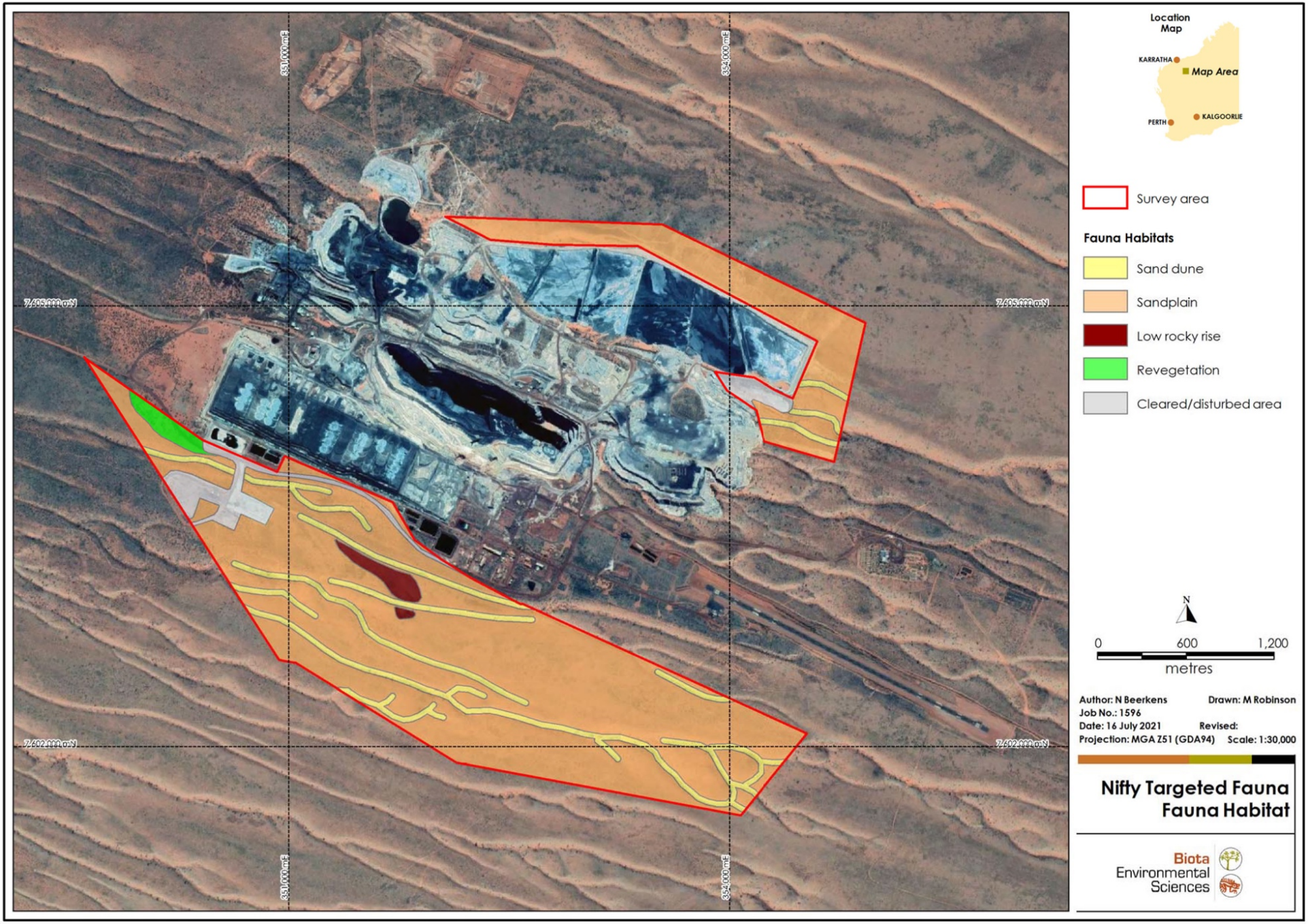

Figure 4.4: Fauna habitats identified within the survey area.

4.2.2 Fauna Records

A total of 67 species of vertebrate fauna were recorded from within the survey area during the field survey. This included two species of significance: Bilby and Northern Marsupial Mole (discussed in Section 5.2). The complete list of species recorded during the survey is presented in Appendix 2.

Table 4.7: Overview of vertebrate fauna species recorded during the survey.

Fauna Group	Status	No. of Species	No. of Significant Species
Ground-dwelling mammals	Native	3	2
	Introduced	4	0
Bats	Native	8	0
Birds	Native	37	0
Reptiles	Native	14	0
Amphibians	Native	1	0
	Total	**67**	**2**

A total of 15 mammal species, including eight bat species, were recorded during the survey. This included four introduced species, the Cat (*Felis catus*), Horse (*Equus caballus*), Red Fox (*Vulpes vulpes*) and Dromedary Camel (*Camelus dromedarius*); together with one naturalised exotic species, the Dog/Dingo (*Canis familiaris familiaris* and/or *C. f. dingo*). A total of 37 species of bird, 14 species of reptile and one species of amphibian were also recorded during the survey.

This page is intentionally left blank.

5.0 Conservation Significance

5.1 Fauna Habitat Conservation Value

Based on examination of aerial imagery, soil-landscape system, geology, and vegetation mapping, none of the fauna habitats identified during the survey are confined to the survey area. Identified fauna habitats (excluding the revegetated area and cleared/disturbed areas) are common and widespread within the study area.

When assessing the value of habitat in the survey area, it is prudent to determine the core habitat of individual species of conservation significance. Core habitat for species of conservation significance equates to "habitat critical to the survival of a species" (DotE 2013). Such habitats include those that are known, or are likely, to be utilised by listed species for key ecological activities such as denning, roosting, breeding, refugia and important foraging areas. As a result, it is assumed that some proportion of this habitat must be maintained across the species' range to ensure the persistence of the species in the region. Secondary habitats may be used for lesser foraging or on a transitory, dispersing, or occasional basis, but do not represent core habitat.

Although common and widespread, it is evident that the sandplain habitat supports Bilby and is likely to support Brush-tailed Mulgara. Additionally, Dune habitat supports the Priority 4 Northern Marsupial Mole. Although these habitats are core habitats for these species, the survey area represents a negligible proportion of such habitat in the study area and beyond. That is, the core and secondary habitats are not restricted to the survey area and their attributes are typical of similar habitat types in the wider locality.

5.2 Significant Vertebrate Fauna Recorded from the Survey Area

The following two species of significance were recorded from the survey area during the current survey:

- Bilby, *Macrotis lagotis* (Vulnerable); and
- Northern marsupial Mole, *Notoryctes caurinus* (Priority 4).

The locations of these records in the study area are given in Table 5.1 and illustrated in Figure 5.1.

Table 5.1: Records of conservation significant vertebrate fauna in the study area with locations.

Species	Conservation Status	Latitude	Longitude	Type of Record	Date
Bilby, *Macrotis lagotis*	Vulnerable	-21.6747	121.5749	Tracks	11/06/21
Northern Marsupial Mole, *Notoryctes caurinus*	Priority 4	-21.6678	121.5558	Digging	12/06/21
		-21.6589	121.5945	Burrow	12/06/21

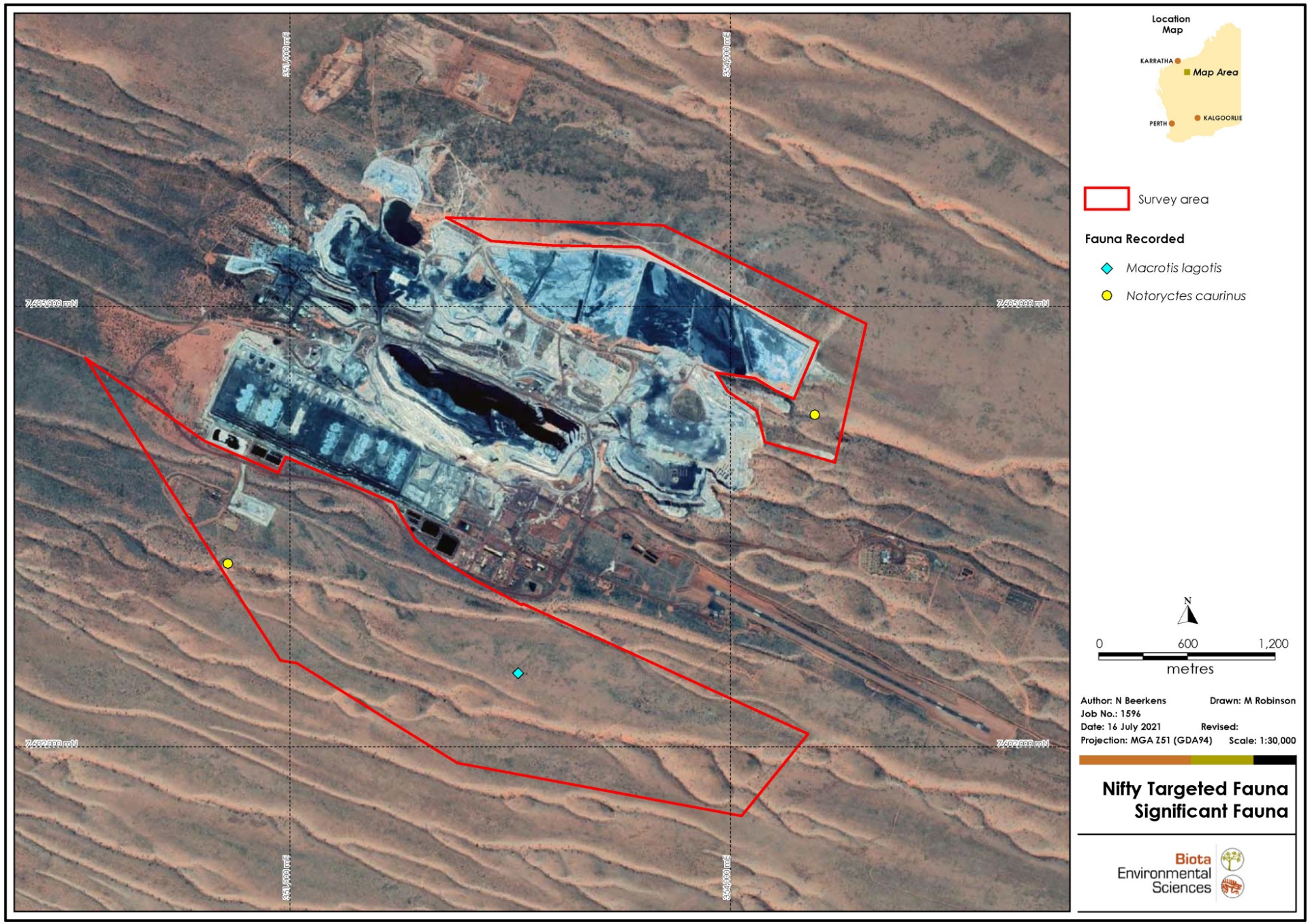

Figure 5.1: Locations of significant fauna recorded during the survey.

Based on previous records from the study area and an assessment of habitat within the survey area, four significant taxa are considered likely to occur, and a further six species may occur within the survey area (Table 5.2).

The likelihood of occurrence of all significant species identified in the desktop study is presented in Appendix 3. Assessment and descriptions of significant species occurring or potentially occurring within the survey area are presented in Sections 5.2.1, 5.2.2 and 5.2.3. As per the criteria detailed in Table 3.1, the assessment of likelihood of occurrence for each species was based on availability of suitable habitat, whether such habitat is core or secondary, as well as records of the species during the current survey or past work included in the desktop study.

Table 5.2: Significant fauna that were recorded within the survey area, or were assessed as "likely to occur" or "may occur".

Species	Common Name	Significance*	
		State	Federal
Recorded			
Macrotis lagotis	Bilby	VU	VU
Notoryctes caurinus	Northern Marsupial Mole	P4	OS
Likely to occur			
Dasycercus blythi	Brush-tailed Mulgara	P4	-
Falco peregrinus	Peregrine Falcon	OS	-
Apus pacificus	Pacific Swift	MI	MI/MA
Gelochelidon nilotica	Gull-billed Tern	MI	MI/MA
May occur			
Macroderma gigas	Ghost Bat	VU	VU
Falco hypoleucos	Grey Falcon	VU	VU
Charadrius veredus	Oriental Plover	MI	MI/MA
Glareola maldivarum	Oriental Pratincole	MI	MI
Rostratula australis	Australian Painted Snipe	EN	EN
Chlidonias leucopterus	White-winged Tern	MI	MI/MA

* CR = Critically Endangered; EN = Endangered; VU = Vulnerable; OS = Other Specially Protected fauna; MI = Migratory; MA = Marine; P1 = Priority 1; P4 = Priority 4.

5.2.1 Significant Vertebrate Fauna Recorded from the Survey Area

Bilby (*Macrotis lagotis*)

The Bilby is listed as Vulnerable under both the EPBC Act and the BC Act. The species formerly occurred in a wide range of semi-arid and arid habitats across over 70% of the Australian mainland, however it has declined markedly and now occupies less than 20% of its former range (Department of the Environment 2014). There are disjunct populations in the Tanami Desert, Gibson Desert, southwestern Kimberley, inland areas of the Pilbara and northern Great Sandy Desert, as well as an outlying population in southwest Queensland and several scattered conservation reserves, into which it has been reintroduced (Friend 1990).

Extant populations occur in a variety of habitats, usually on landforms of low topographic relief and light to medium soils. It prefers areas suitable for burrowing where the substrate comprises sand, sandy clay or sandy gravel (DBCA 2018), though they are also known from atypical stony gravelly areas (M. Dziminski, pers. comm. 2019). Additionally, the Bilby demonstrates a strong association with particular species of *Acacia* that host root-dwelling larvae, which form a major food resource for the species (DBCA 2018).

Bilby appear to be strictly nocturnal and construct a substantial burrow system, which may be up to 3 m in length (Flannery et al. 1990, Strahan 1995). Individuals move between multiple burrows, and have been known to use burrows up to 2 km apart on consecutive days (Pavey 2006). These

burrows, along with other secondary evidence such as foraging diggings, scats and tracks, are usually the easiest means of detecting the presence of bilbies in an area.

The sand dune and sandplain habitats present with the survey area represent suitable Bilby habitat and the species has previously been recorded at Nifty.

Tracks attributable to Bilby were recorded at one location within sandplain habitat during this survey (Table 5.1, Figure 5.1 and Plate 5.1 to Plate 5.3). These tracks were old (up to two weeks) and of poor resolution. However, the gait pattern was consistent with that of Bilby. There are three other species which produce similar tracks, but all are unlikely for the following reasons:

1. Brush-tailed Mulgara – despite being present in suitable habitat for the species, the tracks are too large to represent Brush-tailed Mulgara (Moseby et al. 2012);
2. Northern Quoll – the Northern Quoll may occur in the survey area, given the proximity of previous records (see Northern Quoll section below); and
3. European Rabbit (*Oryctolagus cuniculus*) – the distribution of the European Rabbit is not known to extend into the Great Sandy Desert (van Dyck and Strahan 2008), and the species has not previously been recorded in the study area.

As such, given the suitable habitat in which the tracks were present, and a lack of suitable alternatives species, these tracks may be attributed to Bilby with high certainty.

Despite thorough searches, no burrows were located. The presence of suitable habitat, historical records and Bilby tracks all indicate that Bilbies will utilise the survey area, at least on occasion.

Plate 5.1: Old track, attributable to Bilby.

Plate 5.2: Old track, attributable to Bilby.

Plate 5.3: Set of tracks attributable to Bilby, extending from bottom-right to top-left of image. Includes the tracks presented in Plates 4.1 and 4.2.

Northern Marsupial Mole (*Notoryctes caurinus*)

The Northern Marsupial Mole was delisted from the EPBC Act (where it was previously listed as Endangered) and placed on the DBCA priority species list as a Priority 4 species in 2015 (Threatened Species Scientific Committee 2015). The delisting was based on results of extensive mole trenching surveys that indicated the species was more widespread and common throughout its range than previously thought.

Evidence of Northern Marsupial Mole was recorded from two trenches dug on sand dunes within the survey area (Table 5.1, Figure 5.1, Plate 5.4 and Plate 5.5). Trenching effort in the July survey did not reveal any evidence of marsupial mole burrows. However, this is likely due to significant localised rainfall which fell between surveys (see limitations, section 3.4) and may have removed old evidence of marsupial mole burrows. Given the continuity of sand dune habitat within the study area, Northern Marsupial Mole are likely to be present across all sand dunes in the survey area.

Plate 5.4: Marsupial mole burrow at NIF02MM.

Plate 5.5: Marsupial mole burrow at NIF04MM.

5.2.2 Significant Vertebrate Fauna Likely to Occur or May Occur in the Survey Area

Northern Quoll (*Dasyurus hallucatus*)

The Northern Quoll is listed as Endangered under the BC Act. On mainland Australia, its distribution is restricted to six main areas: the north and western top end of the Northern Territory, northern part of Cape York, the Atherton-Cairns area, the Carnarvon Range-Bowen area of Queensland (Menkhorst and Knight 2011), and the northwest Kimberley and Pilbara regions of Western Australia (Braithwaite and Griffiths 1994). Within the Pilbara, the distributional boundaries are defined in the north, east and south by the Great Sandy Desert, Gibson Desert and Little Sandy Deserts.

The core habitat of the Northern Quoll includes gorges, gullies, free faces, breakaways, boulder piles and incised hills. Secondary habitats include permanent and semi-permanent water, and drainage systems. It is considered a partially arboreal and is an aggressive carnivore, preying on a varied diet of small invertebrates and vertebrates, including lizards, birds, snakes, small mammals and frogs (Oakwood 2000).

Numerous records of this species have been obtained previously within the study area, particularly in the rocky hills in the vicinity of Woodie Woodie, 35 km to the west of the survey area. The Northern Quoll was recorded on two occasions within mine infrastructure at Nifty. Although the habitats present within this survey area are not optimal for Northern Quolls, they may occur.

Brush-tailed Mulgara (*Dasycercus blythi*)

The Brush-tailed Mulgara, *Dasycercus blythi*, is a medium sized (60-120 g) carnivorous marsupial that has a wide but patchy distribution throughout arid south-west Queensland, southern Northern Territory, northern South Australia and northern Western Australia (Woolley et al. 2013).

Brush-tailed Mulgara are prolific burrowers, primarily associated with spinifex sandplain habitats (Pringle et al. 1994, Halpern Glick Maunsell 1998, Kortner et al. 2007). Although favoring one or two burrows, they are known to use up to 15 burrows, within home ranges spanning up to 36 ha (Kortner et al. 2007). Suitable sandplain habitat is prevalent throughout the survey area, however, no evidence of Brush-tailed Mulgara was recorded.

This species has previously been recorded approximately 8 km east of the survey area in 2005, and is likely to occur in the survey area, particularly following significant rainfall, when conditions are favourable and population numbers in the surrounding landscape are high.

Ghost Bat (*Macroderma gigas*)

The Ghost Bat is listed as Vulnerable under both the EPBC Act and BC Act. Ghost Bats previously occurred across most of inland and northern Australia, but are now restricted to the tropical and subtropical north of the continent (Churchill 2008). The distribution of this species is fragmented, with each population showing some genetic differentiation (Armstrong and Wilmer 2004). Ghost Bats occur in a broad range of habitats, with distribution influenced by the availability of suitable caves for roost sites (Churchill 2008). Ghost Bats may forage over large areas, with foraging ranges of over 60 ha (Churchill 1998), and the size of their foraging area is probably inversely related to the productivity of their landscape. Scat material from the Ghost Bat is quite distinctive and can be used to identify temporary roosts or feeding sites. Feeding sites are also usually readily identifiable based on the accumulation of discarded remains of prey animals (van Dyck and Strahan 2008).

No Ghost Bats were recorded during the survey, and no suitable roost sites were found. The species is known to forage over large areas, may occur over many habitat types. It has been recorded on only one occasion at Nifty (Read 1998), with other records previously recorded approximately 30 km east of the survey area. The lack of suitable roost sites within this survey area indicates that Ghost Bats may occur only in the context of occasional aerial foraging, assuming suitable roost sites occur in the study area.

Grey Falcon (*Falco hypoleucos*)

The Grey Falcon is listed as Vulnerable under the BC Act and EPBC Act. It is a medium-sized falcon endemic to Australia and is widespread but sparsely distributed across much of arid inland Australia, occurring mainly on lightly wooded plains and along major watercourses (Johnstone et al. 2013). Wetlands where surface water attracts prey may also attract Grey Falcons, but they will hunt over a variety of habitats, even over treeless plains (Olsen and Olsen 1986). The Grey Falcon primarily hunts birds, especially parrots and pigeons, taken using high-speed chases and stoops; reptiles and mammals are also taken. Natural breeding sites are usually in trees, such as *Eucalyptus* spp., typically in the abandoned nests of crows and butcherbirds (Marchant and Higgins 1993). Telecommunications towers are also used regularly (Falkenburg 2010). Eggs have been recorded in July and August but its breeding season is not certain.

No Grey Falcons were recorded during this survey, but it has previously been recorded at Nifty (Read 1998). All habitats within the survey area are likely to be used for foraging, at least on occasion, with waterholes attracting aggregations of birds likely to represent very favourable foraging habitat. The Grey Falcon may occur within the survey area.

Peregrine Falcon (*Falco peregrinus*)

This species is listed as Specially Protected under the BC Act. The Peregrine Falcon occurs Australia-wide, and inhabits a wide range of habitats including forest, woodlands, wetlands and open country (Pizzey and Knight 2007).

Home ranges are probably defended year-round and are variable in size, though not typically less than 480 ha (Marchant and Higgins 1993). The species typically nests on ledges in cliffs, granite outcrops and quarries, but also in hollow trees and in old nests constructed by other species such as Wedge-tailed Eagles and Ravens (Johnstone and Storr 1998).

No Peregrine Falcons were recorded during this survey, but it has been previously recorded at

Nifty (Ecological Horizons 2013). All habitats within the survey area are likely to be suitable for foraging, at least on occasion and thus this species is likely to occur in the survey area.

Pacific Swift (*Apus pacificus*)

The Pacific Swift is listed as Migratory and Marine under the EPBC Act and Migratory under the BC Act. It occurs as a non-breeding migrant across much of Australia from September to April, particularly in the northern half of the continent. In general, the species is most common closer to the coast, but it does also occur over inland areas. In Australia, the species is entirely aerial in habit, foraging for flying insects and even sleeping on the wing. It is highly mobile, often occurring in association with unsettled weather and low pressure systems (Johnstone and Storr 1998).

The Pacific Swift was not recorded during the survey but the field survey was undertaken when Pacific Swifts are not typically present in Australia and the species has been previously recorded in the study area and occurs widely over inland Australia. It is likely to occur as a sporadic visitor to airspace over all parts of the survey area, particularly in association with the passage of thunderstorms and low-pressure systems.

Oriental Plover (*Charadrius veredus*)

The Oriental Plover is listed as Migratory under the EPBC Act and Migratory under the BC Act. The species is a summer migrant to Australia, occurring primarily from September to April (Johnstone and Storr 1998). The species breeds in Mongolia, northern China and southern Siberia, and is a non-breeding migrant to Australia (Johnstone and Storr 1998). However, unlike most shorebird species, they are not reliant on wetland and coastal habitats while in Australia. Their preferred foraging habitats are sparsely vegetated open areas, including short-grassed or bare plains, bare wetland margins, and recently burnt areas (Johnstone and Storr 1998). This also includes altered 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 are mobile in response to conditions, and disperse across inland northern Australia during the wet season (Minton et al. 2013).

The Oriental Plover was not recorded during the survey, however as it is a summer migrant, the timing of the survey means it is unlikely that the species would have been present. It also has not previously been recorded within the study area. The closest record occurs approximately 180 km to the west of the survey area. Given that the Oriental Plover is highly mobile and suitable foraging habitat occurs broadly through the survey area (SP, LRR), it may occur within the survey area on occasion.

Oriental Pratincole (*Glareola maldivarum*)

The Oriental Pratincole is listed as Migratory under EPBC Act and Migratory under the BC Act. This species is a non-breeding migrant to Australia, and is typically present from October to May, with the largest numbers present from December to March (Johnstone and Storr 1998, Sitters et al. 2004). The Oriental Pratincole uses broadly similar foraging habitats to the Oriental Plover, including short-grassed or bare plains, bare wetland margins. However, Oriental Pratincoles take most of their insect prey aerially (Johnstone and Storr 1998), and so will forage over a wider range of open habitat types. Oriental Pratincole will also use tidal mudflats, beaches, sewage ponds and freshwater wetland areas, primarily for roosting during the heat of the day. They are mobile in response to conditions, and disperse across inland northern Australia during the wet season, occasionally gathering in exceptionally high numbers (Sitters et al. 2004).

The Oriental Pratincole has not been recorded historically from the study area but has been recorded by Biota at several occasions approximately 105 km north of the survey area (Biota 2018, 2020). This species was not recorded during the survey, however as it is a summer migrant, the timing of the survey means it is unlikely that the species would have been present. As the Oriental Pratincole is highly mobile and suitable foraging and roosting habitat is present in the survey area (particularly SP and LLR), this species is may occur in the survey area on occasion.

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

The Gull-billed Tern is listed as Migratory under the EPBC Act and Migratory under the BC Act. However, there are two populations of Gull-billed Tern in Australia which are now treated as separate species under most taxonomies; a resident taxon Australian [Gull-billed] Tern *G.* [*nilotica*] *macrotarsa* and a migratory taxon *G. nilotica affinis,* occurring coastally (Menkhorst et al. 2017).

Australian [Gull-billed] Terns are nomadic and occur widely across Australia, including both coastal and inland areas, but generally remain within Australia. They breed colonially on inland wetlands, and forage over sheltered coastal and inland wetlands, and over open grassland and bare ground (Johnstone and Storr 1998). The species has previously been previously recorded in close proximity to the survey area (Ecological Horizons 2013) and is likely to occur sporadically depending on local conditions (e.g. following large rainfall events or when grasshoppers are abundant). Subspecies *affinis* of Gull-billed Tern is a non- breeding migrant to Australia and is more coastal in its habit (Menkhorst et al. 2017); therefore it would be unlikely to occur in the survey area.

White-winged Tern (*Chlidonias leucopterus*)

The White-winged Tern is listed as Migratory under the EPBC Act and Migratory under the BC Act. This species will utilise inland wetlands but is less likely to forage over terrestrial grasslands than the Gull-billed Tern, preferring to forage over water.

White-winged Terns have been recorded within proximity to the survey area (Read 1998, Ecological Horizons 2013) and may occur sporadically depending on local conditions (e.g. following large rainfall events when surface water is present).

Australian Painted Snipe (*Rostratula australis*)

The Australian Painted Snipe is listed as Endangered under the EPBC Act. The species typically inhabits shallow inland wetlands, either freshwater or brackish, that are permanent or ephemeral. It nests on the ground amongst tall reed-like vegetation near water, and feeds near the water's edge on mudflats, taking invertebrates such as insects, worms and seeds (Taylor et al. 2013). The species has a scattered distribution throughout many parts of Australia. Some individuals are apparently resident in some areas; other individuals appear to be nomadic, temporarily occupying areas where suitable habitat exists (Rogers et al. 2005).

The Australian Painted Snipe was not recorded during the surve, but may occur as a temporary visitor in the survey area following large rainfall events that create flood-out zones suitable for foraging (primarily from November to March). The most likely area that would be used for foraging would be man-made borrow pits where water pools.

5.2.3 Significant Vertebrate Fauna Unlikely to Occur or Would not Occur in the Survey Area

Western Pebble-mound Mouse (*Pseudomys chapmani*)

The Western Pebble-mound Mouse is listed by DBCA as a Priority 4 species, and occurs in the central and eastern Pilbara (Menkhorst and Knight 2011).

The species is typically found on stony hillsides with hummock grasslands (Menkhorst and Knight 2011). It constructs extensive mounds of small stones covering areas from 0.5 to 9.0 m^2 (van Dyck and Strahan 2008). Mounds are most common on spurs and gentle slopes where suitably sized stones are present (van Dyck and Strahan 2008).

Stony habitats were limited in this survey area to the 7.8 ha low rocky rises, and no evidence of the Western Pebble-mound Mouse was observed. The species has not previously been recorded at Nifty and it is unlikely that it occurs within the survey area.

Great Desert Skink (*Liopholis kintorei*)

This species is listed as Vulnerable under the BC Act and Vulnerable under the EPBC Act and is patchily distributed in the Great Sandy Desert, Gibson Desert and Tanami Desert. The study area approaches the western extremity of its range.

The Great Desert Skink occurs in a variety of desert habitats on sandy, clay and loamy soils (Storr et al. 1999). This species inhabits sandplains, paleodrainage lines and undulating gravelly downs (McAlpin et al. 2011). It exhibits limited dispersal ability (typically 0-4 km, up to 9 km), excavating extensive burrow systems, which are occupied by a breeding pair of adults and their offspring continuously for up to seven years (McAlpin et al. 2011). Active burrow systems can be identified by the presence of communal latrines near the burrow system.

The closest known populations of Great Desert Skink are in Karlamilyi National Park, in the vicinity of Punmu, 160 km east and it is unlikely to occur in the study area.

Pilbara Olive Python (*Liasis olivaceus barroni*)

The Pilbara Olive Python is listed as Vulnerable under the BC Act and Vulnerable under the EPBC Act, with 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 (DoAWE 2020).

The 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), and can have a large range (estimated between 88 ha and 449 ha) (DoAWE 2020).

This species is unlikely to occur within the survey area. No evidence was found, and no core habitat is present. The closest record occurs approximately 30 km to the west of the survey area in incised rocky habitat.

Night Parrot (*Pezoporus occidentalis*)

The Night Parrot is listed as Critically Endangered under both the EPBC Act and BC Act. The species occurs in semi-arid and arid areas of inland Australia, with historical records indicating that it was widespread and relatively common in these areas up until the late 19th century (Murphy et al. 2017). Populations are currently known from the Murchison and north-eastern desert regions in WA, as well as from western Queensland.

Descriptions of the species' habitat preferences in the literature are broad, reflecting the wide variety of habitats from which it was historically known. However, all currently known populations are associated with old-growth ringed spinifex (*Triodia* spp.; N. Jackett pers. comm. 2019). Foraging habitats are broadly described as grasses and herbs that may or may not contain shrubs or low trees, with recently-studied populations foraging primarily on chenopods and seeding spinifex and other grasses (Murphy et al. 2017).

No evidence of Night Parrot was recorded during the survey. Additionally, the survey area did not contain any old-growth spinifex roosting habitat. Potentially suitable foraging habitat is present when spinifex is seeding, however, given the lack of old-growth spinifex and distance to natural water bodies (salt lakes and/or drainage lines), the species is considered unlikely to occur within the survey area.

Other Migratory Shorebirds

Several other migratory shorebirds may occur in the survey area at times (Table 5.3). All are listed as Migratory under both the EPBC and BC Acts, while the Curlew Sandpiper is additionally listed as Critically Endangered under both Acts. These species are all non-breeding summer migrants to

Australia and breed in the northern hemisphere during the southern winter. However, smaller numbers do overwinter in Australia, primarily comprising young birds.

Shorebirds forage primarily on muddy margins and shallow waters of wetlands and other inundated habitats, with some exhibiting preferences for saline or freshwater habitats. Individuals of all the species listed below use freshwater habitats regularly and may occasionally use the margins of wetlands and other inundated habitats within the survey area on passage. However, the extent of suitable habitat within the survey area is limited to mine pits and borrow pits, so the survey area would not support any of these species in nationally or internationally significant numbers as per the EPBC Act migratory shorebird guidance (Commonwealth of Australia 2017).

Table 5.3: Migratory shorebirds that may occur in the survey area, following rain.

		Status	
Common Name	**Species**	**State**	**Federal**
Sharp-tailed Sandpiper	*Calidris acuminata*	Migratory	Migratory/Marine
Curlew Sandpiper	*Calidris ferruginea*	Critically Endangered/ Migratory	Critically Endangered/ Migratory/Marine
Pectoral Sandpiper	Calidris melanotos	Migratory	Migratory/Marine
Common Sandpiper	*Actitis hypoleucos*	Migratory	Migratory/Marine
Marsh Sandpiper	*Tringa stagnatilis*	Migratory	Migratory/Marine
Wood Sandpiper	*Tringa glareola*	Migratory	Migratory/Marine
Common Greenshank	*Tringa nebularia*	Migratory	Migratory/Marine

6.0 References

Armstrong, K. M., and W. J. Wilmer (2004). *The importance of determining genetic population structure for the management of Ghost Bats,* Macroderma gigas*, in the Pilbara region of Western Australia.* Oral presentation at the 11th Australasian Bat Society Conference, Toowoomba, Queensland.

Australasian Bat Society (2006). Recommendations of the Australasian Bat Society Inc for reporting standards for insectivorous bat surveys using bat detectors. *The Australian Bat Society Newsletter* 27:6–9.

Beard, J. S. (1968). Vegetation Survey of Western Australia 1:1,000,000 Vegetation Series. Map Sheet 2 - Great Sandy Desert. University of Western Australia Press, Western Australia.

Beard, J. S. (1975). Vegetation Survey of Western Australia 1:1,000,000 Vegetation Series. Map Sheet 5 - Pilbara. University of Western Australia Press, Western Australia.

Benshemesh, J., and M. Schulz (2009). Survey of the underground signs of marsupial moles in the WA Great Victoria Desert. Report Prepared for AngloGold Ashanti Australia, URS Australia Pty Ltd.

Biota (2009). A Two-Phase Fauna Survey of the West Turner Syncline Area. Unpublished report prepared for Rio Tinto Iron Ore, Biota Environmental Sciences, Western Australia.

Biota (2013). Rangelands Landform Field Guide. Internal document, Biota Environmental Sciences, Western Australia.

Biota (2018). Asian Renewable Energy Hub Fauna Survey. Unpublished report prepared for NW Interconnected Power, Biota Environmental Sciences, Western Australia.

Biota (2020). Winu Project Fauna Assessment. Unpublished Report Prepared for Rio Tinto Winu Pty Limited, January 2020, Biota Environmental Sciences.

Braithwaite, R. W., and A. D. Griffiths (1994). Demographic variation and range contraction in the northern quoll, *Dasyurus hallucatus* (Marsupialia: Dasyuridae). *Wildlife Research* 21(2):203–217.

Bush, B., and B. Maryan (2011). *Field Guide to the Snakes of the Pilbara, Western Australia*. Western Australian Museum, Perth.

Churchill, S. (1998). *Australian Bats*. Reed New Holland, Sydney.

Churchill, S. K. (2008). *Australian Bats*, 2nd edition. Allen and Unwin, Australia.

Commonwealth of Australia (2017). *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*. Department of the Environment and Energy, Commonwealth of Australia.

DBCA (2017a). Interim guideline for preliminary surveys of night parrot (*Pezoporus occidentalis*) in Western Australia. Department of Biodiversity, Conservation and Attractions.

DBCA (2017b). Guidelines for Surveys to Detect the Presence of Bilbies, and Assess the Importance of Habitat in Western Australia. Version 1 - August 2017, Department of Biodiversity, Conservation and Attractions.

DBCA (2018). The conservation and management of the bilby (*Macrotis lagotis*) in the Pilbara. Annual Report 2017 - 18, April 2018, Department of Biodiversity, Conservation and Attractions, Perth, WA.

Department of the Environment (2014). *Environment Protection and Biodiversity Conservation Act 1999* Protected Matters Search Tool [WWW Document]. Retrieved from

http://www.environment.gov.au/topics/about-us/legislation/environment-protection-and-biodiversity-conservation-act-1999/protected.

DoAWE (2020). *Liasis olivaceus barroni* - Olive Python (Pilbara subspecies) SPRAT Profile [WWW Document]. Department of Agriculture, Water and the Environment, . Retrieved from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66699.

DotE (2013). Matters of National Environmental Significance - Significant Impact Guidelines 1.1 *Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Canberra, Australia.

DotEE (2016). EPBC Act referral guideline for the endangered northern quoll *Dasyurus hallucatus*. EPBC Act policy statement, Department of the Environment and Energy.

DPIRD (2018). Soil landscape mapping Western Australia. Department of Primary Industries and Regional Development.

DSEWPaC (2010). Survey Guidelines for Australia's Threatened Birds. Department of Sustainability, Environment, Water, Population and Communities.

DSEWPaC (2011a). Survey Guidelines for Australia's Threatened Mammals. Department of Sustainability, Environment, Water, Population and Communities, Canberra. Retrieved from http://www.environment.gov.au/epbc/publications/threatened-mammals.html.

DSEWPaC (2011b). Survey Guidelines for Australia's Threatened Reptiles. Department of Sustainability, Environment, Water, Population and Communities; Commonwealth of Australia. Retrieved from http://www.environment.gov.au/epbc/publications/threatened-mammals.html.

DSEWPaC (2012). Interim Biogeographic Regionalisation for Australia (IBRA), Version 7 (Subregions) - States and Territories. Department of Sustainability, Environment, Water, Population and Communities, Canberra. Retrieved from http://www.environment.gov.au/topics/land/national-reserve-system/science-maps-and-data/australias-bioregions-ibra.

Ecological Horizons (2013). Birla Nifty Copper Operations Fauna Monitoring Program Report. Unpublished draft report prepared for Birla Nifty Copper Operations, Ecological Horizons, Western Australia.

EPA (2016). *Environmental Factor Guideline: Terrestrial Fauna*. Environmental Protection Authority, Western Australia.

EPA (2020). *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*. Environmental Protection Authority, Western Australia.

Falkenburg, I. D. (2010). Aspects of the ecology of the Grey Falcon *Falco hypoleucos* in the South Australian arid zone. *Corella* 35:23–28.

Flannery, T., P. Kendall, and K. Wynn-Moylan (1990). *Australia's Vanishing Mammals Endangered and Extinct Native Species*. RD Press.

Friend, J. A. (1990). Status of bandicoots in Western Australia. Pages 73–84 *in* J. H. Seebeck, P. R. Brown, and R. L. Wallis, editors. *Bandicoots and Bilbies*. Surrey Beatty & Sons in association with Australian Mammal Society, New South Wales. Retrieved June 13, 2012, .

Garnett, S. (2013). *Making Australian threatened species legislation more effective and efficient*. Professional Lecture Series 2, Charles Darwin University. Retrieved from https://www.cdu.edu.au/sites/default/files/Garnett-leaflet.pdf.

Geoscience Australia (2008). Surface geology of Australia 1:1,000,000 scale, Western Australia [Digital Dataset]. Retrieved from http://www.ga.gov.au.

Halpern Glick Maunsell (1998). Mulgara *Dasycercus cristicauda* Research Programme. Halpern Glick Maunsell Pty Ltd.

Johnstone, R. E., A. H. Burbidge, and J. C. Darnell (2013). Birds of the Pilbara region, including seas and offshore islands, Western Australia: distribution, status and historical changes. *Records of the Western Australian Museum* Supplement 78:343–441.

Johnstone, R. E., and G. M. Storr (1998). *Handbook of Western Australian Birds Volume I - Non-Passerines (Emu to Dollarbird)*. Western Australian Museum, Perth.

Kendrick, P. (2003). Great Sandy Desert 2 (GSD2 - Mackay subregion). Pages 332–342 *in* J. E. May and N. L. McKenzie, editors. *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions*. Department of Conservation and Land Management, Western Australia.

Kortner, G., C. Pavey, and F. Geiser (2007). Spatial ecology of the mulgara in arid Australia: impact of fire history on home range size and burrow use. *Journal of Zoology* 273:350–357.

Marchant, S., and P. J. Higgins (1993). *Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings*. Oxford University Press, Melbourne.

MBS (2004). Targeted Rare Fauna Search for Proposed Tailings Storage Facility at Nifty Copper Operations. Unpublished report prepared for Birla Nifty Pty Ltd, MBS Environmental.

MBS (2006). Vegetation Survey and Targeted Rare Flora and Fauna Search of the Waste Rock Dump, Airstrip and Heap Leach Pad Extension Areas, Nifty Copper Operations, Western Australia. Unpublished report prepared for Birla Nifty Pty Ltd, MBS Environmental.

McAlpin, S., P. Duckett, and A. Stow (2011). Lizards Cooperatively Tunnel to Construct a Long-Term Home for Family Members. *PLoS One* 6:e19041. doi:10.1371/journal.pone.0019041.

McKenzie, N. L., and R. Bullen (2009). The echolocation calls, habitat relationships, foraging niches and communities of Pilbara microbats. *Records of the Western Australian Museum* Supplement 78:123–155.

Menkhorst, P., and F. Knight (2011). *A Field Guide to the Mammals of Australia*, 3rd edition. Oxford University Press, Australia.

Menkhorst, P., D. Rogers, R. Clarke, J. Davies, P. Marsack, and K. Franklin (2017). *The Australian Bird Guide*. CSIRO Publishing.

Minton, C., M. Connor, D. Price, R. Jessop, P. Collins, H. Sitters, C. Hassell, G. Pearson, and D. Rogers (2013). Wader numbers and distribution on Eighty Mile Beach, north-west Australia: baseline counts for the period 1981-2003. *Conservation Science Western Australia* 8:345–366.

Moseby, K., T. Nano, and R. Southgate (2012). *Tales in the sand: a guide to identifying Australian arid zone fauna using spoor and other signs*. Ecological Horizons Pty Ltd.

Murphy, S., J. Austin, R. Murphy, J. Silcock, L. Joseph, S. Garnett, N. Leseberg, J. Watson, and A. Burbidge (2017). Observations on breeding Night Parrots (*Pezoporus occidentalis*) in western Queensland. *EMU Austral Ornithology* 117:107–113.

Oakwood, M. (2000). Reproduction and demography of the northern quoll, *Dasyurus hallucatus*, in the lowland savanna of northern Australia. *Australian Journal of Zoology* 48:519–539.

Olsen, P. D., and J. Olsen (1986). Distribution, status, movements and breeding of the Grey Falcon *Falco hypoleucos*. *Emu* 86:47–51.

Pavey, C. R. (2006). National Recovery Plan for the Greater Bilby Macrotis lagotis [WWW Document]. Retrieved July 2, 2013, from http://www.environment.gov.au/biodiversity/threatened/publications/m-lagotis.html.

Pizzey, G., and F. Knight (2007). *The Field Guide to the Birds of Australia*, 8th edition. Harper Collins Publishers, Sydney.

Pringle, H. J. R., A. M. E. van Vreeswyk, and S. A. Gilligan (1994). *Technical Bulletin No. 87: An inventory and condition survey of the north-eastern Goldfields, WA*. Agriculture Western Australia, South Perth WA.

Read, J. (1998). Vertebrate Fauna of the Nifty Mine Site, Great Sandy Desert, with Comments on the Impacts of Mining and Rehabilitation. *The Western Australian Naturalist* 22:1–21.

Rogers, D., I. Hance, S. Paton, C. Tzaros, P. Griffioen, M. Herring, R. Jaensch, L. Oring, A. Silcocks, and M. Weston (2005). The breeding bottleneck: breeding habitat and population decline in the Australian Painted Snipe. Pages 15–23 *Status and Conservation of Seabirds in the East Asian-Australasian Flyway*.

Sitters, H., C. Minton, P. Collins, B. Etheridge, C. Hassell, and F. O'Connor (2004). Extraordinary numbers of Oriental Pratincoles in NW Australia. *Wader Study Group Bulletin* 103:26–31.

Storr, G. M., L. A. Smith, and R. E. Johnstone (1999). *Lizards of Western Australia. 1: Skinks*. Western Australian Museum, Perth.

Strahan, R. (Ed.) (1995). *The Mammals of Australia*. Reed/Australian Museum.

Taylor, R., R. Chatto, and J. Woinarski (2013). Australian Painted Snipe. Northern Territory Government.

Threatened Species Scientific Committee (2015). Listing Advice *Notoryctes caurinus*.

Tille, P. (2006). Soil-landscapes of Western Australia's Rangelands and Arid Interior. Resource Management Technical Report No. 313, December 2006, Department of Agriculture and Food, Perth, WA.

van Dyck, S., and R. Strahan (Eds.) (2008). *The Mammals of Australia*, 3rd edition. Reed New Holland, Sydney.

Western Wildlife (2019a). Woodie Woodie Mine: Level 1 Vertebrate Fauna Survey 2018. Unpublished report prepared for Consolidated Minerals Ltd, Western Wildlife.

Western Wildlife (2019b). Woodie Woodie Mine: Targeted Northern Quoll Survey. Unpublished report prepared for Consolidated Minerals Ltd, Western Wildlife.

Woolley, P. A., A. Haslem, and M. Westerman (2013). Past and present distribution of *Dasycercus*: towards a better understanding of the identity of specimens in cave deposits and the conservation status of the currently recognised species *D. blythi* and *D. cristicauda* (Marsupialia : Dasyuridae). *Australian Journal of Zoology* online:A-J. doi: http://dx.doi.org/10/1071/ZO13034.

Appendix 1

DBCA Regulation 27 (Fauna Taking) Permit

Content

Appendix 2

Desktop Study and Survey Species List

Amphibians

			Conservation Status									
Family	**Species**	**Common Name**	**State**	**C'Wealth**	**This Survey**	**NatureMap**	**ALA**	**EPBC PMST**	**Read 1998**	**Ecological Horizons 2013**	**Biota 2018**	**Biota 2019**
Pelodryadidae	*Cyclorana australis*	Giant Frog									•	
	Cyclorana longipes	Long-footed Frog									•	
	Cyclorana maini	Sheep Frog				•	•		•	•		
	Litoria rubella	Little Red Tree Frog			•	•	•		•	•		
Limnodynastidae	*Neobatrachus aquilonius*	Northern Burrowing Frog				•	•		•	•		
	Notaden nichollsi	Desert Spadefoot				•	•		•	•	•	•
	Platyplectrum spenceri	Centralian Burrowing Frog				•						
Myobatrachidae	*Uperoleia micromeles*	Tanami Toadlet				•	•					•
	Uperoleia russelli	Northwest Toadlet							•	•	•	
	Uperoleia saxatilis	Pilbara Toadlet				•	•					

Reptiles

			Conservation Status											
Family	**Species**	**Common Name**	**State**	**C'Wealth**	**This Survey**	**NatureMap**	**ALA**	**EPBC PMST**	**Read 1998**	**MBS 2006**	**Ecological Horizons 2013**	**Western Wildlife 2019a**	**Biota 2018**	**Biota 2019**
Cheloniidae	*Natator depressus*	Flatback Turtle											•	
Cheluidae	*Chelodina steindachneri*	Flat-shelled Turtle				•	•		•		•			
Carphodactylidae	*Nephrurus cinctus*	Northern Banded Knob-tailed Gecko				•								
	Nephrurus laevissimus					•	•		•		•		•	•
	Nephrurus levis				•	•	•		•	•	•		•	•
Diplodactylidae	*Diplodactylus conspicillatus*	Variable Fat-tailed Gecko				•	•		•	•	•			
	Diplodactylus laevis	Desert Fat-tailed Gecko											•	•
	Diplodactylus savagei	Southern Pilbara Beak-faced Gecko				•	•							
	Lucasium stenodactylus					•	•		•		•		•	•
	Lucasium wombeyi					•	•							
	Oedura fimbria	Western Marbled Velvet Gecko				•							•	
	Rhynchoedura ornata	Western Beaked Gecko			•	•			•	•	•		•	•
	Strophurus ciliaris					•	•		•	•	•		•	•
	Strophurus elderi					•				•	•		•	•
	Strophurus jeanae					•	•		•	•			•	•
Gekkonidae	*Gehyra kimberleyi*	Robust Termitaria Gecko											•	
	Gehyra micra				•									
	Gehyra montium												•	•
	Gehyra pilbara					•	•		•		•		•	•
	Gehyra punctata					•	•		•		•		•	
	Gehyra purpurascens				•	•	•		•		•		•	•
	Gehyra variegata					•	•				•		•	•
	Heteronotia binoei	Bynoe's Gecko				•	•		•		•		•	•
	Heteronotia spelea	Pilbara Cave Gecko				•								
Pygopodidae	*Delma butleri*					•	•		•		•		•	•
	Delma borea								•		•			
	Delma desmosa												•	•
	Delma elegans					•								
	Delma nasuta					•	•				•		•	•

			Conservation Status											
Family	**Species**	**Common Name**	**State**	**C'Wealth**	**This Survey**	**NatureMap**	**ALA**	**EPBC PMST**	**Read 1998**	**MBS 2006**	**Ecological Horizons 2013**	**Western Wildlife 2019a**	**Biota 2018**	**Biota 2019**
	Delma pax					•								
	Delma tincta					•								
	Lialis burtonis					•	•		•	•	•		•	•
	Pygopus nigriceps					•			•		•		•	•
Agamidae	*Ctenophorus caudicinctus*	Ring-tailed Dragon				•	•		•		•	•	•	•
	Ctenophorus clayi	Collared Dragon				•	•		•	•	•			
	Ctenophorus isolepis	Military Dragon			•	•	•		•	•	•	•	•	•
	Ctenophorus nuchalis	Central Netted Dragon			•	•	•		•	•	•		•	•
	Diporiphora paraconvergens	Grey-striped Western Desert Dragon				•	•		•		•		•	•
	Diporiphora pindan	Pindan Dragon											•	•
	Diporiphora vescus	Northern Pilbara Tree Dragon											•	•
	Gowidon longirostris	Long-nosed Dragon				•	•		•		•	•	•	•
	Moloch horridus	Thorny Devil			•	•	•		•	•	•		•	
	Pogona minor					•							•	•
Scincidae	*Carlia munda*					•								
	Carlia triacantha												•	•
	Cryptoblepharus buchananii					•								
	Ctenotus ariadnae					•	•		•		•			
	Ctenotus brooksi					•	•		•		•		•	•
	Ctenotus calurus					•	•		•		•		•	
	Ctenotus colletti					•			•					
	Ctenotus duricola					•	•							
	Ctenotus grandis					•	•		•		•		•	•
	Ctenotus hanloni					•								
	Ctenotus helenae					•	•		•		•		•	•
	Ctenotus leae					•			•		•			
	Ctenotus nasutus					•	•		•		•			
	Ctenotus pantherinus	Leopard Ctenotus			•	•	•		•		•		•	•
	Ctenotus piankai					•	•		•		•		•	•
	Ctenotus quattuordecimlineatus				•	•	•		•		•		•	•
	Ctenotus robustus													
	Ctenotus rubicundus					•	•							
	Ctenotus rufescens												•	•
	Ctenotus saxatilis	Rock Ctenotus				•	•						•	•
	Ctenotus schomburgkii												•	•
	Ctenotus uber				•									
	Cyclodomorphus melanops	Slender Blue-tongue				•	•							
	Egernia cygnitos	Western Pilbara Spiny-tailed Skink											•	
	Eremiascincus isolepis					•							•	
	Eremiascincus musivus	Mosaic Desert Skink											•	•
	Eremiascincus pallidus	Western Narrow-banded Skink				•	•		•		•		•	•
	Eremiascincus richardsonii	Broad-banded Sand Swimmer											•	•
	Lerista bipes					•	•		•		•		•	•

			Conservation Status											
Family	**Species**	**Common Name**	**State**	**C'Wealth**	**This Survey**	**NatureMap**	**ALA**	**EPBC PMST**	**Read 1998**	**MBS 2006**	**Ecological Horizons 2013**	**Western Wildlife 2019a**	**Biota 2018**	**Biota 2019**
	Lerista clara												•	
	Lerista ips					•	•		•		•			
	Lerista jacksoni					•								
	Lerista muelleri					•								
	Lerista separanda												•	•
	Lerista vermicularis												•	•
	Lerista xanthura					•	•		•		•			
	Liopholis kintorei	Great Desert Skink	VU	Vulnerable				•						
	Liopholis striata	Night Skink							•		•			
	Menetia greyii					•	•		•		•		•	•
	Menetia surda					•	•							
	Morethia ruficauda					•							•	•
	Notoscincus ornatus					•	•		•		•		•	•
	Tiliqua multifasciata	Central Blue-tongue			•	•	•		•		•		•	•
Varanidae	*Varanus acanthurus*	Spiny-tailed Goanna				•	•		•		•		•	•
	Varanus brevicauda	Short-tailed Pygmy Goanna				•	•		•		•		•	•
	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	Yellow-spotted Goanna				•								
	Varanus pilbarensis	Northern Pilbara Rock Goanna				•								
	Varanus tristis	Racehorse Goanna				•								
Typhlopidae	*Anilios ammodytes*						•						•	•
	Anilios endoterus						•		•		•			
	Anilios grypus						•		•		•		•	•
	Anilios pilbarensis						•						•	•
Pythonidae	*Antaresia perthensis*	Pygmy Python				•								
	Antaresia childreni	Children's Python				•	•		•		•		•	•
	Aspidites ramsayi	Woma							•		•			
	Aspidites melanocephalus	Black-headed Python				•			•		•		•	•
	Liasis olivaceus barroni	Pilbara Olive Python	VU	Vulnerable		•		•						
Elapidae	*Acanthophis wellsi*	Pilbara Death Adder				•								
	Brachyurophis approximans					•	•							
	Brachyurophis fasciolatus					•								
	Demansia reticulata	Reticulated Whipsnake				•							•	
	Demansia rufescens	Rufous Whipsnake				•			•		•		•	•
	Furina ornata	Moon Snake				•	•						•	
	Suta monarchus	Monk Snake				•								
	Pseudechis australis	Mulga Snake			•	•			•		•		•	•
	Pseudonaja mengdeni	Western Brown Snake				•	•				•		•	•
	Pseudonaja modesta	Ringed Brown Snake				•	•		•		•		•	•
	Pseudonaja nuchalis	Gwardar; Northern Brown Snake							•	•				
	Simoselaps anomalus	Desert Banded Snake				•	•		•		•		•	•

			Conservation Status											
Family	**Species**	**Common Name**	**State**	**C'Wealth**	**This Survey**	**NatureMap**	**ALA**	**EPBC PMST**	**Read 1998**	**MBS 2006**	**Ecological Horizons 2013**	**Western Wildlife 2019a**	**Biota 2018**	**Biota 2019**
	Suta fasciata	Rosen's Snake				•								
	Suta punctata	Spotted Snake				•								

Ground-dwelling Mammals

			Conservation Status													
Family	**Species**	**Common Name**	**State**	**C'Wealth**	**This Survey**	**NatureMap**	**ALA**	**EPBC PMST**	**Read 1998**	**MBS 2004**	**MBS 2006**	**Ecological Horizons 2013**	**Western Wildlife 2019a**	**Western Wildlife 2019b**	**Biota 2018**	**Biota 2019**
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna				•							•	•		
Dasyuridae	*Dasycercus blythi*	Brush-tailed Mulgara, Ampurta	P4			•			•		•	•			•	
	Dasykaluta rosamondae	Kaluta				•	•		•			•			•	•
	Dasyurus hallucatus	Northern Quoll	EN	Endangered		•		•				•		•	•	•
	Ningaui ridei	Wongai Ningaui				•	•		•			•				
	Ningaui timealeyi	Pilbara Ningaui				•	•								•	•
	Planigale ingrami					•			•			•			•	•
	Pseudantechinus macdonnellensis	Fat-tailed Pseudantechinus							•			•				
	Pseudantechinus roryi	Rory's Pseudantechinus				•	•								•	•
	Pseudantechinus woolleyae	Woolley's Pseudantechinus				•								•		
	Sminthopsis macroura	Stripe-faced Dunnart				•										
	Sminthopsis youngsoni	Lesser Hairy-footed Dunnart				•	•		•			•			•	•
Thylacomyidae	*Macrotis lagotis*	Bilby, Dalgyte	VU	Vulnerable	•	•			•			•		•	•	•
Notoryctidae	*Notorychtes caurinus*	Northern Marsupial Mole, Kakarratul	P4		•	•	•		•	•	•	•			•	•
Macropodidae	*Lagorchestes conspicillatus leichardti*	Spectaced Hare-wallaby													•	
	Notamacropus agilis	Agile Wallaby													•	•
	Osphranter robustus	Euro, Biggada				•							•			
	Osphranter rufus	Red Kangaroo, Marlu				•									•	•
	Petrogale lateralis	Black-footed Rock-wallaby													•	•
	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 dingo*	Dingo			•	•									•	•
	Canis familiaris familiaris	Dog				•		•	•	•			•	•	•	
	Vulpes vulpes	Red Fox			•			•	•	•	•				•	
Felidae	*Felis catus*	Cat			•	•		•	•	•	•		•	•	•	•
Equidae	*Equus asinus*	Donkey						•								
	Equus caballus	Horse						•								
Camelidae	*Camelus dromedarius*	Dromedary, Camel			•	•		•	•						•	•
Bovidae	*Bos taurus*	European Cattle				•							•	•		

Bats

			Conservation Status								
Family	**Species**	**Common Name**	**State**	**C'Wealth**	**This Survey**	**NatureMap**	**ALA**	**EPBC PMST**	**Read 1998**	**Biota 2018**	**Biota 2019**
Pteropodidae	*Pteropus scapulatus*	Little Red Flying-fox				•					
Rhinonycteridae	*Rhinonicteris aurantia*	Pilbara Leaf-nosed Bat	VU	Vulnerable				•			
Megadermatidae	*Macroderma gigas*	Ghost Bat	VU	Vulnerable		•		•	•		
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheath-tailed Bat			•	•			•	•	•
	Taphozous georgianus	Common Sheath-tailed Bat			•	•			•	•	•
Molossidae	*Austronomus australis*	White-striped Free-tailed Bat			•				•	•	•
	Chaerephon jobensis	Greater Northern Free-tailed Bat			•	•	•			•	•
	Ozimops lumsdenae	Northern Free-tailed Bat			•					•	•
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat			•	•		•	•	•	•
	Nyctophilus geoffroyi	Lesser Long-eared Bat				•				•	•
	Scotorepens greyii	Little Broad-nosed Bat			•	•			•	•	•
	Vespadelus finlaysoni	Finlayson's Cave-bat			•	•			•	•	
	Scotorepens balstoni	Inland Broad-nosed Bat							•		

Birds

			Conservation Status											
Family	**Species**	**Common Name**	**State**	**C'Wealth**	**This Survey**	**NatureMap**	**ALA**	**EPBC PMST**	**Read 1998**	**Ecological Horizons 2013**	**Western Wildlife 2019a**	**Western Wildlife 2019b**	**Biota 2018**	**Biota 2019**
Casuariidae	*Dromaius novaehollandiae*	Emu				•	•		•	•			•	
Anatidae	*Cygnus atratus*	Black Swan					•		•	•				
	Stictonetta naevosa	Freckled Duck				•								
	Malacorhynchus membranaceus	Pink-eared Duck				•	•		•	•				
	Chenonetta jubata	Maned Duck				•			•	•				
	Anas superciliosa	Pacific Black Duck				•	•		•		•			
	Anas gracilis	Grey Teal				•	•		•	•	•			
	Anas castanea	Chestnut Teal					•			•				
	Aythya australis	Hardhead				•	•		•	•				
Phasianidae	*Coturnix ypsilophora*	Brown Quail								•			•	•
Podargidae	*Podargus strigoides*	Tawny Frogmouth					•		•	•			•	•
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar		Marine		•	•		•	•			•	•
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar				•	•		•	•				
Apodidae	*Apus pacificus*	Pacific Swift	MI	Migratory/ Marine				•	•	•				
Otididae	*Ardeotis australis*	Australian Bustard			•	•	•		•	•	•		•	•
Cuculidae	*Centropus phasianinus*	Pheasant Coucal				•							•	•
	Chrysococcyx basalis	Horsfield's Bronze Cuckoo				•	•		•	•			•	•
	Chrysococcyx osculans	Black-eared Cuckoo		Marine		•		•		•			•	•
	Cacomantis pallidus	Pallid Cuckoo		Marine	•	•	•		•	•	•		•	•
Columbidae	*Phaps chalcoptera*	Common Bronzewing				•	•		•	•	•		•	•
	Ocyphaps lophotes	Crested Pigeon			•	•	•		•	•	•		•	•
	Geophaps plumifera	Spinifex Pigeon			•	•	•			•	•	•		
	Geopelia cuneata	Diamond Dove			•	•	•		•	•	•	•	•	•
	Geopelia placida	Peaceful Dove				•	•							
Rallidae	*Porzana fluminea*	Australian Crake							•	•				
	Tribonyx ventralis	Black-tailed Nativehen							•	•				
	Fulica atra	Eurasian Coot				•	•		•	•				
	Porphyrio melanotus	Australasian Swamphen				•								
	Zapornia pusilla	Baillon's Crake		Marine					•	•				
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		Marine		•	•		•	•				
	Recurvirostra novaehollandiae	Red-necked Avocet		Marine					•	•				
Charadriidae	*Vanellus tricolor*	Banded Lapwing							•	•				
	Vanellus miles	Masked Lapwing											•	•
	Erythrogonys cinctus	Red-kneed Dotterel					•		•					
	Charadrius ruficapillus	Red-capped Plover		Marine					•	•				

			Conservation Status											
Family	**Species**	**Common Name**	**State**	**C'Wealth**	**This Survey**	**NatureMap**	**ALA**	**EPBC PMST**	**Read 1998**	**Ecological Horizons 2013**	**Western Wildlife 2019a**	**Western Wildlife 2019b**	**Biota 2018**	**Biota 2019**
	Charadrius veredus	Oriental Plover	MI	Migratory/ Marine				•						
	Elseyornis melanops	Black-fronted Dotterel				•	•		•	•			•	•
Rostratulidae	*Rostratula australis*	Australian Painted-snipe	EN	Endangered				•						
Scolopacidae	*Calidris canutus*	Red Knot	MI	Migratory/ Marine		•	•							
	Calidris acuminata	Sharp-tailed Sandpiper	MI	Migratory/ Marine				•						
	Calidris ferruginea	Curlew Sandpiper	CR; MI	Critically Endangered /Migratory/ Marine				•						
	Calidris melanotos	Pectoral Sandpiper	MI	Migratory/ Marine				•						
	Actitis hypoleucos	Common Sandpiper	MI	Migratory/ Marine			•	•	•	•				
	Tringa stagnatilis	Marsh Sandpiper	MI	Migratory/ Marine						•				
	Tringa glareola	Wood Sandpiper	MI	Migratory/ Marine						•				
	Tringa nebularia	Common Greenshank	MI	Migratory/ Marine					•	•				
	Stiltia isabella	Australian Pratincole		Marine					•	•				
Glareolidae	*Glareola maldivarum*	Oriental Pratincole	MI	Migratory				•					•	•
Laridae	*Gelochelidon macrotarsa*	Australian [Gull-billed] Tern	MI	Migratory/ Marine		•			•	•				
	Onychoprion fuscatus	Sooty Tern		Marine					•	•				
	Chlidonias hybrida	Whiskered Tern		Marine			•			•				
	Chlidonias leucopterus	White-winged Tern	MI	Migratory/ Marine					•	•				
Ciconiidae	*Ephippiorhynchus asiaticus*	Black-necked Stork					•							
Anhingidae	*Anhinga novaehollandiae*	Australasian Darter					•			•				
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant				•	•			•				
	Phalacrocorax varius	Australian Pied Cormorant					•							
	Phalacrocorax sulcirostris	Little Black Cormorant				•	•		•	•				
	Phalacrocorax carbo	Great Cormorant								•				
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis		Marine		•	•							
	Platalea flavipes	Yellow-billed Spoonbill				•								
Ardeidae	*Nycticorax caledonicus*	Nankeen Night Heron		Marine									•	•
	Bubulcus coromandus	Eastern Cattle Egret		Marine		•		•						
	Ardea pacifica	White-necked Heron				•	•		•	•	•	•	•	•
	Ardea alba	Great Egret		Marine		•	•							
	Egretta novaehollandiae	White-faced Heron				•	•		•	•				
	Egretta garzetta	Little Egret		Marine						•				
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican		Marine			•		•	•			•	•
Accipitridae	*Pandion cristatus*	Eastern Osprey					•	•						
	Elanus axillaris	Black-shouldered Kite				•	•			•	•		•	•
	Lophoictinia isura	Square-tailed Kite					•			•				

			Conservation Status											
Family	**Species**	**Common Name**	**State**	**C'Wealth**	**This Survey**	**NatureMap**	**ALA**	**EPBC PMST**	**Read 1998**	**Ecological Horizons 2013**	**Western Wildlife 2019a**	**Western Wildlife 2019b**	**Biota 2018**	**Biota 2019**
	Hamirostra melanosternon	Black-breasted Buzzard							•	•			•	
	Hieraaetus morphnoides	Little Eagle				•	•		•	•			•	
	Aquila audax	Wedge-tailed Eagle				•	•		•	•	•		•	
	Accipiter fasciatus	Brown Goshawk		Marine	•	•	•		•	•	•		•	•
	Accipiter cirrocephalus	Collared Sparrowhawk				•	•						•	•
	Circus assimilis	Spotted Harrier			•	•	•		•	•	•		•	•
	Milvus migrans	Black Kite				•	•		•	•	•			
	Haliastur sphenurus	Whistling Kite		Marine	•	•	•		•	•	•		•	•
	Haliaeetus leucogaster	White-bellied Sea-Eagle		Marine				•						
Tytonidae	*Tyto javanica*	Eastern Barn Owl				•	•		•	•			•	•
Strigidae	*Ninox connivens*	Barking Owl					•							
	Ninox boobook	Australian Boobook		Marine			•							
Alcedinidae	*Dacelo leachii*	Blue-winged Kookaburra				•	•				•			
	Todiramphus sanctus	Sacred Kingfisher		Marine			•		•	•				
	Todiramphus pyrrhopygius	Red-backed Kingfisher				•	•		•	•	•		•	•
Meropidae	*Merops ornatus*	Rainbow Bee-eater		Marine	•	•	•	•	•	•	•		•	•
Falconidae	*Falco cenchroides*	Nankeen Kestrel		Marine	•	•	•		•	•	•		•	•
	Falco longipennis	Australian Hobby			•	•	•		•	•			•	•
	Falco berigora	Brown Falcon			•	•	•		•	•	•		•	•
	Falco hypoleucos	Grey Falcon	VU	Vulnerable				•	•	•				
	Falco subniger	Black Falcon					•							
	Falco peregrinus	Peregrine Falcon	OS			•			•	•	•			
Cacatuidae	*Nymphicus hollandicus*	Cockatiel			•	•	•		•	•			•	•
	Calyptorhynchus banksii	Red-tailed Black Cockatoo					•						•	•
	Eolophus roseicapilla	Galah			•	•	•		•	•			•	•
	Lophochroa leadbeateri	Major Mitchell's Cockatoo					•							
	Cacatua sanguinea	Little Corella				•	•		•	•	•			
Psittaculidae	*Polytelis alexandrae*	Princess Parrot	P4	Vulnerable				•						
	Barnardius zonarius	Australian Ringneck				•	•				•			
	Pezoporus occidentalis	Night Parrot	CR	Endangered				•						
	Melopsittacus undulatus	Budgerigar			•	•	•		•	•			•	•
Ptilonorhynchidae	*Chlamydera guttata*	Western Bowerbird				•	•				•			
Climacteridae	*Climacteris melanurus*	Black-tailed Treecreeper					•							
Maluridae	*Malurus assimilis*	Purple-backed Fairywren			•	•	•		•	•	•		•	•
	Malurus leucopterus leuconotus	White-winged Fairywren			•	•	•		•	•	•		•	•
	Stipiturus ruficeps	Rufous-crowned Emu-wren				•			•	•				
	Amytornis whitei	Rufous Grasswren				•	•						•	
Meliphagidae	*Epthianura tricolor*	Crimson Chat			•	•	•		•	•	•		•	•
	Epthianura aurifrons	Orange Chat								•				
	Epthianura crocea	Yellow Chat					•							
	Certhionyx variegatus	Pied Honeyeater			•	•	•		•	•			•	•

			Conservation Status											
Family	**Species**	**Common Name**	**State**	**C'Wealth**	**This Survey**	**NatureMap**	**ALA**	**EPBC PMST**	**Read 1998**	**Ecological Horizons 2013**	**Western Wildlife 2019a**	**Western Wildlife 2019b**	**Biota 2018**	**Biota 2019**
	Sugomel niger	Black Honeyeater			•	•	•		•	•	•		•	•
	Lichmera indistincta	Brown Honeyeater			•	•	•		•	•	•		•	•
	Melithreptus gularis	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				•					•			
	Gerygone fusca	Western Gerygone				•					•			
	Acanthiza apicalis	Inland Thornbill				•								
	Acanthiza uropygialis	Chestnut-rumped Thornbill				•								
Pomatostomidae	*Pomatostomus temporalis*	Grey-crowned Babbler				•	•							
Psophodidae	*Psophodes occidentalis*	Chiming Wedgebill											•	•
Artamidae	*Artamus leucorynchus*	White-breasted Woodswallow				•	•							
	Artamus personatus	Masked Woodswallow			•	•	•		•				•	
	Artamus cinereus	Black-faced Woodswallow			•	•	•		•	•	•		•	
	Artamus minor	Little Woodswallow				•	•				•			
	Gymnorhina tibicen	Australian Magpie				•	•							
	Cracticus torquatus	Grey Butcherbird				•	•							
	Cracticus nigrogularis	Pied Butcherbird			•	•	•			•	•	•	•	•
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckooshrike		Marine	•		•		•	•	•	•	•	•
	Lalage tricolor	White-winged Triller			•	•	•		•	•	•		•	•
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella					•							
Oreoicidae	*Oreoica gutturalis*	Crested Bellbird				•							•	
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler				•	•				•		•	
	Colluricincla harmonica	Grey Shrikethrush					•				•	•		
Dicruridae	*Dicrurus bracteatus*	Spangled Drongo		Marine					•	•				
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail			•	•	•		•	•	•	•	•	•
Monarchidae	*Grallina cyanoleuca*	Magpie-lark		Marine	•	•	•		•	•	•	•		
Corvidae	*Corvus orru*	Torresian Crow				•	•		•	•	•	•	•	•
	Corvus bennetti	Little Crow			•	•	•		•	•			•	•
Petroicidae	*Melanodryas cucullata*	Hooded Robin				•	•				•			
	Petroica goodenovii	Red-capped Robin				•	•							
Alaudidae	*Mirafra javanica*	Horsfield's Bush Lark				•	•				•		•	•
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow				•	•		•	•	•			
	Hirundo rustica	Barn Swallow	MI	Migratory				•						
	Hirundo neoxena	Welcome Swallow		Marine		•								

			Conservation Status											
Family	**Species**	**Common Name**	**State**	**C'Wealth**	**This Survey**	**NatureMap**	**ALA**	**EPBC PMST**	**Read 1998**	**Ecological Horizons 2013**	**Western Wildlife 2019a**	**Western Wildlife 2019b**	**Biota 2018**	**Biota 2019**
	Petrochelidon ariel	Fairy Martin				•	•		•	•			•	•
	Petrochelidon nigricans	Tree Martin		Marine		•	•							
Acrocephalidae	*Acrocephalus australis*	Australian Reed Warbler				•								
Locustellidae	*Poodytes carteri*	Spinifexbird				•	•		•	•	•		•	•
	Poodytes gramineus	Little Grassbird				•				•				
	Cincloramphus cruralis	Brown Songlark			•		•		•	•			•	•
	Cincloramphus mathewsi	Rufous Songlark				•	•		•	•	•		•	•
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola					•							
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird				•	•							
Estrildidae	*Emblema pictum*	Painted Finch				•	•				•	•	•	•
	Taeniopygia guttata	Zebra Finch			•	•	•		•	•	•		•	•
	Heteromunia pectoralis	Pictorella Mannikin							•	•			•	•
Motacillidae	*Motacilla tschutschensis*	Eastern Yellow Wagtail	MI	Migratory/ Marine				•						
	Motacilla cinerea	Grey Wagtail	MI	Migratory/ Marine				•						
	Anthus australis	Australian Pipit		Marine	•	•	•		•	•	•		•	•

Appendix 3

Likelihood of Significant Fauna Occurring in the Survey Area

Family	Species Name	Common Name	Conservation Status		NatureMap	ALA	EPBC PMST	Biota 2020	Biota 2018	Western Wildlife 2019 (N Quoll)	Western Wildlife 2019	Ecological Horizons 2013	MBS 2006	MBS 2004	Read 1998	Preferred Habitat	Habitat Available	Likelihood of Occurrence	
			State	Federal														Prior to Survey	Post-survey
REPTILES																			
Scincidae	*Liopholis kintorei*	Great Desert Skink	VU	Vulnerable			✓									Sandy, clay and loamy soils, sandplains, paleodrainage lines and undulating gravelly downs	✓	Unlikely to occur	Unlikely to occur
Pythonidae	*Liasis olivaceus barroni*	Pilbara Olive Python	VU	Vulnerable	✓		✓									Rocky areas within the Pilbara, showing a preference for rocky gorges containing water in streams and rock pools	-	Unlikely to occur	Unlikely to occur
MAMMALS																			
Dasyuridae	*Dasycercus blythi*	Brush-tailed Mulgara, Ampurta	P4		✓				✓			✓				Spinifex grasslands on sandplains and sandy swale between low dunes from south-western Queensland across the Simpson, Tanami, and Great Sandy Deserts of southern and central Northern Territory and central Western Australia.	✓	Likely to occur	Likely to occur
	Dasyurus hallucatus	Northern Quoll	EN	Endangered	✓		✓	✓	✓	✓						Rocky areas and tall open coastal eucalypt forests, sandstone escarpment	-	May occur	May occur
Thylacomyidae	*Macrotis lagotis*	Bilby, Dalgyte	VU	Vulnerable	✓			✓	✓	✓		✓			✓	Acacia shrubland, open tussock grassland on uplands and hills, mulga woodland/ shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas	✓	Likely to occur	Recorded
Notoryctidae	*Notoryctes caurinus*	Northern Marsupial Mole	P4		✓	✓		✓	✓				✓	✓	✓	Vast sandy deserts of central Australia	✓	Likely to occur	Recorded
Muridae	*Pseudomys chapmani*	Western Pebble-mound Mouse	P4		✓			✓	✓		✓					Stony hillsides with hummock grasslands in the central and eastern parts of the Pilbara	-	Unlikely to occur	Unlikely to occur
Rhinonycteridae	*Rhinonicteris aurantia*	Pilbara Leaf-nosed Bat	VU	Vulnerable			✓									Across northern Australia the Orange Leaf-nosed bat is reliant on roost sites in caves or mine adits with stable, very hot (28 – 32°C) and very humid (96 – 100 %) microclimates. Forages over wide range of habitats.	-	Unlikely to occur	Unlikely to occur
Megadermatidae	*Macroderma gigas*	Ghost Bat	VU	Vulnerable	✓		✓								✓	Occurs in a broad range of habitats, with their distribution being influenced by the availability of suitable caves and mines for roost sites	Foraging only	May occur (foraging)	May occur (foraging)
BIRDS																			
Apodidae	*Apus pacificus*	Pacific Swift	MI	Migratory			✓					✓			✓	Entirely aerial when in Australia.	✓	Likely to occur (foraging)	Likely to occur (foraging)
Charadriidae	*Charadrius veredus*	Oriental Plover	MI	Migratory			✓									Estuarine mudflats, sandbanks, beaches or reefs, and grasslands immediately after migration. Thereafter- flat, open, semi-arid or arid grasslands interspersed with hard, bare ground (claypans, paddocks, lawns, recently burnt areas), lightly wooded grasslands.	✓	May occur	May occur

			Conservation Status															
Family	**Species Name**	**Common Name**	**State**	**Federal**	**NatureMap**	**ALA**	**EPBC PMST**	**Biota 2020**	**Biota 2018**	**Western Wildlife 2019 (N Quoll)**	**Western Wildlife 2019**	**Ecological Horizons 2013**	**MBS 2006**	**MBS 2004**	**Read 1998**	**Preferred Habitat**	**Habitat Available**	**Likelihood of Occurrence**	
																		Prior to Survey	**Post-survey**
Rostratulidae	*Rostratula australis*	Australian Painted-snipe	EN	Endangered			✓									Shallow, terrestrial freshwater wetlands (temporary and permanent lakes, swamps, claypans), inundated grassland or saltmarsh and dams. Often include tussocks of grass, sedges, rushes or reeds, or samphire. Breeding: shallow wetlands with areas of bare wet mud and both upper and canopy cover.	✓	May occur	May occur
Scolopacidae	*Calidris canutus*	Red Knot	MI	Migratory	✓	✓										Coastal sandy estuaries, muddy tidal flats.	-	Would not occur	Would not occur
	Calidris acuminata	Sharp-tailed Sandpiper	MI	Migratory/ Marine			✓									Muddy edges of shallow fresh or brackish wetlands with inundated or emergent low vegetation including sedges, saltmarsh or grass. Includes swamps, lakes, dams, saltpans, hypersaline saltlakes, saltworks, sewage dams, and flooded paddocks.	Marginal	Unlikely to occur	Unlikely to occur
	Calidris ferruginea	Curlew Sandpiper	CR; MI	Critically Endangered/ Migratory			✓									Intertidal mudflats in sheltered coastal areas (estuaries, bays, inlets and lagoons), non-tidal swamps, lakes and lagoons near the coast, Inland around ephemeral and permanent lakes, dams, waterholes and bore drains with bare edges of mud or sand. Fresh or brackish waters.	Marginal	Unlikely to occur	Unlikely to occur
	Calidris melanotos	Pectoral Sandpiper	MI	Migratory			✓									Shallow fresh to saline wetlands. Coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. When found inland, generally in wetlands that have open fringing mudflats and low, emergent or fringing vegetation.	Marginal	Unlikely to occur	Unlikely to occur
	Actitis hypoleucos	Common Sandpiper	MI	Migratory		✓	✓					✓			✓	Wide range of coastal and inland wetlands mostly found around muddy margins (narrow, steep) or rocky shores (rarely mudflats). Often associated with mangroves.	Marginal	Unlikely to occur	Unlikely to occur
	Tringa stagnatilis	Marsh Sandpiper	MI	Migratory								✓				Permanent or ephemeral wetlands, intertidal mudflats, shallow freshwater lakes.	Marginal	Unlikely to occur	Unlikely to occur
	Tringa glareola	Wood Sandpiper	MI	Migratory								✓				Well-vegetated, shallow, freshwater wetlands such as swamps, dominated by taller fringing vegetation, especially Melaleuca and Red River Gums. Inundated grasslands and wooded floodplains where floodwaters are temporary or receding, drying wetlands.	Marginal	Unlikely to occur	Unlikely to occur
	Tringa nebularia	Common Greenshank	MI	Migratory								✓			✓	Edges of wetlands, mudflats, channels, shallow edges around water, shallow pools,	Marginal	Unlikely to occur	Unlikely to occur

Family	Species Name	Common Name	Conservation Status		NatureMap	ALA	EPBC PMST	Biota 2020	Biota 2018	Western Wildlife 2019 (N Quoll)	Western Wildlife 2019	Ecological Horizons 2013	MBS 2006	MBS 2004	Read 1998	Preferred Habitat	Habitat Available	Likelihood of Occurrence	
			State	Federal														Prior to Survey	Post-survey
																puddles, slightly elevated rocks, sandbanks and muddy islets.			
Glareolidae	*Glareola maldivarum*	Oriental Pratincole	MI	Migratory			✓	✓	✓							Open plains, floodplains, short grassland. Often near terrestrial wetlands or along the coast.	✓	May occur	May occur
Laridae	*Gelochelidon [nilotica] macrotarsa*	Australian [Gull-billed] Tern	MI	Migratory								✓				Tidal creeks, estuaries, mudflats, coastal salt lakes, freshwater swamps, river pools, dams, clay pans and water courses in interior.	✓	Likely to occur	Likely to occur
	Gelochelidon nilotica affinis	Gull-billed Tern	MI	Migratory								✓				Estuaries, mudflats, tidal creeks and near-coastal wetlands.	-	Unlikely to occur	Unlikely to occur
	Chlidonias leucopterus	White-winged Tern	MI	Migratory								✓			✓	Coastal, subcoastal, or terrestrial wetlands.	-	May occur	May occur
Falconidae	*Falco hypoleucos*	Grey Falcon	VU	Vulnerable			✓					✓			✓	Lightly wooded plains, major watercourses with taller trees or isolated man-made structures such as communications towers.	✓	May occur (foraging)	May occur (foraging)
	Falco peregrinus	Peregrine Falcon	OS		✓							✓			✓	Forest, woodlands, wetlands and open country, ledges in cliffs, granite outcrops and quarries.	✓	Likely to occur (foraging)	Likely to occur (foraging)
Psittaculidae	*Polytelis alexandrae*	Princess Parrot	P4	Vulnerable			✓									Highly nomadic, occupies eastern deserts of Western Australia, forages on spinifex.	✓	Unlikely to occur	Unlikely to occur
	Pezoporus occidentalis	Night Parrot	CR	Endangered			✓									Remote arid and semi-arid areas. Roosting and nesting in clumps of dense vegetation (primarily old and large spinifex clumps) that is naturally fragmented and therefore protected from fire. Grasslands, shrublands, scattered trees and shrubs, Mulga woodland.	Marginal	Unlikely to occur	Unlikely to occur
Hirundinidae	*Hirundo rustica*	Barn Swallow	MI	Migratory			✓									Open country in coastal lowlands, often near water, towns and cities. Seen on overhead wires, freshwater wetlands, Melaleuca wetlands, mesophyll shrub thickets and tussock grassland.	✓	Unlikely to occur	Unlikely to occur
Motacillidae	*Motacilla tschutschensis*	Eastern Yellow Wagtail	MI	Migratory			✓									Wet meadows, marshland, grassy and muddy lakeshores, fields, often near livestock, shrubland, grassland, and wetlands.	✓	Unlikely to occur	Unlikely to occur
	Motacilla cinerea	Grey Wagtail	MI	Migratory			✓									Flowing water, rocky or surrogate rocky habitat, mountain streams, weirs, inland wetlands, grassland, forested areas, and lowland water courses.	Marginal	Unlikely to occur	Unlikely to occur