Ministers North to Yandi Corridor

Two Phase Targeted Fauna Survey

BHP WAIO

October 2018

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EXECUTIVE SUMMARY

BHP Western Australian Iron Ore (BHP WAIO) commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a two-phase targeted vertebrate fauna survey of the Ministers North to Yandi Corridor, hereafter referred to as the Study Area. The Study Area is situated directly south of BHP WAIO's Yandi mine and approximately 90 km north-west of Newman, in the Pilbara region of Western Australia.

Four databases were searched and eight relevant reports reviewed to obtain information on species previously recorded within and within the vicinity of the Study Area. The results were investigated and used in the planning of the two-phase targeted vertebrate fauna field survey. The surveys consisted of: habitat assessments (based on BHP WAIO guidelines), targeted transect searches (on foot and in helicopter); motion sensitive cameras; ultrasonic bat recordings, acoustic bird recordings, Northern Quoll trapping sites and opportunistic recording of target and other fauna species.

Twenty-seven conservation significant species and one locally significant species (Chocolate Wattled Bat (*Chalinolobus morio)* were identified during the desktop assessment. Of these two were recorded from the current surveys, four are considered likely to occur, six could possibly occur, four could rarely occur, eight are unlikely to occur and four are highly unlikely to occur within the Study Area. The two species of conservation significance recorded during the current survey were; the Western Pebble Mound Mouse (*Pseudomys chapmani*) (listed as Priority 4 by the Department of Biodiversity, Conservation and Attractions) and the Peregrine Falcon (*Falco peregrinus*) (listed as Schedule 7 under the *Wildlife Conservation Act 1950*). The Western Pebble Mound Mouse has previously been recorded within 10 km of the Study Area. The Peregrine Falcon was previously recorded approximately 14 km from the Study Area. No species listed as Threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the *Wildlife Conservation Act 1950* were recorded within the Study Area. Of the species possible or likely to occur in the Study Area six been recorded 10 km of the Study Area; Northern Quoll (*Dasyurus hallucatus*), Ghost Bat (*Macroderma gigas*), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*), Pilbara Olive Python (*Liasis olivaceus barroni*), Chocolate Wattled Bat (*Chalinolobus morio*) and Common Greenshank (*Tringa nebularia*).

From the field survey, a total of 94 vertebrate fauna species representing 44 families were recorded from the Study Area. These comprised 17 mammals (including two introduced species), 54 bird, and 23 herpetofauna species.

Seven fauna habitat types were identified within the Study Area: Basalt Outcrop, Breakaway/ Cliff, Gorge/ Gully, Hillcrest/ Hillslope, Major Drainage Line, Minor Drainage Line and Drainage Area/ Floodplain. Hillcrest/Hillslopes was the most common habitat within the Study Area. The least common fauna habitats were the Major Drainage Line, Breakaway/ Cliff (small areas located in the north-western, central and south-eastern portions of the Study Area), Gorge/ Gully (small areas located in the north-western and south-eastern portions of the Study Area), Basalt Outcrops and Minor Drainage Lines. The most significant fauna habitat types of the Study Area

were the Gorge/Gully and Major Drainage Line, representing habitat most likely to support species of conservation significance.

Thirteen water features were recorded during the current survey. Most of the water features were recorded in the second survey, most likely due to as a large rainfall event which occurred just prior to the survey. All thirteen water features represent potential foraging habitat, at least seasonally, for the Pilbara Olive Python. Water feature MNY-WB-02 was considered the most significant within the Study Area as it represented a semi-permanent river pool that was likely to hold water for most of the year, as indicated by its size (3 m wide, 15 m long and ~1 m deep) and the presence of *Typha* spp. (reeds). This water feature provides potential habitat and resources to species of conservation significance, and other fauna, for most of the year.

1 INTRODUCTION

1.1 Background

BHP Western Australian Iron Ore (BHP WAIO) commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a two-phase targeted vertebrate fauna survey of the Ministers North to Yandi Corridor, hereafter referred to as the Study Area (Figure 1.1). The Study Area, which comprises 2,091 hectares (ha), is situated directly south of BHP WAIO's Yandi mine (Figure 1.1) and approximately 90 km north-west of Newman, in the Pilbara region of Western Australia.

1.2 Objectives

The objective of the survey was to identify the occurrence of species of conservation significance and their supporting habitats within the Study Area. This was undertaken by:

- Completing a comprehensive database and literature review for the Study Area to determine the presence, or likely presence, for species of conservation significance. This included an assessment of the likelihood of potential conservation significant species being present within the Study Area based on habitat suitability and extent;
- Completing a two-phase targeted vertebrate fauna survey of conservation significant species with an emphasis on detecting Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Night Parrot; and
- Further characterising and mapping existing broad fauna habitats occurring across the Study Area.

1.3 Background to Protection of Fauna

Within Western Australia, native fauna are protected under the *Wildlife Conservation Act 1950* (WC Act) and at a national level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Any action that has the potential to impact on native fauna needs to be approved by relevant state and/or federal departments as dictated by the state *Environmental Protection Act 1986* (EP Act). Some species of fauna that are determined to be at risk of extinction or decline are afforded extra protection under these Acts. For the purposes of this report, these species are deemed to be of conservation significance. A summary of applicable legislation and status codes is provided in Table 1.1 and additional information on status codes is provided in Appendix A. A number of migratory bird species are also prioritised for conservation under international agreements and therefore protected under the EPBC Act and WC Act as Migratory.

For some species, there is insufficient information to determine their status. These species are generally considered by the EPA and the Department of Biodiversity, Conservation and Attractions (DBCA) as being of conservation significance for all development related approvals and are listed on a 'Priority List' that is regularly reviewed and maintained by the DBCA (Table 1.1).

Table 1.1 Definitions and terms for fauna of conservation significance

Agreement, Act or List	Status Codes
Federal	
***Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)** The Department of the Environment and Energy (DoEE) lists threatened fauna, which are determined by the Threatened Species Scientific Committee (TSSC) per criteria set out in the Act. The Act lists fauna that are considered to be of conservation significance under one of eight categories (listed under 'Status Codes').	• Extinct (EX) • Extinct in the Wild (EW) • Critically Endangered (CE) • Endangered (EN) • Vulnerable (VU) • Conservation Dependent (CD) • Migratory (MG) • Marine (MA)
State	
***Wildlife Conservation Act 1950* (WC Act)** At a state level, native fauna are protected under the *Wildlife Conservation Act 1950*. Species in need of conservation are given a ranking ranging from Critically Endangered to Vulnerable.	• Schedule 1 (Critically Endangered) (S1) • Schedule 2 (Endangered) (S2) • Schedule 3 (Vulnerable) (S3) • Schedule 4 (Extinct) (S4) • Schedule 5 (Migratory) (S5) • Schedule 6 (Conservation Dependent) (S6) • Schedule 7 (Other Specially Protected) (S7)
DBCA Priority List DBCA produces a list of Priority species that have not been assigned statutory protection under the *Wildlife Conservation Act 1950*. This system gives a ranking from Priority 1 to Priority 4.	• Priority 1 (Poorly-known species) (P1) • Priority 2 (Poorly-known species) (P2) • Priority 3 (Poorly-known species) (P3) • Priority 4 (Rare, Near Threatened, and other species in need of monitoring) (P4)

705000 710000 715000 720000 725000

7485000 7480000 7475000

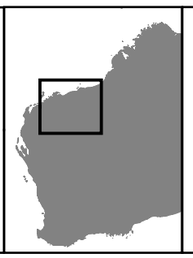
Yandi Mine

Phils Creek Mi

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

Legend

- Study Area
- Major Resource Projects
- BHP Tenements
- Railway



biologic Environmental Survey

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0 1 2 4 km

BHP - Ministers North to Yandi Corridor

Vertebrate Fauna Survey

Fig. 1.1: Location of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 14/09/2018

2 ENVIRONMENT

2.1 Vegetation

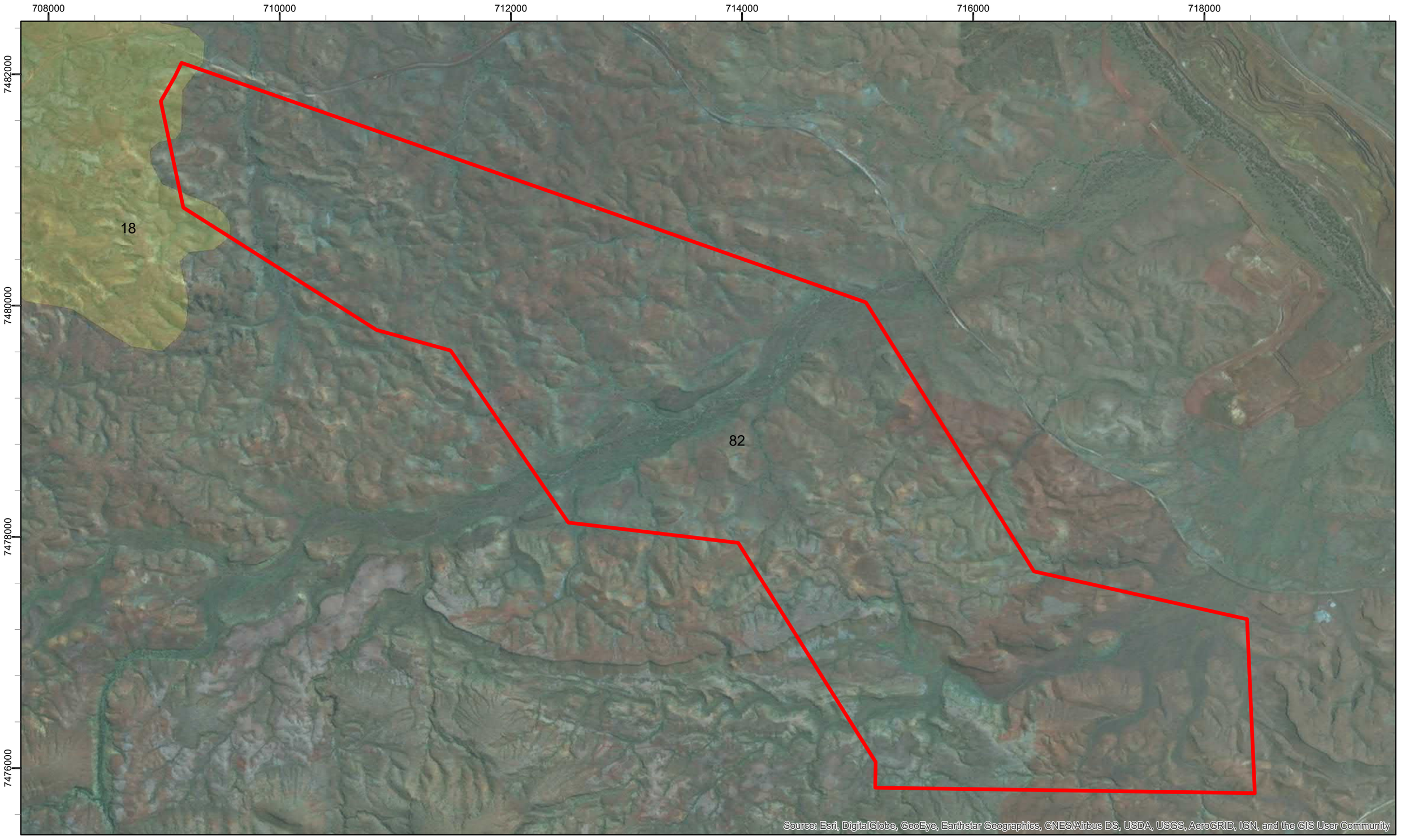
The Study Area is located within the Hamersley Botanical District, part of the Eremaean Province (Beard, 1990). The Hamersley Botanical District is dominated by tree and shrub - steppe communities consisting mainly of *Eucalyptus* and *Acacia* species. *Triodia pungens, Triodia wiseana* and some Mulga (*Acacia aneura* complex) occur within valley areas, and short grass plains occur on alluvia. The vegetation within the Study Area is classified as the following two vegetation associations (Figure 2.1), as mapped by Beard (1975) and later refined by Shepherd *et al.* (2002):

- 82: Hummock grasslands, low tree steppe; Snappy gum over *Triodia wiseana*; and
- 18: Low woodland; mulga.

While the Pre-European extent for each vegetation association is close to 100 percent, less than 10 percent of each association occurs within formal or informal reserves (Table 2.1).

Table 2.1: Pre-European vegetation associations of the Study Area

Vegetation Association	Description	Pre-Euro. Extent Remaining (ha)	Remaining area (ha) in IUCN Class I-IV Reserves	% remaining Other Reserves	% remaining in DBCA Managed PL	% of Study Area
Hamersley - 82	Hummock grasslands, low tree steppe; Snappy gum over *Triodia wiseana*	2,290,910 (100%)	8.9	0.2	1.0	99.2
Hamersley - 18	Low woodland; mulga (*Acacia aneura* complex)	24,659,110 (99.9%)	2	0.3	2.5	0.8



Legend

Study Area

Vegetation Association

- Hamersley - 18
- Hamersley - 82

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1:30,000

0 0.5 1 2 km

BHP - Ministers North to Yandi

Two Phase Targeted Fauna Survey

Fig. 3.1: Pre-European vegetation associations of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 14/09/2018

2.2 Climate

The Pilbara bioregion has a semi-desert to tropical climate, with rainfall occurring sporadically throughout the year, although mostly during summer (Thackway & Cresswell, 1995). Summer rainfall is usually the result of tropical storms in the north or tropical cyclones that impact upon the coast and move inland (Leighton, 2004). The winter rainfall is generally lighter and is the result of cold fronts moving north easterly across the state (Leighton, 2004). The average annual rainfall ranges from 200-350 mm, although there are significant fluctuations between years (BoM, 2018), with up to 1200 mm falling in some locations in some years (McKenzie *et al.*, 2009).

Long-term climatic data was not available for the Study Area; however, the BoM weather station at Marillana (Station 5009), and BHP's Barimunya station (Station 505053, located 15 km to the north-west) can be used as reference points for climatic observations in the Study Area (BoM, 2018). The average monthly temperatures at Barimunya and rainfall observations at Marillana for a 12-month period covering both survey phases (August 2017 – July 2018) are plotted against the longer-term averages in Figure 2.2. Survey periods are shown in orange.

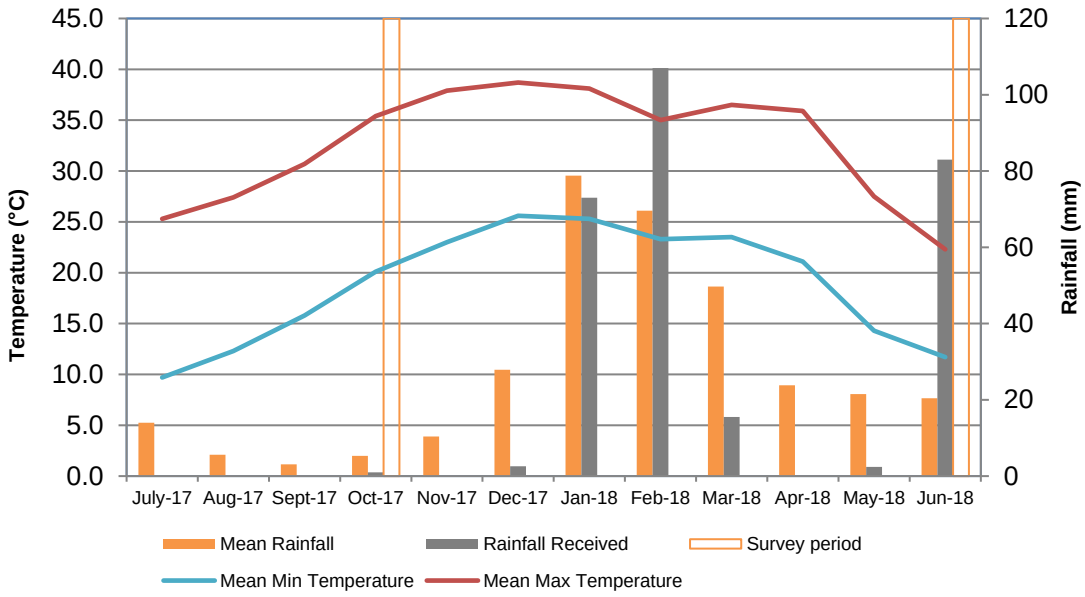

Figure 2.2 Long term average rainfall plotted against recent rainfall observations at Marillana (station 5009), and average monthly temperatures from Barimunya (station 505053) (BoM, 2018).

The long-term average (LTA) annual rainfall at Marillana Station is 324.1 mm (BoM, 2018). The average monthly maximum temperature ranges from 22.3°C in June to 38.7°C in December. Average monthly minimum temperature ranges from 9.7°C in July to 25.6°C in December (BoM, 2018) (Figure 2.2).

The Pilbara dry-season is typically three months from August to October. The months leading up to the Phase 1 survey, September 2017 and October 2017, experienced almost no rainfall (0 and 1 mm respectively) (BoM, 2018). This would have resulted in average to low fauna activity.

Timing for the Phase 2 survey (June 2018) proceeded the typical Pilbara wet-season months with rainfall observations (Marillana station) in the 3 months prior (March-May) significantly lower

than long term averages (BoM, 2018); however, the month of June experienced significantly higher than average rainfall with 83 mm recorded in a three day window (6 - 8 June) approximately 1 week prior to the survey, with 42.5 mm recorded in one day alone (BoM, 2018). Temperatures were considered average for the seasons surveyed (BoM, 2018). This would have resulted in average conditions for recording fauna.

2.3 Geology

The regional geology has been described and mapped by the Geological Survey of Western Australia at a scale of 1:250,000 (Thorne & Tyler, 1997). The geology within the Study Area belongs to the Hamersley Group of the Hamersley Basin, a late Archaean to early Proterozoic (2765-2470 Ma) basin which occurs over the southern part of the Pilbara Craton (Thorne & Tyler, 1997). The geology of the Study Area is broadly classified as metamorphosed banded ironstone, chert, mudstone, siltstone, rhyolite, and numerous dolerite sills.

2.4 Soil

The CSIRO (2009's) Atlas of Australian Soils described and mapped the soils of Australia following Bettany *et al.* (1967). The broad soil type mapped following Bettany *et al.* (1967) is soil type Fa13 – Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams along with some soils on the steeper slopes. Associated are (Dr2.33, Dr2.32) soils on the limited areas of dissected pediments, while (Um5.52) and (Uf6.71) soils occur on the valley plains.

Tille (2006) collated the most recent and detailed mapping of Western Australia's Rangelands and Arid Interior. The Study Area falls within the Hamersley Plateaux zone of the Fortescue Province, which is said to comprise "hills and dissected plateaux (with some stony plains and hardpan wash plains) on sedimentary and volcanic rocks of the Hamersley Basin (Ophthalmia Fold Belt)" Tille (2006). The soils of this province are described as "stony soils with red shallow loams and some red/brown non-cracking clays and red loamy earths" (Tille, 2006).

Extensive hills and ridges occurring within the Study Area support areas with poorly formed skeletal soils or in some cases a complete lack of soil cover (where surface expression of the Robe pisolite are found). The hill slopes support uniform medium or fine textured soils consisting of loams and sands that are generally shallow, stony and lack nutrients. There are small areas of stony plains where the soils are better developed and deeper, represented most commonly as hard alkaline red-brown loams. The soils in the major drainage lines are alluvial sands and gravels with banks formed by a combination of alluvial sediments and duplex soils (Tille, 2006).

2.5 Topography

The Study Area occurs within the central Hamersley Ranges, which, together with the Ophthalmia Ranges, comprise the majority of the Hamersley Plateau. The dominant landform features are

rocky hills with scree slopes and minor outcropping and rolling stony plains (Tille, 2006). The topography of the Study Area is variable with a series of hills, breakaways, plateaux, and strike ridges dissected by gullies and drainage lines (Thorne & Tyler, 1997). This landscape also extends beyond the Study Area to the north and south. The tallest mountains occur in the north east, known as the "Three Sisters".

2.6 Drainage and Groundwater

The average annual rainfall in the region is approximately 324.1 mm (as measured at Marillana Station), which occurs mainly as tropical summer storms associated with low pressure systems, thus annual totals can vary widely. The minor and major drainage lines within the Study Area feed into the Marillana Creek, which meanders west to east in the area north of the Study Area. Flows are highly sporadic, and only occur after prolonged heavy rainfall as short-duration flooding with rapid peaks and slightly less rapid declines. Water rarely persists for long after flooding, tending to permeate down as a source of groundwater recharge into the underlying aquifer although occasional persistent surface water occurs (BHP WAIO, 2011).

2.7 Land Systems

A total of 102 land systems were defined in the Pilbara at a scale of 1: 250,000 (van Vreeswyk *et al.*, 2004). The Study Area lies across four of these land systems (Figure 2.3). The northern and southern halves of the Study Area primarily comprise ranges associated with the McKay and Newman land systems respectively. A localised area within the central sector of the Study Area supports mesas characteristic of the Robe land system, with stony plains of the Boolgeeda land system represented in the south-east corner of the Study Area (Figure 2.3).

Table 2.2: Land Systems of the Study Area

Land System	Land Type	Description	Extent in Study Area	
			Ha	%
Boolgeeda	Stony plains with spinifex grasslands	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or Mulga shrublands.	50.10	2.40
McKay	Hills and ranges with spinifex grasslands	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands.	1262.75	60.38
Newman	Hills and ranges with spinifex grasslands	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	723.26	34.58
Robe	Mesas, breakaways and stony plains with spinifex grasslands	Low plateaux, mesas and buttes of limonite's supporting soft spinifex (and occasionally hard spinifex) grasslands.	55.25	2.64
Total			**2091.36**	**100**

708000 710000 712000 714000 716000 718000

7482000 7480000 7478000 7476000

Mine
McKay System
River System
McKay System
Robe System
River System
Robe System
Boolgeeda System
Robe System
Newman System

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

Legend

Study Area

Land System

- Boolgeeda System
- McKay System
- Mine
- Newman System
- River System
- Robe System

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1:30,000

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Two Phase Targeted Fauna Survey

Fig. 2.3: Land Systems of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 14/09/2018

3 METHODS

3.1 Desktop Assessment

3.1.1 Database Searches

Four databases were searched to obtain information on species previously recorded within the vicinity of the Study Area and conservation significant species with the potential to occur within the Study Area (Protected Matters Database, Table 3.1).

- BirdLife Australia's Birdata Custom Bird List (Birdlife Australia, 2017) – to determine avifauna recorded from the region;
- Department of Biodiversity Conservation and Attractions' (DBCA) NatureMap database (DBCA, 2017a) – to determine fauna recorded from the region;
- DBCA's Threatened and Priority Fauna Search (DBCA, 2017b) - to determine threatened fauna recorded from the region and;
- Department of Environment and Energy's (DoEE) Protected Matters Database (DoEE, 2017a) – to determine matters of national environmental significance recorded from the area.

Table 3.1: Databases used for the vertebrate fauna review

Provider	Database	Parameters
Birdlife Australia (2017)	Birdata Custom Bird List Received 9 November 2017	Circle of radius 40 km centred on the point -22.7875, 119.0719
DBCA (2017a)	NatureMap Accessed 23 November 2017	Circle of radius 10 km centred on the point -22.7875, 119.0719
DBCA (2017b)	Threatened and Priority Fauna Search Received 10 October 2017	Study Area (shapefile) buffered by 25 km
DoEE (2017a)	Protected Matters Database Search Tool Accessed 23 November 2017	Circle of radius 10 km centred on the point -22.7875, 119.0719

3.1.2 Literature Review

Nine locally relevant fauna survey reports were reviewed as part of the desktop assessment, comprising:

- Marillana Creek Western Access Corridor Biological Assessment (Halpern Glick Maunsell, 1999)
- Yandi Life of Mine Flora and Fauna (Maunsell, 2003)
- Ministers North Biological Survey (ecologia, 2006)
- Munjina and Ministers North (Yandi Hub) Fauna Assessment (ENV Australia, 2009)
- Yandicoogina Junction South West and Oxbow Fauna Survey (Biota, 2010)
- Yandi Vertebrate Fauna Review (Biologic, 2011d)
- Area C to Yandi Fauna Survey (Biologic, 2011b)
- Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota, 2013)
- Ministers North Level 2 Vertebrate Fauna Survey (Biologic, 2017)

3.2 Field Survey

The field survey was undertaken over two phases: Phase 1 was conducted from the 9th to the 13th of October 2017 and Phase 2 was conducted from the 15th to the 23th of June 2018.

3.2.1 Survey Team and Licensing

The assessment was undertaken by two zoologists: Phase 1 was undertaken by Morgan O'Connell and Thomas Rasmussen and Phase 2 was undertaken by Ray Lloyd and Brighton Downing. The survey was conducted under DBCA Regulation 17 license 08-001253-1 and 08-001253-2 issued to M. O'Connell.

3.2.2 Habitat Assessments and Mapping

A total of 46 fauna habitat assessments were undertaken throughout the Study Area to define and delineate broad fauna habitat types present. This included habitat assessments at the motion camera, ultrasonic and acoustic sampling locations (Figure 3.1) Habitats in the Study Area were assessed using methodology and terminology modified from the Australian Soil and Land Survey Field Handbook (National Committee on Soil and Terrain, 2009). The characteristics recorded during the habitat assessments were:

- site information, photo and location;
- landform: slope, relative inclination of slope, morphological type and landform type;
- vegetation: leaf litter %, twig litter %, wood litter, dead stags and hollow bearing trees, broad floristic formation, vegetation structure (tall, mid and low), and dominant species;
- land surface: micro relief, sheet erosion, rill erosion, gully erosion, gully depth, abundance and size of coarse fragments, rock outcropping, water bodies, comments on nests, burrows, roosts and diggings;
- soil: texture, colour;
- substrate: bare ground, rock size, rock type, rock outcropping; and
- disturbance: time since last fire, evidence of weeds, grazing, or human disturbances.

Fauna habitats were assessed for the likelihood that they may support conservation significant fauna. All major fauna habitat types present within the Study Area were rated (High, Medium or Low) per the criteria in (Section 3.3).

3.2.3 Trapping Sites

Two trapping sites were established in the Study Area during Phase 2 in accordance with DoE's Referral Guidelines for Northern Quoll (DoE, 2016). At each site fifty Elliot Traps (a mixture of small and large Elliott's) were set with universal bait and deployed in habitat considered prospective for detecting Northern Quoll (specifically Breakaway / Cliff habitat). Traps were checked daily, within three hours of sunrise. Each trapping site was open for seven nights equating to a total of 700 trapping nights.

3.2.4 Targeted Searches

Targeted searches were undertaken to identify the occurrence of fauna of conservation significance and to search for important habitat features, such as water features and caves. Targeted searches were conducted within the most prospective areas in terms of habitat features and habitats suitable for species of conservation significance. During the targeted searches, and while traversing the Study Area, the team recorded all vertebrate fauna species of conservation significance encountered, either from primary (*i.e.* direct observation) or secondary (*e.g.* burrows, scratching's, diggings and scats) evidence. Targeted transect were conducted on foot and via helicopter to detect fauna and their habitats.

3.2.5 Ultrasonic Recordings – Bats

Overnight recordings of bat echolocation calls were undertaken using SM4BAT+ SM2 (Wildlife Acoustics, USA) fitted with an external, omnidirectional SMX-US ultrasonic microphone. The location of each SM4 unit was selected based on prospective bat foraging grounds, such as at overhangs. The unit was positioned to provide shelter from direct sun or rain, whilst retaining an unobstructed 'line of sight' between the microphone and the likely bat flyway. Each SM4 was preconfigured to activate at astronomical sunset each day and deactivate at astronomical sunrise the following morning. Jumper settings, audio settings, selectable filters and selectable triggers used to preconfigure each SM2 unit, and hence define the volume and frequency ranges sought, followed the manufacturer's recommendations for bat detection (Wildlife Acoustics, 2011).

SongMeter4 (SM4-BAT+) and SongMeter2 (SM2) ultrasonic bat detectors targeting Ghost Bat and Pilbara Leaf-nosed bat were deployed within potentially suitable habitat focusing on water bodies and rocky areas having potential cave roosts. Detectors were set in 11 locations throughout the Study Area for a total of 32 recording nights (Figure 3.1). Ultrasonic recordings were analysed by Bob Bullen (Bat Call WA).

3.2.6 Acoustic Recordings – Night Parrot

Overnight recordings using SM4 units were also undertaken for the Night Parrot. SM4 units were fitted with SMX-II acoustic microphones and set to record between 0-500 Hz each night. Units were deployed within long unburnt spinifex hummock grasslands, specifically *Triodia longiceps* hummock grasslands, which is similar to habitat confirmed to support populations elsewhere (Murphy *et al.*, 2017a; Murphy *et al.*, 2017b; Night Parrot Recovery Team, 2017) and in accordance with interim guidelines developed by DPaW (2017).

SM4 units targeting Night Parrot were deployed across the Study Area at five locations for a total of 12 recording nights (Figure 3.1). All recordings were analysed manually by Bob Bullen (Bat Call WA).

3.2.7 Motion Cameras

Bushnell Trophy Cam and Ltl Acorn motion cameras were deployed to survey for species of conservation significance, specifically Northern Quoll, Northern Brushtail Possum (*Trichosurus*

vulpecula arnhemensis). In accordance with DoE's Referral Guidelines for Northern Quoll, camera transects comprising 10 cameras were deployed at three locations considered prospective for detecting Northern Quoll (specifically major drainage lines, gorges, cliffs and rocky hilltops) during the Phase 2 (DoE, 2016). Cameras were deployed for 4 to 5 nights equating to a total of 130 sampling nights (Figure 3.1). A further thirty motion cameras were deployed opportunistically throughout the study area during Phase 1 and Phase 2 for a total of 60 sampling nights. Cameras were baited with universal bait (oats, peanut butter and sardines) or wet cat food. The resulting footage was analysed manually by Biologic personnel.

3.2.8 Opportunistic Vertebrate Fauna Records

Opportunistic records of vertebrate species encountered during the survey were documented. Birds were recorded on a presence/absence basis, determined by call identification, visual identification and/or tracks and traces.

3.2.9 Taxonomy and Nomenclature

BHP's checklist of vertebrate fauna was followed for nomenclature and taxonomy of mammal, birds, reptile and amphibian. This list broadly follows the latest checklist published by the Western Australian Museum (WAM, 2018) (for mammals, reptiles and amphibians), and the current checklist of Australian birds maintained by Birds Australia (based on, Christidis & Boles, 2008).

708000 710000 712000 714000 716000 718000

7482000

7480000

7478000

7476000

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

Legend

- Study Area
- Northern Quoll - Trapping
- Northern Quoll - Motion Camera
- Motion Camera
- Recorder - Acoustic
- Recorder - Ultrasonic
- Targeted Search
- Habitat Assessment

biologic Environmental Survey

N

1:30,000

0 0.5 1 2 km

BHP - Ministers North to Yandi Corridor

Two Phase Targeted Fauna Survey

Fig. 3.1: Fauna sampling site locations

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 14/09/2018

3.3 Assessment on Occurrence of Fauna

Conservation significant fauna species recorded from the databases and previous reports were assessed for their likelihood to occur within the Study Area using the decision matrix below (Table 3.2).

Table 3.2: Species likelihood of occurrence in the Study Area decision matrix

Range categories:	Habitat Categories				
	Core habitat known to occur	**Foraging habitat known to occur**	**Dispersal habitat known to occur**	**Potential dispersal habitat**	**No known habitat occurs**
Species recorded <5 km	Highly Likely	Likely	Likely	Possible	Possible
Species recorded 5-10 km	Likely	Likely	Possible	Possible	Rarely
Species recorded 10-40 km	Likely	Possible	Possible	Rarely	Unlikely
Species recorded >40 km	Possible	Possible	Rarely	Rarely	Unlikely
Species rarely recorded in region	Possible	Rarely	Unlikely	Unlikely	Highly Unlikely

This decision matrix is only intended to be an indicative guide, and was applied with the following considerations:

- The range categories are subject to interpretation based on the known range of each species and its natural dispersal capabilities (for example, >50 km range may be a significant distance for a fossorial skink, but not a migratory bird);
- Both the range categories and the habitat categories can vary markedly for different types of fauna such as birds, reptiles, mammals, and amphibians, and fauna with different ecological niches within each of these groups;
- The degree of habitat specificity for each species is a major determining factor for each of the habitat categories, and this in turn is dependent on the current state of ecological knowledge of the species.
- The amount and location of previous sampling is a major factor influencing the applicability of the range categories, as well as the amount of effort that has been expended in (and the accessibility of) the area in question for sampling;
- The current state of taxonomy is another major factor for species that are poorly known taxonomically and thus difficult to identify accurately, as well as for any recent changes of classification and/or conservation category. Such taxonomic changes can affect the reliability of previous records within fauna databases, the conservation status of the newly defined species/ populations, and the assumptions regarding species ranges and habitat preferences; and

- The language used in each of the habitat and range categories may be useful for some taxa and not for others (for example, 'rarely' occurrences may be useful for describing birds or fauna which can traverse large distances, but in the case of fauna with more limited dispersal capabilities such as reptiles, there is no basis for 'rarely' occurrences. Such likelihoods may be more likely to represent range extensions.

3.4 Potential Limitations

The EPA (2016) outlines several potential limitations to fauna surveys. These aspects are assessed and discussed in Table 3.3 below.

Table 3.3: Survey limitations and constraints

Potential limitation or constraint	Applicability to this survey
Experience of personnel.	The field personnel involved in the survey have a combined total of more than 10 years of fauna survey experience in the Pilbara.
Scope (faunal groups sampled and whether any constraints affect this)	The scope was a two-phase targeted survey and was conducted within that framework. No nocturnal work was undertaken by the field personal; this reduced the ability for opportunistic detection of nocturnally active species.
Proportion of fauna identified	All observed fauna were identified at the point of observation. All recorded bat calls were successfully identified.
Sources of information (recent or historic) and availability of contextual information	A significant amount of survey work has been undertaken within the vicinity of the Study Area (particularly within 20 km of the Study Area) and the surrounding region, and the majority of these previous survey results were available for review. These reports were available at the time of reporting.
Proportion of the task achieved	A targeted survey of the Study Area was completed and related to the results of surveys in the broader area.
Disturbances (e.g. fire or flood)	The lack of rainfall during phase 1 may have resulted in average to low fauna activity. However, Phase 2 was the primary survey for detecting targeted species and so conditions were not considered to be a limitation of this survey. However, recent fires may have influenced the fauna present.
Intensity of survey	A two-phase targeted survey was identified by BHP WAIO as the requirement for this survey.
Completeness of survey	The survey was adequately completed to meet the requirements of a targeted survey.
Resources (e.g. degree of expertise available)	All resources required to complete the survey were available.
Remoteness or access issues	The Study Area was accessed using a helicopter (first season) and, despite limited vehicle access for the second phase, adequate coverage of the Study Area was achieved. Thus, the sampling techniques used during this survey were not significantly constrained by accessibility or remoteness.

4 RESULTS AND DISCUSSION

4.1 Desktop Assessment

The literature review and database searches identified a total of 338 species of vertebrate fauna, which have previously been recorded and/ or have the potential to occur within the Study Area. This comprised 41 native mammals, 10 non-native mammals, 156 birds, 119 reptiles, eight amphibians and four fish (Appendix B). Note that some of these species are unlikely to occur in the Study Area as the database searches were undertaken over a larger area than the Study Area itself, therefore containing habitats that do not necessarily occur within the Study Area. Additionally, many species tend to be patchily distributed even where appropriate habitats are present, and many species of birds can occur as regular migrants, occasional visitors or vagrants.

Of the 338 species of vertebrate fauna identified as being previously recorded and/ or having the potential to occur, 27 species are of conservation significance comprising seven mammals, 16 birds and four reptiles (Table 4.1). Additionally, one locally significant species was identified in the desktop assessment (Biologic, 2017; Biota, 2013; DBCA, 2017a); the Chocolate Wattled Bat (*Chalinolobus morio*). This species has a restricted distribution in the southern part of Western Australia (Churchill, 2008). Weeli Wolli Spring and Marillana Creek represent the only two locations in the Pilbara where this species has been recorded and are the most northern records for this species (McKenzie & Bullen, 2009). Given its geographic separation from the main population in Western Australia, the Pilbara population may be genetically distinct. Therefore, although not formally listed as a conservation significant species, it is considered locally significant.

Table 4.1: Species of conservation significance identified from the desktop assessment

Common name	Species	Conservation Status			
		EPBC Act	WC Act	DBCA	IUCN
Mammals					
Northern Quoll	*Dasyurus hallucatus*	EN	S2		EN
Bilby, Dalgyte	*Macrotis lagotis*	VU	S3		VU
Ghost Bat	*Macroderma gigas*	VU	S3		VU
Pilbara Leaf-nosed Bat	*Rhinonicteris aurantia*	VU	S3		
Short-tailed Mouse	*Leggadina lakedownensis*			P4	
Western Pebble-mound Mouse	*Pseudomys chapmani*			P4	
Brush-tailed Mulgara	*Dasycercus blythi*			P4	
Chocolate Wattle Bat	*Chalinolobus morio*	Locally significant			
Birds					
Curlew Sandpiper	*Calidris ferruginea*	CR/MG	S3/S5		
Night Parrot	*Pezoporus occidentalis*	EN	S1		EN
Australian Painted Snipe	*Rostratula australis*	EN	S2		EN
Southern Giant Petrel	*Macronectes giganteus*	EN/MG	S5		
Grey Falcon	*Falco hypoleucos*		S3		VU
Eastern Osprey	*Pandion haliaetus*	MG	S5		
Fork-tailed Swift	*Apus pacificus*	MG	S5		
Oriental Plover	*Charadrius veredus*	MG	S5		
Barn Swallow	*Hirundo rustica*	MG	S5		
Yellow Wagtail	*Motacilla flava*	MG	S5		
Grey Wagtail	*Motacilla cinerea*	MG	S5		
Sharp-tailed Sandpiper	*Calidris acuminata*	MG	S5		
Pectoral Sandpiper	*Calidris melanotos*	MG	S5		
Common Sandpiper	*Tringa hypoleucos*	MG	S5		
Common Greenshank	*Tringa nebularia*	MG	S5		
Peregrine Falcon	*Falco peregrinus*		S7		
Reptiles					
Pilbara Olive Python	*Liasis olivaceus* subsp. *barroni*	VU	S3		
Pilbara Flat-headed Blind-snake	*Anilios ganei*			P1	
Pilbara Barking Gecko	*Underwoodisaurus seorsus*			P2	
Spotted Ctenotus	*Ctenotus uber* subsp. *johnstonei*			P2	

4.2 Field Survey

A total of 94 vertebrate fauna species were recorded within the Study Area during the field surveys, comprising 54 avifauna, 17 mammals (two introduced) and 23 herpetofauna (Appendix C). Table 4.2 presents the individual and cumulative results of both phase 1 and 2 showing faunal group totals recorded.

Table 4.2: Summary of vertebrate fauna recorded during the survey

Fauna Group	Number of Species – Phase 1	Number of Species - Phase 2	Cumulative totals (both survey phases)
Avifauna	35	47	54
Non-volant mammals (Native)	7	8	7
Non-volant mammals (Introduced)	1	2	2
Bats	6	7	8
Amphibians	0	0	0
Reptiles	10	18	23
Total	**59**	**82**	**94**

None of the fauna species recorded from the Study Area were gazetted as Threatened Fauna pursuant to the EPBC Act. However, two species of conservation significance were recorded during the survey: the Peregrine Falcon and the Western Pebble-mound Mouse. Locations of the records are provided in Figure 4.1, and details of the occurrence of this species in and around the Study Area are listed in Table 4.3 below.

4.3 Conservation Significant Fauna

Of the 27 conservation significant species returned in the database searches, two were confirmed during the current surveys, three are likely to occur, six could possibly occur, four could rarely occur, eight are unlikely to occur and four are highly unlikely to occur within the Study Area. Additionally, one locally significant species is considered likely to occur. These species, along with an assessment of their likely presence in the Study Area (based on available habitat), are listed in Table 4.4.

For any potentially occurring conservation significant species which remained undetected during the targeted survey, there are several possible explanations, including:

- habitats (vegetation, soil and landform characteristics) within the Study Area are not suitable (e.g. both cave roosting bat species);
- the Study Area is considered geographically marginal or near the limits of the species' known distribution;
- the species are nomadic or have large home ranges so may not have been present in the Study Area during the time of survey;

- some of these species (e.g. dasyurids) are considered to be ‘boom or bust’ species and so may only occur in the Study Area during good to excellent seasonal conditions when food and other resources are available;
- and/or some species are very cryptic or difficult to survey (e.g. Pilbara Olive Python).

The assessment of some conservation significant species as either unlikely or highly unlikely to occur (Table 4.3) is based on factors such as the absence of habitat for the particular species, lack of occurrence records (outside of known distribution) and/or lack of occurrence evidence during surveys. The conservation significant bat species listed (Ghost Bat, Pilbara Leaf Nosed Bat, and Little Northern Freetail Bat) are highly unlikely to use the Study Area for roosting due to the lack of caves observed and any records would only be dispersing or foraging individuals. Many of the other conservation significant species regarded as unlikely to occur within the Study Area are migratory avian species (e.g. Southern Giant Petrel) more commonly found in coastal habitats such as lagoons, estuaries, and bays. Species such as the Brush-tailed Mulgara and Greater Bilby are reliant on sand-based habitats, which are absent in the Study Area, and for this reason they are unlikely to occur.

Table 4.3: Conservation significant species that have been recorded or may occur in the Study Area

Name	Conservation listing	Known habitat	Records within or within the vicinity of the study area	Potential habitats within the study area	Likelihood of occurrence
Mammals					
Northern Quoll *Dasyurus hallucatus*	EPBC Act Endangered WC Act Schedule 2 IUCN Endangered	Northern Quolls favour rocky areas such as ranges, escarpments, mesas, gorges, breakaways, boulder fields, major drainage lines and treed creek lines, as well as structurally diverse woodland or forest areas containing large diameter trees, termite mounds or hollow logs (DoE, 2016). Dens are made in rock crevices, tree holes or occasionally termite mounds (Oakwood, 2002). The Northern Quoll has been recorded in numerous land systems which comprise sandstone and dolomite hills and ridges, shrublands, sandy plains, clay plans and tussock grasslands and coastal fringes including dunes islands and beaches (DBCA, 2017a).	Northern Quoll (*Dasyurus hallucatus*) has been recorded from Yandi Mine (~1.5 km north) on two occasions: once on motion-camera during a survey (Biologic, 2018b) and once as road kill (Morgan O'Connell, *pers. obs.*) Furthermore, numerous records have been documented by DBCA (2017b) more than 19km north of the Study Area. Three records were also documented 18.7 km south of the Study Area DBCA (2017b).	Suitable denning habitat exists in the Gorge/ Gully habitat, while the Major Drainage Line provide potential dispersal habitat. Given that Northern Quoll was not picked up on motion camera and no scats were observed, it would be unlikely that a permanent population occurs within the Study Area. Dispersing males may occasionally pass through from the north west, suggesting that if a number of consecutive good rainfall years improved habitat productivity then a population could be established.	Possible

Name	Conservation listing	Known habitat	Records within or within the vicinity of the study area	Potential habitats within the study area	Likelihood of occurrence
Pilbara Leaf-nosed Bat *Rhinonicteris aurantia*	EPBC Act Vulnerable WC Act Schedule 3	Pilbara Leaf-nosed Bat roosts within caves and abandoned Mines with high humidity (95%) and temperature (32 °C) (Armstrong, 2001). This Species forages in caves and along waterbodies with fringing vegetation (TSSC, 2016).	One record of Pilbara Leaf-nosed Bat has been documented by DBCA (2017b) approximately 10 km north-west of the Study Area. This species was also recorded during Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota, 2013). A further 175 records have been documented by DBCA (2017b) more than 18 km north of the Study Area. Only one record has been documented south of the Study Area (20 km) (DBCA, 2017b).	The species may forage across numerous habitats within the Study Area including Gorge/ Gully, Hillcrest/ Hillslope and low hills. The Breakaway/ Cliff habitat is patchy in the north-west, around the Major Drainage Line (runs north-east to south-west in the central portion of the Study Area) and floodplain area in the south-eastern portion of the Study Area; however, it is considered likely that this species would only occur in the Study Area very occasionally when dispersing or foraging through the landscape given that no roosting caves were recorded during this survey and known roosts are up to 25 km away.	Possible
Ghost Bat *Macroderma gigas*	EPBC Act Vulnerable WC Act Schedule 3 IUCN Vulnerable	Ghost Bats roost in deep, complex caves beneath bluffs of low, rounded hills, granite rock piles and abandoned mines (Armstrong & Anstee, 2000). These features often occur within habitat types including Gorge/ Gully, Hillcrest/ Hillslope and low hills (Armstrong & Anstee, 2000).	Biologic (2011b) recorded Ghost Bat scats ~7km south of the Study Area within a cave in the Area C to Yandi Study Area. Another record of Ghost Bat exists approximately 10 km south of the Study Area (DBCA, 2017b) and a further 28 records have been documented <25 km south of the Study Area. The species is known to occur within the region and may forage across most of the Study Area.	The Breakaway/ Cliff, Gorge/ Gully, Major Drainage Line and drainage floodplain habitats throughout the Study Area provide suitable foraging habitat for the species; however, it is considered likely that this species would only occur in the Study Area occasionally when dispersing or foraging through the landscape given that no deep caves were recorded during this survey.	Possible

Name	Conservation listing	Known habitat	Records within or within the vicinity of the study area	Potential habitats within the study area	Likelihood of occurrence
Greater Bilby *Macrotis lagotis*	EPBC Act Vulnerable WC Act Schedule 3 IUCN Vulnerable	Variety of habitats including spinifex hummock grassland and *Acacia* shrubland, on soft soils (Burrows *et al.*, 2012). In the Pilbara often associated with major drainage line sandy terraces (Dziminski & Carpenter, 2016; How *et al.*, 1991; Marlow *et al.*, 2011).	There are a number of records to the north of the Study Area the closest of which are ~27 km away from 2013 and 2014 (DBCA, 2017a).	The Greater Bilby typically inhabits sandy plains and thus is unlikely to occur in the Study Area. Furthermore, its current distribution does not include the Hamersley Range.	Unlikely
Short-tailed Mouse *Leggadina lakedownensis*	DBCA Priority 4	This species is endemic to northern Australia, where it occurs from Cape York in the east to the Pilbara, in Western Australia, although the distribution is discontinuous (Moro & Kutt, 2008). There are populations present on Thevenard Island and Serruriae Island (the latter is a translocated population – intentionally introduced for conservation purposes), both in Western Australia (Lee, 1995; Moro & Kutt, 2008). It is a nocturnal species found in areas of open tussock and hummock grassland, *acacia* shrubland, and savanna woodland, on alluvial clay or sandy soils(Lee, 1995; Moro & Kutt, 2008). Generally restricted to cracking clays in the region (Gibson & McKenzie, 2009).	Biologic (2011c) recorded this species at Tandanya in the cracking clay habitat and surrounds (approximately 30 km to the south west. A Western Australian Museum record also exists near to Boundary Ridge (DBCA, 2017a), approximately 25 km to the south west.	This species is generally recorded in cracking clay habitat (not present in the Study Area) (Biologic, 2011c), however it has also been recorded in stony plain habitat and broad drainage areas (Gibson & McKenzie, 2009). Therefore, this species may occur in the Study Area within Drainage Area/ Floodplain habitat type.	Possible

Name	Conservation listing	Known habitat	Records within or within the vicinity of the study area	Potential habitats within the study area	Likelihood of occurrence
Western Pebble-mound Mouse *Pseudomys chapmani*	DBCA Priority 4	The Western Pebble -mouse occupies rocky hummock grassland areas with little or no soil. The habitat is usually vegetated with an open to mid-dense *Triodia basedowii* hummock grassland and scattered emergent *Cassia*, *Acacia* and *Ptilotus* spp. (Start *et al.*, 2000). They have also known to occupy, at lower densities, on the ridges and outcrops where there was hummock grassland of *T. wiseana* with many emergent *Eucalyptus* and Acacia spp. (Dunlop & Pound, 1981; Start *et al.*, 2000). They more commonly inhabit lower land slopes where weathering produces pebbles of the preferred size (average 3.5 grams) (Start *et al.*, 2000). The prevalence of mounds is not necessarily a reliable indicator of abundance or even presence, as mounds are often used by successive generations (Anstee, 1996; Ford & Johnson, 2007) and may persist in the landscape for many years. Moreover, mice utilise several mounds in the course of a night, this included the primary mound (mound used as daytime refuge) and one or two mounds within their home range (Anstee, 1996).	Active mounds belonging to this species were recorded at 14 locations, nine of which were within the Study Area. A further four recently inactive mounds were recorded, one of which was within the Study Area. Finally, inactive mounds were recorded at ten locations, seven of which were within the Study Area (Figure 4.1). Previous reports assessed as part of the desktop assessment all recorded the Pebble-mound Mouse (DBCA, 2017b) Two records (secondary evidence) of the species within the Study Area near the southern border and a further 44 within 10 km of the Study Area (DBCA, 2017b).	All mounds recorded during the survey were within the Hillcrest/ Hillslope habitat. This habitat type was the most common and widespread habitat type occurring across the Study Area. The remaining habitat types are unlikely to provide important habitat for the species.	Confirmed

Name	Conservation listing	Known habitat	Records within or within the vicinity of the study area	Potential habitats within the study area	Likelihood of occurrence
Brush-tailed Mulgara *Dasycercus blythi*	DBCA Priority 4	Prefers spinifex *Triodia* spp. grasslands on sand plains and the swales between low dunes (Pavey *et al.*, 2012; Woolley, 2006). Mature spinifex hummocks appear to be important for protection from introduced predators (Körtner *et al.*, 2007).	Mulgara has been recorded at Marillana, approximately 20km to the north east (Biologic, 2011a).There are also three records ~18km west of the Study Area from 2014 (DBCA, 2017b).	No sandy substrates exist in the Study Area (Sand Plain).	Unlikely
Chocolate Wattled Bat *Chalinolobus morio*	Locally significant	This species has a restricted distribution in the southern part of Western Australia (Churchill, 2008). Weeli Wolli Spring and Marillana Creek represent the only two locations in the Pilbara where this species has been recorded and are the most northern records for this species (McKenzie & Bullen, 2009). Given its geographic separation from the main population in Western Australia, the Pilbara population may be genetically distinct.	The species was not recorded during the current survey. The species is known from multiple records <1km north-wets of the Study Area (2014-2015) along Marillana Creek and ~15 km south of the Study Area at Weeli Wolli Creek (DBCA, 2017a). The species was recorded on two occasions by Biologic (2017) approximately 3 km south of the Study Area.	The Major Drainage Line which intersects the Study Area is a tributary of Marillana Creek – a known flyway for the species. As such the species may frequent the Study Area while foraging. However, no suitable roosting habitat is located within the Study Area.	Likely
Birds					
Curlew Sandpiper *Calidris ferruginea*	EPBC Act Critically Endangered/ Migratory, WC Act Schedule 3/ Schedule 5	The Curlew Sandpiper inhabits intertidal mudflats in sheltered coastal areas (i.e. estuaries, bays, inlets and lagoons). This rare species generally roosts on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands (DoEE, 2017b).	The nearest record is approximately 100 km south east of the Study Area from 2005 (DBCA, 2017a).	The species is rarely recorded within the region (DBCA, 2017a) and no highly suitable habitat exists in the Study Area.	Unlikely

Name	Conservation listing	Known habitat	Records within or within the vicinity of the study area	Potential habitats within the study area	Likelihood of occurrence
Night Parrot *Pezoporus occidentalis*	EPBC Act Endangered WC Act Schedule 1 IUCN Endangered	The Night Parrot prefers sandy/stony plain habitat with old-growth spinifex (*Triodia*) for roosting and nesting in conjunction with native grasses, herbs and chenopods for foraging (DPaW, 2017)	The nearest record is approximately 52 km north of the Study Area from 2005 (DBCA, 2017a).	No stony/sandy plains were documented during the current survey. It wasn't identified from the SM4 recordings.	Unlikely
Australian Painted Snipe *Rostratula australis*	EPBC Act Endangered WC Act Schedule 2	The Australian Painted Snipe generally occupies shallow terrestrial freshwater wetlands (i.e. temporary and permanent lakes, swamps and claypans) with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire (Garnett *et al.*, 2011). The Australian Painted Snipe breeding habitat requirements are quite specific; they require shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby (Garnett *et al.*, 2011).	The nearest record is approximately 55 km east of the Study Area from 2012 (DBCA, 2017b). However the species rarely recorded within the region (Knuckey *et al.*, 2013), and such records are located around the Fortescue Marsh and or coastal areas. The species is generally uncommon at inland waters of Western Australia.	This species requires suitable wetland areas even in drought conditions (DoEE, 2017b), which are not present within the Study Area.	Unlikely
Southern Giant Petrel *Macronectes giganteus*	EPBC Act Endangered, WC Act Schedule 1	The Southern Giant-Petrel is marine bird that occurs in Antarctic to subtropical waters (Garnett & Crowley, 2000)	Three records exist ~ 14 km south east of the Study Area from 2011 (DBCA, 2017b).	The species is rarely recorded within the region (DBCA, 2017a) and no highly suitable habitat exists in the Study Area.	Unlikely

Name	Conservation listing	Known habitat	Records within or within the vicinity of the study area	Potential habitats within the study area	Likelihood of occurrence
Grey Falcon *Falco hypoleucos*	WC Act Schedule 3 IUCN Vulnerable	This species appears to have a distribution centred on ephemeral or permanent drainage lines (Garnett & Crowley, 2000) with numerous records from the Fortescue Marsh region. Grey Falcons prefer sparsely-treed, open plains and drainage lines for hunting (Slater *et al.*, 2009). It favours timbered lowland plains, particularly *acacia* shrublands that are crossed by tree-lined watercourses but frequents other grassland and woodland habitats. It hunts birds, insects, and mammals, and will also feed on carrion. They nest in the abandoned nest of a raptor or corvid (Slater *et al.*, 2009) in trees or man-made structures.	Grey Falcon is mostly known from around the Fortescue Marsh, nesting in tall infrastructure such as repeater stations and powerlines (Biologic, 2011c). One record exists ~26km north of the Study Area at Koodaideri Springs from 2014 (DBCA, 2017b).	The Study Area may provide foraging habitat for this species. In particular, the Major Drainage Line and Drainage Area/ Floodplain habitats. The tall trees in Major Drainage Line habitat may provide some opportunity for nesting.	Possible

Name	Conservation listing	Known habitat	Records within or within the vicinity of the study area	Potential habitats within the study area	Likelihood of occurrence
Fork-tailed Swift *Apus pacificus*	EPBC Act Migratory WC Act Schedule 3	A migratory species that breeds in north-east and east Asia, wintering in Australia and southern New Guinea (Johnstone & Storr, 1998). The species is known to be entirely aerial within the Pilbara region and does not utilise the terrestrial surface. It would be reasonably likely to occur in the skies above the Study Area and the wider local area occasionally, possibly being attracted to thunderstorms and cyclonic systems (Johnstone & Storr, 1998).	This species has been observed flying over Marillana Camp in 2011 (Biologic, 2011d). One record (with a count of 9 individuals) has been documented 16.7 km E of the Study Area along with one record 22.6 SE of the Study Area (DBCA, 2017b).	As this species is almost entirely aerial, it is possible to occur temporarily in any part of the Study Area.	Rarely
Eastern Osprey *Pandion haliaetus*	EPBC Act Migratory WC Act Schedule 5	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands (Johnstone & Storr, 1998). They are known to travel large distances inland following drainage lines before returning to the coast.	An Osprey was recorded at Weeli Wolli springs (~15 km south) and remained in the area for a number of months (G. Swann, *pers. obs*)	Major Drainage Line habitat may be suitable for this species.	Possible
Common Greenshank *Tringa nebularia*	EPBC Act Migratory WC Act Schedule 5	The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity (BirdLife International, 2009).	Biota (2013) Recorded this species around Marillana Creek ~8km north west of the Study Area. A further two records exist around Area C West, ~ 8km west of the Study Area from 2011 (DBCA, 2017b).	The species may irregularly visit Major Drainage Line habitats within the Study Area, during periods of inundation, although would not be reliant on such habitats.	Rarely

Name	Conservation listing	Known habitat	Records within or within the vicinity of the study area	Potential habitats within the study area	Likelihood of occurrence
Oriental Plover *Charadrius veredus*	EPBC Act Migratory WC Act Schedule 3	When the Oriental Plover first arrives on Australian soil, it typically inhabits coastal habitats including estuarine mudflats and sandbanks, on sandy or rocky ocean beaches, nearby reefs, or in near-coastal grasslands. It then disperse farther inland to flat, open, semi-arid or arid grasslands, where the grass is short and sparse, and interspersed with hard, bare ground, such as claypans, dry paddocks, playing fields, lawns and cattle camps or open areas that have been recently burnt (DoEE, 2017b). Therefore, this species is unlikely to occur in the Study Area.	The nearest record is ~195km north of the Study Area from 1999 and 2005 (DBCA, 2017a).	The species is rarely recorded within the region (DBCA, 2017a) and no highly suitable habitat exists in the Study Area.	Highly Unlikely
Barn Swallow *Hirundo rustica*	EPBC Act Migratory, WC Act Schedule 5	The Barn Swallow is a non-breeding summer visitor to the Pilbara. It favours areas near water (Johnstone *et al.*, 2013).	The nearest record is ~270 km north of the Study Area from 2005 and 2014 (DBCA, 2017a).	The species is rarely recorded within the region (DBCA, 2017a) and no highly suitable habitat exists in the Study Area.	Highly Unlikely
Grey Wagtail *Motacilla cinerea*	EPBC Act Migratory, WC Act Schedule 5	The Grey Wagtail is associated with fast-flowing mountain streams and rivers with riffles and exposed rocks or shoals, often in forested areas. It is also found in more lowland watercourses and even canals (BirdLife International, 2017a).	The nearest record is ~60 km north of the Study Area from 2012 (DBCA, 2017a).	The species is rarely recorded within the region (DBCA, 2017a) and no highly suitable habitat exists in the Study Area.	Highly Unlikely

Name	Conservation listing	Known habitat	Records within or within the vicinity of the study area	Potential habitats within the study area	Likelihood of occurrence
Yellow Wagtail *Motacilla flava*	EPBC Act Migratory, WC Act Schedule 5	This species occupies a range of damp or wet habitats with low vegetation (i.e. meadows, marshes, waterside pastures, sewage farms and bogs to damp steppe and grassy tundra (BirdLife International, 2017b).	The nearest record is ~600 km north east of the Study Area from 2002 and 2003 (DBCA, 2017a).	The species is rarely recorded within the region (DBCA, 2017a) and no highly suitable habitat exists in the Study Area.	Highly Unlikely
Common Sandpiper *Actitis hypoleucos*	EPBC Act Migratory, WC Act Schedule 5	The Common sandpiper inhabits estuaries and deltas of streams, as well as banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans. The muddy margins utalised by the species are often narrow and may be steep. The species often utilises mangroves as roost sites (DoEE, 2017b).	May occur within the Study Area or within the vicinity of the Study Area (<10 km) according to DoEE (2017a). Was recorded during Yandi Mine survey (Maunsell, 2003) 2 km north of the Study Area.	The species could possibly occur as an irregularly visitor within the Major Drainage Line habitats within the Study Area during periods of inundation.	Rarely
Sharp-tailed Sandpiper *Calidris acuminata*	EPBC Act Migratory, WC Act Schedule 5	The Sharp-tailed Sandpiper is a migratory wader that frequents the Western Australian north-west during the monsoonal wet season (Johnstone *et al.*, 2013).	The nearest record is ~76 km north east of the Study Area from 2003 (DBCA, 2017a).	The species could possibly occur as an irregularly visitor within the Major Drainage Line habitats within the Study Area during periods of inundation.	Rarely
Pectoral Sandpiper *Calidris melanotos*	EPBC Act Migratory, WC Act Schedule 5	The Pectoral Sandpiper inhabits coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. It prefers wetlands with open fringing mudflats and low, emergent or fringing vegetation. Furthermore, they forage in shallow water or soft mud at the edge of wetlands (DoEE, 2017b).	The nearest record is ~95 km south east of the Study Area from 1981 (DBCA, 2017a).	The species is rarely recorded within the region (DBCA, 2017a) and no highly suitable habitat exists in the Study Area.	Unlikely

Name	Conservation listing	Known habitat	Records within or within the vicinity of the study area	Potential habitats within the study area	Likelihood of occurrence
Peregrine Falcon *Falco peregrinus*	DBCA Other specially protected fauna. WC Act Schedule 7	The Peregrine Falcon is considered rare over much of its range, including the Pilbara. In arid areas, it is most often encountered along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Johnstone & Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces and occasionally within tall trees occurring along Major Drainage Lines (Olsen & Olsen, 1989).	This species was observed within the Study Area during the targeted survey. A single peregrine Falcon was observed perched in a tree above a gorge. There are also two occurrences in the database search approximately 14 km WNW of the Study Area. There are 10 records that exits from 2011, 2012 and 2014 from 14 to 26km north west/ north of the Study Area (DBCA, 2017b).	The Study Area provides foraging habitat and Breakaway/ Cliff habitat type may provide suitable nesting locations for the species. The Breakaway/ Cliff habitat is patchy in the north-west, around the Major Drainage Line (runs north-east to south-west in the central portion of the Study Area).	Confirmed
Reptiles					
Pilbara Olive Python *Liasis olivaceus barroni*	EPBC Act Vulnerable WC Act Schedule 1	This species is primarily nocturnal and tends to shelter in small caves or under vegetation during the day, although it is occasionally active after sunrise, particularly in the warmer summer months (DSEWPaC, 2013). In the winter months, adult pythons can sometimes be found basking in the morning sun (Pearson, 2001 in (DSEWPaC, 2013)). The breeding season of the Pilbara Olive Python extends from June to August, when males will travel up three kilometres in search of a mate (DSEWPaC, 2013).	Maunsell (2003) have recorded two scats belonging to Pilbara Olive Python; one ~3km north of the east portion of the Study Area and one ~4km north west of the eastern portion of the Study Area Biologic (2011d) also recorded secondary evidence of this species approximately 3 km north east of the Study Area. According to DBCA (2017b) another twenty records exist within 25km of the Study Area., the nearest of which is 4.35 km north.	The Gorge/ Gully habitat and Breakaway/ Cliff habitat types may provide suitable habitat for the species, especially where water features are present. The Breakaway/ Cliff habitat is patchy in the north-west, around the Major Drainage Line (runs north-east to south-west in the central portion of the Study Area) and floodplain area in the south-eastern portion of the Study Area. Gorge/ Gully habitat is also present in the north-western and south-eastern sections of the Study.	Likely

Name	Conservation listing	Known habitat	Records within or within the vicinity of the study area	Potential habitats within the study area	Likelihood of occurrence
Pilbara Flat-headed Blindsnake *Anilios ganei*	DBCA Priority 1	Given the Pilbara Flat-headed Blindsnake has a cryptic fossorial habit, this species is rarely encountered. Little is known of this species' ecology but like most other blind snakes, it is insectivorous, feeding on termites and their eggs, and larvae and pupae of ants (Wilson & Swan, 2014). The Pilbara Flat-headed Blindsnake is associated with moist gorges and gullies (Wilson & Swan, 2014), and potentially with a wide range of other stony habitats.	During the (Biologic, 2011c) survey it was recorded at two locations (17 km south of the study area), a very rocky slope below the vertical wall of a gully and also in Mulga woodland habitat, showing that the species is not necessarily restricted to gorges and gully systems. One record exists ~17 km south of the Study Area form 2006 (DBCA, 2017b).	May occur in all habitat types in the Study Area, in particular Gorge/ Gully and Hillcrest/ Hillslope.	Likely
Pilbara Barking Gecko *Underwoodisaurus seorsus*	DBCA Priority 2	Despite extensive survey effort within the region in recent years this species has only been found at a small number of sites. It has been encountered in rocky areas of the Hamersley Range. They have also been observed at the bottom of a rocky gorge with a low tree cover and in vegetation consisting of low sparse trees of *Eucalyptus leucophloia*, low shrubs of *Acacia pilbara* and *Triodia wiseana* (Doughty & Oliver, 2011).	According to DBCA (2017b). four records exist ~20 km south west of the Study area from 2004. A further two exist ~23km south of the Study Area from 2011 (DBCA, 2017b).	This species has the potential to occur in Gorge/ Gully and Breakaway/ Cliff Habitat within the Study Area. It is also likely to occur within the Hillcrest/ Hillslope habitat.	Likely

Name	Conservation listing	Known habitat	Records within or within the vicinity of the study area	Potential habitats within the study area	Likelihood of occurrence
Ctenotus uber subsp. *johnstonei*	DBCA Priority 2	Little is known of this taxon, and its taxonomic status is uncertain. Specimens from the Pilbara may be grouped with *Ctenotus uber* subsp. *johnstonei*, or they may belong to an undescribed taxon, in which case they would have no official conservation status. As a precautionary approach, the Pilbara taxon is treated as the Priority 2 subspecies. Within the Pilbara, the taxon is known from Triodia on hillslopes, *Acacia xiphophylla* over chenopods, and *Acacia xiphophylla* scattered tall shrubs to high open shrubland (ENV 2004).	A number of records have been made at BHP's Dynasty tenement approximately 90km to the south (Biologic, 2018a).	Most of the records for this species in the south and central Pilbara occur within Mulga woodlands (Biologic, 2018a), which are not found within this Study Area.	Unlikely

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

Legend

- Study Area
- Peregrine Falcon - Individual (alive)
- Western Pebble-mound Mouse - Mound (active)
- Western Pebble-mound Mouse - Mound (recently inactive)
- Western Pebble-mound Mouse - Mound (inactive)

biologic Environmental Survey

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BHP - Ministers North to Yandi Corridor

SRE Invertebrate Fauna Survey

Fig. 4.1: Conservation significant fauna recorded in the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 17/09/2018

4.4 Fauna Habitats

Seven fauna habitat types were identified within the Study Area: Basalt Outcrop, Breakaway/ Cliff, Gorge/ Gully, Hillcrest/ Hillslope, Major Drainage Line, Minor Drainage Line and Drainage Area/ Floodplain (Figure 4.2, Table 4.4). Hillcrest/ Hillslopes is the most common habitat within the Study Area, while the least common fauna habitat types were the Major Drainage Line, Breakaway/ Cliff (small areas located in the north-western, central and south-eastern portions of the Study Area), Gorge/ Gully (small areas located in the north-western and south-eastern portions of the Study Area), Basalt Outcrops and Minor Drainage Lines (Table 4.4). Only two habitat assessment sites in the north-western portion of the Study Area (within Hillcrest/ Hillslope habitat) exhibited signs of cattle grazing.

Fauna habitat types of the Study Area considered most likely to support conservation significant species were the Gorge/Gully and Major Drainage Line habitats. Major Drainage Line habitat may provide potential habitat for migratory water birds at any persistent pools following rainfall, as well as breeding, foraging, and dispersal opportunities for species such as Peregrine Falcons and Pilbara Flat-Headed Blind Snake; however, these habitats are not restricted to the Study Area and exist widely across the Pilbara.

4.5 Habitat Features

Thirteen water features were recorded during the surveys (Figure 4.2, Appendix D). Most of the water features were recorded in the second survey after a large rainfall event (83 mm recorded seven days prior). All thirteen represent potential foraging habitat, at least seasonally, for the Pilbara Olive Python. The water feature considered most important was a semi-permanent river pool (MNY-WB-02), which was recorded in the north-western portion of the Study Area and considered likely to hold water for most of the year. MNY-WB02 measured 3 m wide, 15 m long and ~1 m deep, and was fringed with *Typha* spp. (reeds). This water feature provides potential habitat and a resources to species of conservation significance, and other fauna, for most of the year.

Water sources are a limiting factor for many ecosystems (James *et al.*, 1995), particularly within arid-zone ecosystems such as the Pilbara (Burbidge *et al.*, 2010; Doughty *et al.*, 2011); and often represent areas of comparatively high productivity (Murray *et al.*, 2003). While temporary water sources may be abundant during and following the wet season, important features are those which provide resources for most of the year. These features were highlighted because they may provide important sources of shelter, food and water for species of conservation significance.

Four caves and overhangs were recorded within the Study Area, with a further two recorded just outside. Such features were highlighted because they may support species of conservation significance such as the Ghost Bat. No evidence of the Ghost Bat or Pilbara Leaf-nosed Bat was recorded from any of the caves, however they were deemed as potential feeding roosts as they possessed features similar to that of known feeding sites being deep, dark and with a stable microclimate (Armstrong, 2000; Armstrong & Anstee, 2000) (Figure 4.2, Appendix E).

Table 4.4: Description of fauna habitats within the Study Area

Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
Hillcrests/ slopes 1603 ha 76.66%	These fauna habitats tend to be more open and structurally simple than other fauna habitats and are dominated by varying species of spinifex. Common features of these habitats are rocky substrates, often with exposed bedrock, and skeletal red soils. This habitat is usually dominated by *Eucalyptus* woodlands, *Acacia* and *Grevillea* scrublands and *Triodia* low hummock grasslands.	Very extensive and widely distributed. The most common fauna habitat within the Study Area.	Very extensive in the region, occurring wherever there are ridges and low rises.	
Drainage Area/ Floodplain 261 ha 12.50%	Drainage area/ Floodplain habitat tends to be associated with rivers and major drainage lines having wide valley floors. They usually have alluvial sands or clay loams supporting open to sparse low woodlands and shrublands over grasses. Often dominated by Buffel grass.	Moderately extensive within the south-eastern half of the Study Area associated with the major drainage line valleys, and accounting for a moderate proportion of the Study Area.	Moderately extensive along major rivers and creeks. The Fortescue Marsh is the most extensive form or this habitat within the wider region.	

Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
Minor Drainage Line 72 ha 3.43%	Characterised by low and sparse vegetation compared to Major Drainage Lines. Consisted of *Acacia* low woodland sometimes with scattered *Eucalyptus xerothermica* and *Corymbia hamersleyana*. The understorey generally lack density and often consists solely of sparse tussock grassland, often of **Cenchrus ciliaris* where it has been introduced. The substrate can be sandy in places but generally consists of a loam gravel or stone.	Minor Drainage Lines run throughout the Study Area, particularly through the central section. Represents a small proportion of the Study Area.	A common habitat in the Hamersley Range and adjacent to the Study Area.	
Basalt Outcrops 41 ha 1.98%	This habitat occurs where the surrounding material has eroded, exposing large rock faces and boulders piles. The fine crystalline structure of basalt tends to fracture in straight plains providing excellent crevices and cracks for a wide range of reptile and mammal fauna. Vegetation is sparse through these areas due to the lack or paucity of soil availability.	Small proportion of this habitat occurs within the central portion of the Study Area associated with hillcrest and slopes.	A reasonably common habitat, patchily distributed through the Pilbara, more prevalent in the north. They tend to be isolated features in the landscape varying in size, height and connectivity thus some patches could be considered more important than others.	

Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
Gorge/ Gully 40 ha 1.92%	Gorges and gullies are rugged, steep-sided valleys incised into the surrounding landscape. Gorges tend to be deeply incised, with vertical cliff faces, while gullies are more open (but not as open as Drainage Area or Valleys). Caves and rock pools are most often encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred.	Run along Minor Drainage Lines within the north-west and south-east portions of the. Absent from the central portion dominated by a major drainage line which is a tributary of Yandi Creek. Representing a small proportion of the total land area of the Study Area.	These are minor/uncommon habitats associated with minor drainage lines.	
Major Drainage Line 37 ha 1.78%	Major Drainage Lines comprise mature River Red Gums/ Coolabahs over dry river pools. Open, sandy or gravelly riverbeds characterise this habitat type. In non-grazed areas, the vegetation adjacent to the main channel or channels is denser, taller and more diverse than adjacent terrain.	The Major Drainage Line within the Study Area runs south-west to north-east bisecting the approximate centre of the Study Area. Covers a relatively small proportion.	Common habitat throughout the Pilbara and are generally associated with all major rivers in the Pilbara, such as the Fortescue, De Grey, Yule and Turner rivers. However, because they tend to be relatively narrow, linear features, they only represent a small proportion of the total land area. Water presence can be as episodic flows, temporary, or permanent pools.	

Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
Breakaway/ Cliff 36 ha 1.73%	Breakaways and Cliffs tend to be more open and structurally simple due to their recent depositional history than other fauna habitats and are dominated by varying species of spinifex. A common feature of these habitats is a rocky substrate, often with exposed bedrock, and skeletal red soils. These are usually dominated by *Eucalyptus* woodlands, Acacia and Grevillea scrublands and *Triodia* spp. low hummock grasslands.	Uncommon, generally patchy and sparsely distributed in several areas throughout the Study Area associated with hillcrests.	Extensive areas of Crest/Slope habitat occur throughout the Hamersley Range Sub-bioregion, and wider the Pilbara.	

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

Legend

Study Area

Habitat Feature

Cave

Waterhole

Fauna Habitats

Basalt Outcrops

Breakaway/ Cliff

Drainage Area/ Floodplain

Gorge/ Gully

Hillcrest/ Hillslope

Major Drainage Line

Minor Drainage Line

biologic Environmental Survey

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BHP - Ministers North to Yandi Corridor

SRE Invertebrate Fauna Survey

Fig. 4.2: Fauna habitats within the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 17/09/2018

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Appendix A Conservation listings

International Union for Conservation of Nature

Category	Definition
Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (CR)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases, great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Extinct (EX)	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild (EW)	Taxa known to survive only in captivity.
Critically Endangered (CE)	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (EN)	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild in the medium-term future.
Migratory (MG)	Consists of species listed under the following International Conventions: Japan-Australia Migratory Bird Agreement (JAMBA) China-Australia Migratory Bird Agreement (CAMBA) Convention on the Conservation of Migratory Species of Wild animals (Bonn Convention)

Wildlife Conservation Act 1950

Category	Definition
Schedule 1 (S1)	Rare or likely to become extinct, as *critically endangered* fauna.
Schedule 2 (S2)	Rare or likely to become extinct, as *endangered* fauna.
Schedule 3 (S3)	Rare or likely to become extinct, as *vulnerable* fauna.
Schedule 4 (S4)	Being fauna that is presumed to be extinct.
Schedule 5 (S5)	Birds that are subject to international agreements relating to the protection of migratory birds.
Schedule 6 (S6)	Special conservation need being species dependent on ongoing conservation intervention.
Schedule 7 (S7)	In need of special protection, otherwise than for the reasons pertaining to Schedule 1 through to Schedule 6 Fauna.

Department of Biodiversity, Conservation and Attractions Priority codes

Category	Definition
Priority 1 (P1)	Taxa with few, poorly known populations on threatened lands.
Priority 2 (P2)	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3 (P3)	Taxa with several, poorly known populations, some on conservation lands.
Priority 4 (P4)	Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection but could be if present circumstances change.

Appendix B Vertebrate fauna during the database assessment

Mammals

Species	Common name	Conservation Status				Databases			Previous Reports								
		EPBC	WCA	DBCA	IUCN	DoEE	NatureMap	DBCA Threatened and Protected Fauna	Yandi Life of Mine Flora and Fauna (Maunsell Australia 2003)	Yandi Vertebrate Fauna Review (Biologic 2011a)	Area C to Yandi Fauna Survey (Biologic 2011e)	Ministers North Level 2 Vertebrate Fauna Survey (Biologic 2017)	Yandicoogina Junction South West and Oxbow Fauna Survey (Biota 2010)	Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota 2013)	Ministers North Biological Survey (ecologia 2006)	Munjina and Ministers North (Yandi Hub) Fauna Assessment (ENV 2009)	Marillana Creek Western Access Corridor Biological Assessment (Maunsell 1999)
TACHYGLOSSIDAE																	
Tachyglossus aculeatus	Echidna						●										
DASYURIDAE																	
Dasycercus blythi	Brush-tailed Mulgara			P4			●	●									
Dasykaluta rosamondae	Little Red Kaluta						●							●		●	
Dasyurus hallucatus	Northern Quoll	EN	S2		EN	●	●	●									
Ningaui ridei	Wongai Ningaui						●										
Ningaui timealeyi	Pilbara Ningaui						●					●	●	●		●	
Planigale ingrami	Long-tailed Planigale						●							●		●	
Planigale maculata	Common Planigale						●										
Pseudantechinus woolleyae	Woolley's Pseudantechinus						●				●						
Sminthopsis hirtipes	Hairy-footed Dunnart						●										
Sminthopsis macroura	Stripe-faced Dunnart						●							●			
Sminthopsis ooldea	Ooldea Dunnart						●										
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart						●										
THYLACOMYIDAE																	
Macrotis lagotis	Bilby, Dalgyte	VU	S3		VU	L	●										
MACROPODIDAE																	
Osphranter robustus subsp. erubescens	Euro, Biggada						●		●	●	●	●		●	●	●	●
Osphranter rufus	Red Kangaroo, Marlu						●									●	●
Petrogale rothschildi	Rothschild's Rock-wallaby						●			●	●			●			
Petrogale sp.	Rock-wallaby						●										
MEGADERMATIDAE																	
Macroderma gigas	Ghost Bat	VU	S3		VU	L	●	●			●						
HIPPOSIDERIDAE																	
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	S3			●	●	●						●			
EMBALLONURIDAE																	
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat						●			●	●	●		●		●	
Taphozous georgianus	Common Sheathtail-bat						●				●	●		●	●	●	
Taphozous hilli	Hill's Sheathtail-bat						●							●			
MOLOSSIDAE																	
Chaerephon jobensis subsp. colonicus	Northern Freetail-bat						●				●	●		●	●	●	
Ozimops lumsdenae	Northern (Beccari's) Free-tailed Bat						●					●		●		●	

Species	Common name	Conservation Status				Databases			Previous Reports								
		EPBC	WCA	DBCA	IUCN	DoEE	NatureMap	DBCA Threatened and Protected Fauna	Yandi Life of Mine Flora and Fauna (Maunsell Australia 2003)	Yandi Vertebrate Fauna Review (Biologic 2011a)	Area C to Yandi Fauna Survey (Biologic 2011e)	Ministers North Level 2 Vertebrate Fauna Survey (Biologic 2017)	Yandicoogina Junction South West and Oxbow Fauna Survey (Biota 2010)	Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota 2013)	Ministers North Biological Survey (ecologia 2006)	Munjina and Ministers North (Yandi Hub) Fauna Assessment (ENV 2009)	Marillana Creek Western Access Corridor Biological Assessment (Maunsell 1999)
Austronomus australis	White-striped Freetail-bat										•			•			
VESPERTILIONIDAE																	
Chalinolobus gouldii	Gould's Wattled Bat						•			•	•	•		•	•	•	
Chalinolobus morio	Chocolate Wattled Bat						•					•		•			
Nyctophilus daedalus	Northern Long-eared Bat						•							•	•		
Nyctophilus geoffroyi	Lesser Long-eared Bat						•				•	•		•	•	•	
Scotorepens greyii	Little Broad-nosed Bat						•			•	•	•		•	•	•	
Vespadelus finlaysoni	Finlayson's Cave Bat						•				•	•		•	•	•	
MURIDAE																	
**Mus musculus*	House Mouse					L	•					•				•	
Notomys alexis	Spinifex Hopping-mouse						•										
Leggadina lakedownensis	Short-tailed Mouse			P4			•										
Pseudomys chapmani	Western Pebble-mound Mouse			P4			•	•	•	•	•	•	•	•	•	•	•
Pseudomys delicatulus	Delicate Mouse						•										
Pseudomys desertor	Desert Mouse						•					•		•			
Pseudomys hermannsburgensis	Sandy Inland Mouse						•					•	•	•		•	
Pseudomys nanus	Western Chestnut Mouse						•										
Zyzomys argurus	Common Rock-rat						•						•	•		•	
Zyzomys woodwardi	Kimberley Rock-rat						•										
BOVIDAE																	
**Bos taurus*	European Cattle						•		•		•		•	•		•	
**Bubalus bubalis*	Water Buffalo						•										
CAMELIDAE																	
**Camelus dromedarius*	Camel					L	•							•		•	
CANIDAE																	
**Canis familiaris*	Dog						•			•				•		•	•
**Vulpes vulpes*	Red Fox					L										•	
FELIDAE																	
**Felis catus*	Cat					L	•		•		•	•				•	•
EQUIDAE																	
**Equus asinus*	Donkey					L	•			•	•		•				
**Equus caballus*	Horse					L	•							•			
**Oryctolagus cuniculus*	Rabbit					L	•										

Birds

Species	Common name	Conservation Status				Database Searches				Previous Reports								
		EPBC	WCA	DBCA	IUCN	DoEE	NatureMap	DBCA Threatened and Protected Fauna	Birdlife Birdata	Yandi Life of Mine Flora and Fauna (Maunsell Australia 2003)	Yandi Vertebrate Fauna Review (Biologic 2011a)	Area C to Yandi Fauna Survey (Biologic 2011e)	Ministers North Level 2 Vertebrate Fauna Survey (Biologic 2017)	Yandicoogina Junction South West and Oxbow Fauna Survey (Biota 2010)	Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota 2013)	Ministers North Biological Survey (ecologia 2006)	Munjina and Ministers North (Yandi Hub) Fauna Assessment (ENV 2009)	Marillana Creek Western Access Corridor Biological Assessment (Maunsell 1999)
ACANTHIZIDAE																		
Acanthiza apicalis	Inland Thornbill						•		•						•			•
Acanthiza chrysorrhoa	Yellow-rumped Thornbill						•		•									
Acanthiza robustirostris	Slaty-backed Thornbill						•		•									
Acanthiza uropygialis	Chestnut-rumped Thornbill						•		•								•	
Aphelocephala leucopsis	Southern Whiteface						•		•									
Gerygone fusca	Western Gerygone						•		•	•	•	•		•	•		•	•
Pyrrholaemus brunneus	Redthroat						•		•									
Smicrornis brevirostris	Weebill						•		•	•	•	•	•	•	•	•	•	•
ACCIPITRIDAE																		
Aquila audax	Wedge-tailed Eagle						•		•						•		•	
Accipiter cirrocephalus	Collared Sparrowhawk						•		•			•					•	
Accipiter fasciatus	Brown Goshawk	MA					•		•		•		•		•			
Circus approximans	Swamp Harrier	MA					•											
Circus assimilis	Spotted Harrier						•		•				•		•		•	
Elanus caeruleus subsp. axillaris	Black-shouldered Kite						•		•								•	
Haliastur sphenurus	Whistling Kite	MA					•		•		•	•	•	•	•		•	
Hamirostra isura	Square-tailed Kite						•		•									
Hamirostra melanosternon	Black-breasted Buzzard						•		•								•	
Hieraaetus morphnoides	Little Eagle						•		•				•	•				
Milvus migrans	Black Kite						•		•		•		•		•		•	
Pandion haliaetus	Eastern Osprey	IA	S5				•											
ACROCEPHALIDAE																		
Acrocephalus australis	Australian Reed-Warbler						•		•	•	•				•			
AEGOTHELIDAE																		
Aegotheles cristatus	Australian Owlet-nightjar						•		•	•	•		•		•	•	•	•
ALAUDIDAE																		
Mirafra javanica	Horsfield's Bushlark						•		•						•			
ALCEDINIDAE																		
Dacelo leachii subsp. leachii	Blue-winged Kookaburra						•		•	•	•	•	•	•	•			
Todiramphus pyrrhopygius	Red-backed Kingfisher						•		•	•		•	•	•	•			
Todiramphus sanctus	Sacred Kingfisher						•		•		•		•		•		•	•

Species	Common name	Conservation Status				Database Searches				Previous Reports								
		EPBC	WCA	DBCA	IUCN	DoEE	NatureMap	DBCA Threatened and Protected Fauna	Birdlife Birdata	Yandi Life of Mine Flora and Fauna (Maunsell Australia 2003)	Yandi Vertebrate Fauna Review (Biologic 2011a)	Area C to Yandi Fauna Survey (Biologic 2011e)	Ministers North Level 2 Vertebrate Fauna Survey (Biologic 2017)	Yandicoogina Junction South West and Oxbow Fauna Survey (Biota 2010)	Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota 2013)	Ministers North Biological Survey (ecologia 2006)	Munjina and Ministers North (Yandi Hub) Fauna Assessment (ENV 2009)	Marillana Creek Western Access Corridor Biological Assessment (Maunsell 1999)
ANATIDAE																		
Anas gracilis	Grey Teal													•				
Anas superciliosa	Pacific Black Duck						•		•	•	•	•			•			
Dendrocygna eytoni	Plumed Whistling-duck						•		•									
ANHINGIDAE																		
Anhinga novaehollandiae	Australasian Darter						•		•						•			
APODIDAE																		
Apus pacificus	Fork-tailed Swift	MG	S5			L	•	•			•							
ARDEIDAE																		
Ardea ibis	Cattle Egret					M												
Ardea modesta	Eastern Great Egret					L	•	•										
Ardea novaehollandiae	White-faced Heron						•		•		•				•			
Ardea pacifica	White-necked Heron						•		•			•						
Nycticorax caledonicus subsp. australasiae	Nankeen Night-Heron	MA					•								•			
ARTAMIDAE																		
Artamus cyanopterus	Dusky Woodswallow												•					
Artamus cinereus	Black-faced Woodswallow						•		•	•	•	•	•	•	•	•	•	•
Artamus leucorynchus	White-breasted Woodswallow						•											
Artamus minor	Little Woodswallow						•		•	•	•	•	•	•	•	•	•	
Artamus personatus	Masked Woodswallow						•		•					•	•	•		•
Cracticus nigrogularis	Pied Butcherbird						•		•	•	•	•	•		•	•	•	•
Cracticus tibicen	Australian Magpie						•		•	•	•	•	•		•		•	•
Cracticus tibicen subsp. dorsalis	White-backed magpie						•											
Cracticus tibicen subsp. tibicen	Black-backed Magpie						•											
Cracticus torquatus	Grey Butcherbird						•		•				•				•	
BURHINIDAE																		
Burhinus grallarius	Bush Stone-curlew						•											
CACATUIDAE																		
Cacatua roseicapilla	Galah						•		•	•			•		•		•	
Cacatua sanguinea	Little Corella						•		•	•	•			•	•		•	•
Nymphicus hollandicus	Cockatiel						•		•						•		•	
CAMPEPHAGIDAE																		

Species	Common name	Conservation Status				Database Searches				Previous Reports								
		EPBC	WCA	DBCA	IUCN	DoEE	NatureMap	DBCA Threatened and Protected Fauna	Birdlife Birdata	Yandi Life of Mine Flora and Fauna (Maunsell Australia 2003)	Yandi Vertebrate Fauna Review (Biologic 2011a)	Area C to Yandi Fauna Survey (Biologic 2011e)	Ministers North Level 2 Vertebrate Fauna Survey (Biologic 2017)	Yandicoogina Junction South West and Oxbow Fauna Survey (Biota 2010)	Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota 2013)	Ministers North Biological Survey (ecologia 2006)	Munjina and Ministers North (Yandi Hub) Fauna Assessment (ENV 2009)	Marillana Creek Western Access Corridor Biological Assessment (Maunsell 1999)
Coracina maxima	Ground Cuckoo-shrike						•		•				•		•		•	
Coracina novaehollandiae subsp. subpallida	Black-faced Cuckoo-shrike	MA					•		•	•	•	•	•	•	•	•	•	•
Lalage tricolor	White-winged Triller						•		•	•	•				•	•	•	•
CAPRIMULGIDAE																		
Eurostopodus argus	Spotted Nightjar	MA					•		•	•	•		•		•	•	•	
CASUARIIDAE																		
Dromaius novaehollandiae	Emu						•		•	•					•		•	
CHARADRIIDAE																		
Charadrius veredus	Oriental Plover	MG	S5			M												
Elseyornis melanops	Black-fronted Dotterel						•		•	•	•				•			
Erythrogonys cinctus	Red-kneed Dotterel						•											
COLUMBIDAE																		
Geopelia cuneata	Diamond Dove						•		•	•			•	•	•	•		•
Geopelia striata	Zebra Dove						•											
Geopelia striata subsp. placida	Peaceful Dove						•		•	•	•	•	•	•		•	•	
Geophaps plumifera subsp. ferruginea	Spinifex Pigeon						•		•	•	•	•	•	•	•	•	•	•
Ocyphaps lophotes	Crested Pigeon						•		•	•	•	•	•	•	•	•	•	•
Phaps chalcoptera	Common Bronzewing						•		•	•	•	•	•		•	•	•	
CORVIDAE																		
Corvus bennetti	Little Crow						•		•					•				
Corvus coronoides	Australian Raven						•											
Corvus orru subsp. cecilae	Torresian Crow						•		•	•	•	•	•	•	•	•	•	•
Corvus splendens	House Crow						•											
CUCULIDAE																		
Cacomantis pallidus	Pallid Cuckoo	MA					•		•							•		•
Centropus phasianinus subsp. highami	Pheasant Coucal						•		•					•				
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo	MA					•		•	•				•	•	•		
Chrysococcyx osculans	Black-eared Cuckoo	MA					•		•									•
DICAEIDAE																		
Dicaeum hirundinaceum	Mistletoebird						•		•	•						•	•	
ESTRILDIDAE																		

Species	Common name	Conservation Status				Database Searches				Previous Reports								
		EPBC	WCA	DBCA	IUCN	DoEE	NatureMap	DBCA Threatened and Protected Fauna	Birdlife Birdata	Yandi Life of Mine Flora and Fauna (Maunsell Australia 2003)	Yandi Vertebrate Fauna Review (Biologic 2011a)	Area C to Yandi Fauna Survey (Biologic 2011e)	Ministers North Level 2 Vertebrate Fauna Survey (Biologic 2017)	Yandicoogina Junction South West and Oxbow Fauna Survey (Biota 2010)	Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota 2013)	Ministers North Biological Survey (ecologia 2006)	Munjina and Ministers North (Yandi Hub) Fauna Assessment (ENV 2009)	Marillana Creek Western Access Corridor Biological Assessment (Maunsell 1999)
Emblema pictum	Painted Finch						•		•	•	•	•	•	•	•	•	•	
Neochmia ruficauda subsp. subclarescens	Star Finch (Western)								.		•	•		•				
Taeniopygia guttata subsp. castanotis	Zebra Finch						•		•	•	•	•	•	•	•	•	•	•
FALCONIDAE																		
Falco berigora	Brown Falcon						•		•	•	•	•	•		•	•	•	
Falco cenchroides	Nankeen Kestrel	MA							•	•			•	•	•		•	•
Falco hypoleucos	Grey Falcon		S3		VU		•	•										
Falco longipennis	Australian Hobby						•		•	•					•		•	•
Falco peregrinus	Peregrine Falcon		S7				•	•	•						•			
HIRUNDINIDAE																		
Hirundo rustica	Barn Swallow	MG	S5			M												
Petrochelidon ariel	Fairy Martin						•		•						•		•	
Petrochelidon nigricans	Tree Martin						•		•			•		•	•			
LOCUSTELLIDAE																		
Megalurus cruralis	Brown Songlark								•						•		•	
Megalurus mathewsi	Rufous Songlark								•	•	•			•	•		•	
Eremiornis carteri	Spinifexbird						•		•	•		•	•		•	•	•	
MALURIDAE																		
Amytornis striatus subsp. whitei	Striated Grasswren						•.		•	•		•				•		
Amytornis striatus subsp. striatus	Striated Grasswren							•										
Malurus lamberti subsp. assimilis	Variegated Fairy-wren						•		•	•		•	•	•	•	•	•	•
Malurus leucopterus subsp. leuconotus	White-winged Fairy-wren						•		•.	•		•	•		•			
Malurus splendens	Splendid Fairy-wren						•		•									
Stipiturus ruficeps	Rufous-crowned Emu-wren						•		•	•		•						
MEGALURIDAE																		
Megalurus timoriensis	Little Grassbird											•						
MELIPHAGIDAE																		
Acanthagenys rufogularis	Spiny-cheeked Honeyeater						•		•	•				•	•	•	•	
Certhionyx variegatus	Pied Honeyeater						•		•									
Conopophila whitei	Grey Honeyeater						•		•									
Epthianura tricolor	Crimson Chat						•		•	•					•	•		
Gavicalis virescens	Singing Honeyeater						•		•	•	•	•	•	•	•		•	•

Species	Common name	Conservation Status				Database Searches				Previous Reports								
		EPBC	WCA	DBCA	IUCN	DoEE	NatureMap	DBCA Threatened and Protected Fauna	Birdlife Birdata	Yandi Life of Mine Flora and Fauna (Maunsell Australia 2003)	Yandi Vertebrate Fauna Review (Biologic 2011a)	Area C to Yandi Fauna Survey (Biologic 2011e)	Ministers North Level 2 Vertebrate Fauna Survey (Biologic 2017)	Yandicoogina Junction South West and Oxbow Fauna Survey (Biota 2010)	Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota 2013)	Ministers North Biological Survey (ecologia 2006)	Munjina and Ministers North (Yandi Hub) Fauna Assessment (ENV 2009)	Marillana Creek Western Access Corridor Biological Assessment (Maunsell 1999)
Lichmera indistincta	Brown Honeyeater						•		•	•				•	•	•	•	•
Manorina flavigula	Yellow-throated Miner						•		•	•	•	•	•	•	•	•	•	•
Melithreptus gularis subsp. *laetior*	Black-chinned Honeyeater						•		•	•	•	•			•		•	
Ptilotula keartlandi	Grey-headed Honeyeater						•		•	•	•	•	•	•	•	•		
Ptilotula pencillata	White-plumed Honeyeater								•	•	•	•	•	•	•		•	•
Ptilotula plumula	Grey-fronted Honeyeater								•				•					
Purnella albifrons	White-fronted Honeyeater						•											
Sugomel niger	Black Honeyeater								•						•			
MEROPIDAE																		
Merops ornatus	Rainbow Bee-eater					M	•	•	•	•	•	•	•	•	•	•	•	•
MONARCHIDAE																		
Grallina cyanoleuca	Magpie-lark	MA					•		•	•	•	•	•	•	•		•	•
MOTACILLIDAE																		
Anthus australis subsp. australis	Australasian Pipit						•.		•						•			•
Motacilla flava	Yellow Wagtail	MG	S5			M												
Motacilla cinerea	Grey Wagtail	MG	S5			M												
OTIDIDAE																		
Ardeotis australis	Australian Bustard						•		•		•	•	•		•		•	•
PACHYCEPHALIDAE																		
Colluricincla harmonica subsp. rufiventris	Grey Shrike-thrush						•		•	•	•	•	•	•	•		•	•
Oreoica gutturalis	Crested Bellbird						•		•	•	•			•	•	•	•	•
Pachycephala rufiventris subsp. rufiventris	Rufous Whistler						•		•	•	•	•	•	•			•	•
PARDALOTIDAE																		
Pardalotus rubricatus	Red-browed Pardalote						•		•	•		•	•	•	•	•		
Pardalotus striatus subsp. murchisoni	Striated Pardalote						•		•.	•		•	•	•	•	•		•
PELECANIDAE																		
Pelecanus conspicillatus	Australian Pelican	MA					•		•						•			
PETROICIDAE																		
Melanodryas cucullata	Hooded Robin						•		•	•	•	•	•	•	•	•	•	•
Petroica goodenovii	Red-capped Robin						•		•						•			•
PHALACROCORACIDAE																		
Phalacrocorax melanoleucos	Little Pied Cormorant										•			•				

Species	Common name	Conservation Status				Database Searches				Previous Reports								
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Phalacrocorax sulcirostris	Little Black Cormorant						•		•		•							
Phalacrocorax varius subsp. hypoleucos	Pied Cormorant						•								•			
PHASIANIDAE																		
Coturnix pectoralis	Stubble Quail	MA												•				
Coturnix ypsilophora	Brown Quail						•		•				•				•	
PODARGIDAE																		
Podargus strigoides	Tawny Frogmouth						•		•			•			•	•		
POMATOSTOMIDAE																		
Pomatostomus superciliosus	White-browed Babbler						•		•								•	•
Pomatostomus temporalis subsp. rubeculus	Grey-crowned Babbler						•		•	•	•	•	•	•	•	•	•	
PROCELLARIIDAE																		
Macronectes giganteus	Southern Giant Petrel	EN/MI	S5				•	•										
PSITTACIDAE																		
Melopsittacus undulatus	Budgerigar						•		•				•		•	•		•
Neopsephotus bourkii	Bourke's Parrot						•		•								•	
Pezoporus occidentalis	Night Parrot	EN	S1		EN	L												
Platycercus zonarius subsp. zonarius	Port Lincoln Parrot						•		•	•	•	•	•	•	•	•	•	•
Psephotus varius	Mulga Parrot						•		•									
PSOPHODIDAE																		
Cinclosoma castaneothorax	Chestnut-breasted Quail-thrush						•		•									
Psophodes occidentalis	Chiming Wedgebill						•		•									
PTILINORHYNCHIDAE																		
Ptilonorhynchus maculatus subsp. guttatus	Western Bowerbird						•		•	•	•		•		•	•	•	•
Ptilonorhynchus nuchalis subsp. nuchalis	Great Bowerbird						•											
RALLIDAE																		
Gallirallus philippensis	Buff-banded Rail	MA							•									
Porphyrio porphyrio	Purple Swamphen						•											
Porzana tabuensis	Spotless Crake	MA					•											
RECURVIROSTRIDAE																		
Himantopus himantopus	Black-winged Stilt	MA					•		•									
RHIPIDURIDAE																		

Species	Common name	Conservation Status				Database Searches				Previous Reports								
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Rhipidura albiscapa	Grey Fantail						•		•			•			•		•	
Rhipidura leucophrys subsp. leucophrys	Willie Wagtail						•		•	•	•	•	•	•	•	•	•	•
ROSTRATULIDAE																		
Rostratula benghalensis subsp. australis	Australian Painted Snipe	EN	S2		EN	M												
SCOLOPACIDAE																		
Calidris acuminata	Sharp-tailed Sandpiper	MG	S5			M												
Calidris ferruginea	Curlew Sandpiper	CR/MG	S3/5			M												
Calidris melanotos	Pectoral Sandpiper	MG	S5			M												
Tringa hypoleucos	Common Sandpiper	MG	S5			M				•								
Tringa nebularia	Common Greenshank	MG	S5				•	•							•			
STRIGIDAE																		
Ninox boobook	Boobook Owl								•		•		•		•		•	
Ninox connivens	Barking Owl						•			•					•			
THRESKIORNITHIDAE																		
Threskiornis spinicollis	Straw-necked Ibis	MA					•		•									
TURNICIDAE																		
Turnix velox	Little Button-quail						•		•						•		•	•
TYTONIDAE																		
Tyto alba	Barn Owl						•		•								•	

Reptiles

Species	Common name	Conservation Status				Database Searches			Previous Reports								
		EPBC	WCA	DBCA	IUCN	DoEE	NatureMap	DBCA Threatened and Protected Fauna	Yandi Life of Mine Flora and Fauna (Maunsell Australia 2003)	Yandi Vertebrate Fauna Review (Biologic 2011a)	Area C to Yandi Fauna Survey (Biologic 2011e)	Ministers North Level 2 Vertebrate Fauna Survey (Biologic 2017)	Yandicoogina Junction South West and Oxbow Fauna Survey (Biota 2010)	Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota 2013)	Ministers North Biological Survey (ecologia 2006)	Munjina and Ministers North (Yandi Hub) Fauna Assessment (ENV 2009)	Marillana Creek Western Access Corridor Biological Assessment (Maunsell 1999)
AGAMIDAE																	
Diporiphora valens	Southern Pilbara Tree Dragon						•							•		•	
Diporiphora winneckei	Blue-lined Dragon															•	
Pogona minor subsp. minor	Dwarf Bearded Dragon						•							•		•	
Tympanocryptis cephalus	Earless Pebble Dragon				DD		•										
Amphibolurus longirostris	Long-nosed Dragon						•			•	•	•	•	•		•	•
Diporiphora amphiboluroides	Mulga Dragon													•			
Ctenophorus caudicinctus subsp. caudicinctus	Ring-tailed Dragon						•			•	•	•	•	•	•	•	
Ctenophorus isolepis subsp. isolepis	Military Dragon or Crested Dragon						•			•			•	•		•	
Ctenophorus nuchalis	Central Netted Dragon						•										
Ctenophorus reticulatus	Western Netted Dragon						•										
BOIDAE																	
Antaresia perthensis	Pygmy Python						•					•		•			
Antaresia stimsoni	Stimson's Python						•				•	•		•			
Aspidites melanocephalus	Black-headed Python						•							•			
Liasis olivaceus subsp. barroni	Pilbara Olive Python	VU	S3			L	•	•	•	•							
CARPHODACTYLIDAE																	
Nephrurus wheeleri subsp. cinctus	Banded Knob-tailed Gecko						•							•			
Underwoodisaurus seorsus	Pilbara Barking Gecko			P2			•	•									
DIPLODACTYLIDAE																	
Crenadactylus ocellatus subsp. horni	Clawless Gecko						•					•			•	•	
Diplodactylus conspicillatus	Fat-tailed Gecko						•									•	
Diplodactylus pulcher	Fine-faced Gecko						•										
Diplodactylus savagei	Southern Pilbara Beak-faced Gecko						•					•		•			
Lucasium stenodactylum	Pale-snouted Ground Gecko						•						•	•			
Lucasium wombeyi	Gecko						•							•			
Oedura fimbria	Western Marbled Velvet Gecko						•		•	•	•	•	•	•	•	•	
Rhynchoedura ornata	Western Beaked Gecko						•					•		•		•	
Strophurus elderi	Jewelled Gecko						•									•	
Strophurus jeanae	Gecko						•										
Strophurus wellingtonae	Gecko						•					•				•	

Species	Common name	Conservation Status				Database Searches			Previous Reports								
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ELAPIDAE																	
Acanthophis wellsi	Pilbara Death Adder						•									•	
Brachyurophis approximans	North-western Shovel-nosed Snake						•					•				•	
Demansia psammophis subsp. *cupreiceps*	Yellow-faced Whipsnake						•					•	•	•			
Demansia rufescens	Rufous Whipsnake						•					•		•			
Furina ornata	Moon Snake						•		•			•		•			
Parasuta monachus	Inland Hooded Snake						•							•			
Pseudechis australis	Mulga Snake						•		•	•		•		•	•	•	
Pseudonaja mengdeni	Western Brown Snake						•					•		•			
Pseudonaja modesta	Ringed Brown Snake						•							•		•	
Pseudonaja nuchalis	Gwardar				DD		•					•					
Suta fasciata	Rosen's Snake						•									•	
Suta punctata	Little Spotted Snake						•										
Vermicella snelli	Pilbara Bandy Bandy						•										
GEKKONIDAE																	
Gehyra montium	Gecko											•					
Gehyra pilbara	Pilbara Dtella						•							•		•	
Gehyra punctata	Spotted Rock Dtella						•					•	•	•	•	•	
Gehyra purpurascens	Gecko						•										
Gehyra variegata	Tree Dtella						•		•	•		•		•	•	•	
Heteronotia sp.							•										
Heteronotia binoei	Bynoe's Gecko						•		•			•		•		•	
Heteronotia spelea	Desert Cave Gecko						•					•		•		•	
Lucasium stenodactylum	Sand Plain Gecko								•							•	
Lucasium wombeyi																•	
PYGOPODIDAE																	
Delma butleri	Legless Lizard						•									•	
Delma elegans	Legless Lizard						•										
Delma haroldi	Neck-barred Delma						•									•	
Delma nasuta	Long-nosed Delma						•						•	•			
Delma pax	Legless Lizard						•					•	•	•	•		
Delma tincta	Legless Lizard						•							•			
Lialis burtonis	Burton's legless lizard						•					•		•		•	

Species	Common name	Conservation Status				Database Searches			Previous Reports								
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Pygopus nigriceps	Hooded Scaly foot						•								•	•	
SCINCIDAE																	
Lerista jacksoni	Jackson's Three-toed Slider						•										
Lerista labialis	Southern Sand-slider Skink						•										
Lerista macropisthopus	Skink						•										
Lerista muelleri	Skink						•					•		•	•	•	
Lerista neander	Skink						•										
Lerista timida	Dwarf Three-toed Slider						•										
Lerista verhmens	Powerful Lerista						•										
Lerista zietzi	Pilbara Blue-tailed Slider						•					•		•	•		
Menetia greyii	Dwarf Skink						•							•		•	
Menetia surda subsp. surda	Skink						•										
Morethia ruficauda subsp. exquisita	Fire-tailed Skink						•					•		•	•	•	
Notoscincus ornatus	Ornate Soil-crevice Skink						•										
Proablepharus reginae	Skink						•										
Tiliqua multifasciata	Central Blue-tongue Lizard						•							•		•	
Carlia munda	Shaded-litter Rainbow Skink						•				•	•	•	•		•	
Carlia triacantha	Desert Rainbow Skink						•							•			
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink						•										
Cryptoblepharus plagiocephalus	Fence Skink						•					•				•	
Cryptoblepharus ustulatus	Russet Snake-eyed Skink						•			•	•	•		•			
Ctenotus ariadnae	Ariadne's Ctenotus						•										
Ctenotus duricola	Skink						•					•		•			
Ctenotus grandis subsp. titan	Grand Ctenotus						•										
Ctenotus hanloni	Skink						•						•				
Ctenotus helenae	Skink						•							•		•	
Ctenotus inornatus	Skink											•					
Ctenotus leonhardii	Skink						•										
Ctenotus pantherinus subsp. ocellifer	Leopard Ctenotus						•					•	•	•		•	
Ctenotus quattuordecimlineatus	Fourteen-lined Ctenotus						•										
Ctenotus rubicundus	Ruddy Ctenotus						•					•	•	•	•		
Ctenotus rutilans	Pilbara Rusty Ctenotus						•							•		•	
Ctenotus saxatilis	Rock Ctenotus						•			•	•	•		•	•	•	

Species	Common name	Conservation Status				Database Searches			Previous Reports								
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Ctenotus schomburgkii	Barred Wedge-tailed Ctenotus						•							•			
Ctenotus serventyi	North-western Sandy-loam Ctenotus						•										
Ctenotus uber	Spotted Ctenotus						•										
Ctenotus uber subsp. johnstonei	Spotted Ctenotus		P2				•										
Cyclodomorphus melanops subsp. melanops	Slender Blue-tongue						•						•	•		•	
Egernia cygnitos	Pygmy Spiny-tailed Skink (western)						•										
Egernia depressa	Pygmy Spiny-tailed Skink						•										
Egernia formosa	Goldfields Crevice-skink						•			•	•	•		•			
Egernia pilbarensis	Pilbara Skink														•		
Eremiascincus fasciolatus	Narrow-banded Sand Swimmer													•		•	
Eremiascincus isolepis	Skink											•					
Eremiascincus pallidus	Western Narrow-banded Skink						•					•					
Eremiascincus richardsonii	Broad-banded Sand Swimmer						•									•	
Lerista amicorum	Skink						•										
Lerista bipes	Two-toed Skink						•										
TYPHLOPIDAE																	
Anilios ammodytes	Blind Snake											•		•		•	
Anilios ganei	Pilbara Flat-headed Blind-snake			P1			•	•									
Anilios grypus	Blind Snake													•		•	
VARANIDAE																	
Varanus acanthurus	Spiny-tailed Monitor						•					•		•		•	
Varanus brevicauda	Short-tailed Pygmy Monitor						•							•			
Varanus bushi	Bush's Monitor						•			•							
Varanus caudolineatus	Stripe-tailed Pygmy Monitor						•										
Varanus eremius	Pygmy Desert Monitor						•										
Varanus giganteus	Perentie						•				•	•			•		
Varanus gilleni	Pygmy Mulga Monitor															•	
Varanus gouldii	Gould's Monitor or Bungarra						•							•			
Varanus hamersleyensis	Southern Pilbara Rock Goanna						•										
Varanus panoptes	Yellow Spotted Monitor						•					•		•	•	•	
Varanus pilbarensis	Pilbara Rock Monitor						•		•		•	•		•	•	•	
Varanus tristis subsp. tristis	Racehorse Goanna						•			•		•		•			

Amphibians

Species	Common name	Conservation Status				Databases			Yandi Life of Mine Flora and Fauna (Maunsell Australia 2003)	Yandi Vertebrate Fauna Review (Biologic 2011a)	Area C to Yandi Fauna Survey (Biologic 2011e)	Ministers North Level 2 Vertebrate Fauna Survey (Biologic 2017)	Yandicoogina Junction South West and Oxbow Fauna Survey (Biota 2010)	Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota 2013)	Ministers North Biological Survey (ecologia 2006)	Munjina and Ministers North (Yandi Hub) Fauna Assessment (ENV 2009)	Marillana Creek Western Access Corridor Biological Assessment (Maunsell 1999)
		EPBC	WCA	DBCA	IUCN	DoEE	NatureMap	DBCA Threatened and Protected Fauna									
HYLIDAE																	
Cyclorana maini	Main's Frog						●			●	●			●			
Cyclorana platycephala	Water-Holding Frog						●										
Litoria rubella	Little Red Tree Frog						●			●		●		●	●	●	●
MYOBATRACHIDAE																	
Pseudophryne douglasi	Gorge Toadlet						●										
Uperoleia russelli	Russell's Toadlet						●										
Uperoleia saxatilis	Pilbara Toadlet						●					●		●			
LIMNODYNASTIDAE																	
Neobatrachus aquilonius	Northern Burrowing Frog						●										
Neobatrachus sutor	Shoemaker Frog						●										

Fish

Species	Common name	Conservation Status				Database Searches				Previous Reports							
		EPBC	WCA	DBCA	IUCN	DoEE	NatureMap	DBCA Threatened and Protected Fauna	Birdlife Birdata	Yandi Life of Mine Flora and Fauna (Maunsell Australia 2003)	Yandi Vertebrate Fauna Review (Biologic 2011)	Ministers North Level 2 Vertebrate Fauna Survey (Biologic 2017)	Yandicoogina Junction South West and Oxbow Fauna Survey (Biota 2010)	Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota 2013)	Ministers North Biological Survey (ecologia 2006)	Munjina and Ministers North (Yandi Hub) Fauna Assessment (ENV 2009)	Marillana Creek Western Access Corridor Biological Assessment (Maunsell 1999)
MELANOTAENIIDAE																	
Melanotaenia australis	Western Rainbowfish						•										
PLOTOSIDAE																	
Neosilurus hyrtlii	Hyrtl's catfish						•										
TERAPONTIDAE																	
Amniataba percoides	Barred Grunter						•										
Leiopotherapon unicolor	Spangled Perch						•										

Appendix C Fauna recorded during the current survey

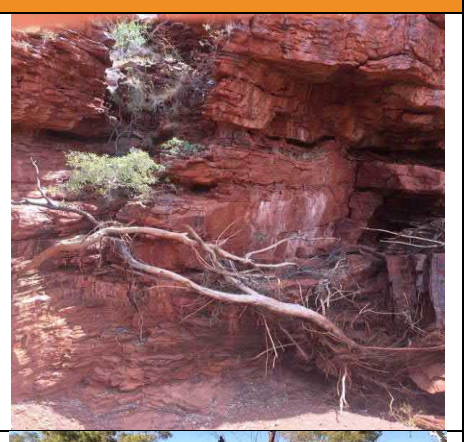
Species	Opportunistic Phase 1	Bat Detector Phase 1	Motion Camera Phase 1	Opportunistic Phase 2	Bat Detector Phase 2	Motion Camera Phase 2	Elliot Trap Phase 2
Birds							
Accipiter cirrocephalus				X			
Amytornis striatus subsp. *whitei*	X			X			
Ardeotis australis				X			
Artamus cinereus	X			X			
Artamus minor	X			X			
Artamus personatus						X	
Cacatua sanguinea	X			X			
Cacatua roseicapilla	X			X		X	
Cacomantis pallidus	X			X			
Chrysococcyx basalis	X						
Circus assimilis				X			
Colluricincla harmonica			X	X			
Coracina novaehollandiae subsp. *subpallida*				X			
Corvus orru cecilae	X			X		X	
Cracticus nigrogularis				X		X	
Cracticus tibicen				X			
Dacelo leachii subsp. *leachii*				X			
Elanus caeruleus subsp. *axillaris*	X						
Emblema pictum	X		X	X		X	
Eremiornis carteri	X						
Eurostopodus argus	X						
Falco berigora	X			X			
Falco cenchroides				X			
Falco longipennis				X			
Falco peregrinus				X			

Species	Opportunistic Phase 1	Bat Detector Phase 1	Motion Camera Phase 1	Opportunistic Phase 2	Bat Detector Phase 2	Motion Camera Phase 2	Elliot Trap Phase 2
Gavicalis virescens	X			X			
Geopelia cuneata	X			X			
Geopelia striata subsp. *placida*	X						
Geophaps plumifera subsp. *ferruginea*	X			X			
Grallina cyanoleuca	X			X			
Hamirostra melanosternon				X			
Lalage tricolor	X						
Lichmera indistincta	X			X			
Malurus lamberti subsp. *assimilis*				X			
Manorina flavigula				X			
Megalurus mathewsi				X			
Melanodryas cucullata				X			
Merops ornatus	X			X			
Milvus migrans	X						
Mirafra javanica				X			
Ocyphaps lophotes	X			X			
Oreoica gutturalis	X						
Pardalotus striatus subsp. *murchisoni*	X						
Phaps chalcoptera				X		X	
Platycercus zonarius subsp. *zonarius*	X			X			
Pomatostomus temporalis subsp. *rubeculus*				X			
Ptilonorhynchus maculatus subsp. *guttatus*	X			X			
Ptilotula keartlandi	X			X			
Ptilotula penicillata	X			X			
Rhipidura leucophrys subsp. *leucophrys*	X			X		X	
Smicrornis brevirostris	X			X			
Taeniopygia guttata subsp. *castanotis*	X			X		X	

Species	Opportunistic Phase 1	Bat Detector Phase 1	Motion Camera Phase 1	Opportunistic Phase 2	Bat Detector Phase 2	Motion Camera Phase 2	Elliot Trap Phase 2
Todiramphus pyrrhopygius				X			
Turnix velox	X			X			
Mammals							
Austronomus australis					X		
**Canis familiaris*	X		X	X		X	
Chaerephon jobensis		X			X		
Chalinolobus gouldii		X			X		
**Felis catus*	X		X	X		X	
Nyctophilus geoffroyi					X		
Ozimops lumsdenae		X			X		
Osphranter robustus subsp. *erubescens*	X			X			
Osphranter rufus	X					X	
Petrogale rothschildi			X			X	
Pseudantechinus woolleyae			X			X	X
Pseudomys chapmani	X			X			
Scotorepens greyii		X			X		
Tachyglossus aculeatus				X			
Taphozous georgianus		X			X		
Vespadelus finlaysoni		X		X	X		
Zyzomys argurus			X			X	X
Reptiles							
Acanthophis wellsi				X			
Antaresia perthensis				X			
Cryptoblepharus ustulatus	X			X			
Ctenophorus caudicinctus subsp. *caudicinctus*	X			X			
Ctenophorus isolepis subsp. *isolepis*				X			
Ctenotus pantherinus subsp. *ocellifer*	X						

Species	Opportunistic Phase 1	Bat Detector Phase 1	Motion Camera Phase 1	Opportunistic Phase 2	Bat Detector Phase 2	Motion Camera Phase 2	Elliot Trap Phase 2
Ctenotus saxatilis	X						
Ctenotus inornatus				X			
Cyclodomorphus melanops subsp. *melanops*						X	
Egernia formosa	X		X				
Eremiascincus isolepis				X			
Gehyra punctata				X			
Heteronotia binoei				X			
Heteronotia spelea				X			
Lerista muelleri				X			
Lerista zietzi				X			
Morethia ruficauda subsp. *exquisita*	X		X	X			
Oedura fimbria	X			X			
Pseudechis australis			X	X			
Strophurus wellingtonae				X			
Varanus panoptes	X						
Varanus tristis			X				
Varanus acanthurus				X			

Appendix D Water features recorded in the Study Area

Water feature ID	Latitude	Longitude	Date	Type	Aquatic Vegetation Present	Permanent	Width	Length	Depth	Photo
MNY-WB-01	-22.811158	119.1134023	10/10/2017	Tiny seep	No	No	0.03	0.001	0	
MNY-WB-02	-22.7683141	119.04332925	11/10/2017	River Pool	Typha (reeds)	Yes	3	15	1	
MNY-WB-03	-22.78243706	119.0643262	11/10/2017	Rock Pool	No	No	2	5	0.75	
MNY-WB-04	-22.81087794	119.1148179	17/06/2018	Rock Pool	No	No	2	12	0.5	
MNY-WB-05	-22.8105298	119.1150439	17/06/2018	Rock Pool	No	No	3	25	0.5	
MNY-WB-06	-22.78153	119.0635861	20/06/2018	Rock Pool	No	No	1.5	4.5	0.25	
MNY-WB-07	-22.78216393	119.06435978	20/06/2018	Rock Pool	No	No	1.5	7	0.25	

Water feature ID	Latitude	Longitude	Date	Type	Aquatic Vegetation Present	Permanent	Width	Length	Depth	Photo
MNY-WB-08	-22.7825295	119.06546907	20/06/2018	Rock Pool	No	No	1	6	0.25	
MNY-WB-09	-22.7823763	119.0642416	20/06/2018	Rock Pool	No	No	2	3	0.25	
MNY-WB-10	-22.813279645	119.1162056	23/06/2018	Rock Pool	No	No	1.5	10	0.5	
MNY-WB-11	-22.81263945	119.1161466	23/06/2018	Rock Pool	No	No	0.5	4	0.25	
MNY-WB-12	-22.81326347	119.1161368	23/06/2018	Rock Pool	No	No	0.5	4	0.25	
MNY-WB-13	-22.81109543	119.1162895	23/06/2018	Rock Pool	No	No	4	8	0.5	

Appendix E Caves recorded during the survey

Cave Name	Latitude	Longitude	Date Assessed	Entrance position	Aspect	Cave Exposure	Entrance Type	Entrance Shape	Entrance Width	Entrance Height	Floor Slope	Cave Depth	Chamber Height	Number of Chambers	Photo
MNY.06	-22.808	119.109929	2018-06-23	Upper Slope	North/ East	Semi Exposed	Cavity	Horizontal	3	1.5	Incline	7	1.5	1	
MNY.05	-22.8086	119.1138161	2018-06-23	Lower Slope	South/ East	Semi Exposed	Cavity	Round/Oval	2	1.5	Incline	4	1.8	1	
MNY.04	-22.7959	119.0975687	2018-06-22	Upper Slope	North/ East	Exposed	Overhang	Round/Oval	12	4	Incline	3	4	1	
MNY.03	-22.7916	119.1001297	2018-06-22	Upper Slope	North/ West	Exposed	Overhang	Horizontal	5	1.5	Flat	2	1.5	1	
MNY.02	-22.7925	119.1179784	2018-06-21	Upper Slope	East	Exposed	Overhang	Vertical	3.5	1.5	Flat	4	1.5	1	

Cave Name	Latitude	Longitude	Date Assessed	Entrance position	Aspect	Cave Exposure	Entrance Type	Entrance Shape	Entrance Width	Entrance Height	Floor Slope	Cave Depth	Chamber Height	Number of Chambers	Photo
MNY.01	-22.8117	119.1235626	2018-06-19	Mid Slope	East	Exposed	Overhang	Horizontal	4	2	Flat	4	2	1