30 June 2009



BROCKMAN RESOURCES LTD
Marillana Iron Ore Project
Vertebrate Fauna Assessment

Providing sustainable environmental strategies, management and monitoring solutions to industry and government.

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MARILLANA IRON ORE PROJECT

VERTEBRATE FAUNA ASSESSMENT

30 June 2009

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***ecologia* Environment (2009)**

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Executive Summary

The Marillana Iron Ore Project is located in the Hamersley Iron Province 100 km north-west of Newman. Brockman Resources Limited (Brockman) proposes to mine on tenement E47/1408, which covers 96 km^2 of the Fortescue Valley margin and borders the Hamersley Range. Brockman are proposing to operate an open pit mine, mining at a rate of 25 Mtpa, with transport of ore to Port Hedland by road or rail.

Brockman commissioned *ecologia* Environment (*ecologia*) to undertake a comprehensive biological survey (Level 2 survey) of the vertebrate fauna of the Marillana Iron Ore project area, as part of the environmental impact assessment.

ecologia conducted a two phase Level 2 vertebrate fauna survey in the project area during April/May (autumn) 2008 and August/September (spring) 2008. Field survey methodology was devised in accordance with the Environmental Protection Authority's Guidance Statement No. 56 (EPA 2004) and Position Statement No.3 (EPA 2002).

Conformance of this assessment to EPA Position Statement No. 3 is outlined in Table S.1.1 below.

Five main fauna habitat types were identified in the project area. These were sandy spinifex grassland, stony spinifex plain, creekline, longitudinal sand dune and mulga woodland. Six systematic survey sites were established within these five fauna habitats, utilising a combination of pit traps, funnel traps, Elliott traps and Sheffield cage traps, as well as fixed-time bird censuses. Opportunistic searches were conduced at the systematic sites as well as a further eighteen opportunistic sites.

Prior to surveying, *ecologia* undertook a review of all fauna records from the project area and surroundings, based the Western Australian Museum Fauna Base, Department of Environment and Conservation records and surveys previously undertaken in the area. The literature and database review identified 40 species of mammal, 114 bird, 95 reptile and three amphibian species which have the potential to occur in the project area.

Twenty-three species of mammal (including five introduced), 82 species of bird, and 43 species of reptile were recorded during the survey. No amphibians were recorded due to dry conditions.

Seventeen species of conservation significance have the potential to occur in the project area. Of these, two species, the Australian Bustard (*Ardeotis australis*), listed as DEC Priority 4, and the Rainbow Bee-eater (*Merops ornatus*), listed as Migratory under the *Environment Protection and Biodiversity Conservation Act 1999*, were recorded within the project area. A further five species, Northern Short-tailed Mouse, Fork-tailed Swift, Peregrine Falcon, Grey Falcon and Pilbara Olive Python were considered likely to occur.

The Rainbow Bee-eater occurs over most of Australia and in south-east Asia and is common throughout its range. The species was recorded throughout the project area favouring the Weeli Wolli creekline. This area is not subject to current mining activities and impacts are likely to be minimal.

The Australian Bustard, DEC Priority 4, is a nomadic species, and even though it was recorded within the project area during this survey, impacts are likely to be minimal as suitable habitat occurs directly adjacent to it.

Night Parrots (*Pezoporus occidentalis*), listed as Endangered under the EPBC Act and Schedule 1 under the WA *Wildlife Conservation Act 1950*, are also discussed as there is possible suitable habitat for the species within the project area. Dense, tall, long-unburnt spinifex found in sandy spinifex plains and longitudinal sand dune habitats has the potential to provide habitat for Night Parrot. Areas containing this habitat type can be found between

the sand dunes in the north-west section of the project area and at the base of the alluvial fans to the south of the Weeli Wolli creek and railway line.

A lack of records of Night Parrot means that its habitat preferences and distribution are not well known. Consequently, it is difficult to estimate its probability of occurrence in the project area with any certainty. It is recommended that impacts to potential habitat are avoided. However, due to the small size of these areas, Night Parrots are unlikely to be significantly impacted by the project.

The risk of regional impacts to conservation significant species was deemed to be low for all species.

Table S.1.1 Conformance of Project to EPA Position Statement No. 3

REQUIREMENT	RELEVANCE TO PROJECT	PROJECT COMPLIANCE
Impact on Biodiversity	Where impact on biodiversity cannot be avoided, the proponent must demonstrate that the impact will not result in unacceptable loss.	The project is unlikely to cause significant declines to rare fauna populations. Only two conservation significant species were recorded during the survey, both of which are unlikely to be impacted. Impacts to vertebrate fauna are discussed in Section 6.0
State, National and International Agreements, Legislation and Policy on Biodiversity	Information gathered for environmental impact assessment in Western Australia meets State, National and International Agreements, Legislation and Policy in regard to biodiversity conservation.	State, national and international agreements were referred to in the production of this report. Impacts to species listed under relevant legislature are addressed in Section 5.0.
EPA Standards, Requirements and Protocols	The quality of information and scope of field surveys meets the standards, requirements and protocols as determined and published by the EPA.	The current survey conforms to a Level 2 survey, comprising a desktop review and a detailed two phase fauna survey, following EPA Guidance Statement No. 56.
Biodiversity Conservation and Ecological Function Values	Sufficient information is provided to address biodiversity conservation and ecological function values.	The results of the survey are compared with those of previous surveys and databases relevant to the region, providing a regional context to the information collected. Fauna assemblages and habitats observed are described and potential impacts to biodiversity and ecological function are discussed in Section 6.0.
State Biological Databases	Terrestrial biological surveys will be made publicly available and will contribute to the bank of data available for the region.	Survey data will be submitted to DEC.

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1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

The Marillana Iron Ore Project is located in the Hamersley Iron Province 100 km north-west of Newman (Figure 1.1). Brockman Resources Limited (Brockman) proposes to mine on tenement E47/1408 and transport the ore to Port Hedland by road or rail. An existing railway line already runs through the tenement, roughly west-east.

The exploration lease, tenement E47/1408, has an area of 9,532 ha and is located in the Fortescue Valley, bordering the Hamersley Range where extensive areas of supergene iron ore mineralisation are developed within the dissected Brockman Iron Formation which caps the range.

The iron ore mineralisation within E47/1408 is best described as detrital hematite-goethite material with grades ranging from 55-63% Fe. Brockman are proposing to operate an open pit mine, mining at a rate of 25 Mtpa.

The proposed mining operations will require clearing up to 3,300 ha.

1.2 LEGISLATIVE FRAMEWORK

The *Environmental Protection Act 1986* is "an Act to provide for an Environmental Protection Authority (EPA), for the prevention, control and abatement of environmental pollution, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing." Section 4a of this Act outlines five principles that are required to be addressed to ensure that the objectives of the Act are addressed. Three of these principles are relevant to native fauna and flora:

- *The Precautionary Principle*

  Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

- *The Principles of Intergenerational Equity*

  The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

- *The Principle of the Conservation of Biological Diversity and Ecological Integrity*

  Conservation of biological diversity and ecological integrity should be a fundamental consideration.

Projects undertaken as part of the Environmental Impact Assessment (EIA) process are required to address guidelines produced by the EPA, in this case Guidance Statement No. 56: *Terrestrial Fauna Surveys for Environmental Impact in Western Australia* (EPA 2004), and principles outlined in the EPA's Position Statement No. 3: *Terrestrial Biological Surveys as an element of Biodiversity Protection* (EPA 2002).

Native flora and fauna in Western Australia are protected at a federal level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and at a State level under the *Wildlife Conservation Act 1950* (WC Act). Conservation categories for these acts can be found in Appendix A.

The EPBC Act was developed to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance, to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources and to promote the conservation of biodiversity. The EPBC Act includes provisions to protect native species (and in particular prevent the extinction, and promote the recovery, of threatened species) and to ensure the conservation of migratory species. In addition to the principles outlined in Section 4a of the EP Act, Section 3a of the EPBC Act includes a principle of ecologically sustainable development dictating that decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.

The WC Act was developed to provide for the conservation and protection of wildlife in Western Australia. Under Section 14 of this Act, all fauna and flora within Western Australia is protected; however, the Minister may, via a notice published in the *Government Gazette*, declare a list of fauna taxa identified as likely to become extinct, rare, or otherwise in need of special protection. The current listing was gazetted in August 2008.

1.3 SURVEY OBJECTIVES

Brockman Resources Limited (Brockman) commissioned *ecologia* Environment (*ecologia*) to undertake a comprehensive biological survey (Level 2 survey) of the vertebrate fauna of the Marillana Iron Ore project area as part of the environmental impact assessment.

The EPA's objectives with regards to fauna management are to:

- maintain the abundance, species diversity and geographical distribution of terrestrial fauna; and
- protect Specially Protected (Threatened) fauna, consistent with the provisions of the WC Act.

The aim of this survey was to provide sufficient information to the EPA to assess the impact of the project on the vertebrate fauna of the area, thereby ensuring that these objectives will be upheld.

This report satisfies the requirements documented in EPA's Guidance Statement No. 56 and Position Statement No. 3 by providing:

- A review of background information (including literature and database searches).
- An inventory of vertebrate fauna species occurring in the study area, incorporating recent published and unpublished records.
- An inventory of species of biological and conservation significance recorded or likely to occur within the project area and surrounds.
- A detailed description of fauna habitats occurring in the study area.
- A description of the characteristics of the faunal assemblage.
- An appraisal of the current knowledge base for the area, including a review of previous surveys conducted in the area which are relevant to the current study.
- A review of regional and biogeographical significance, including the conservation status of species recorded in the project area.

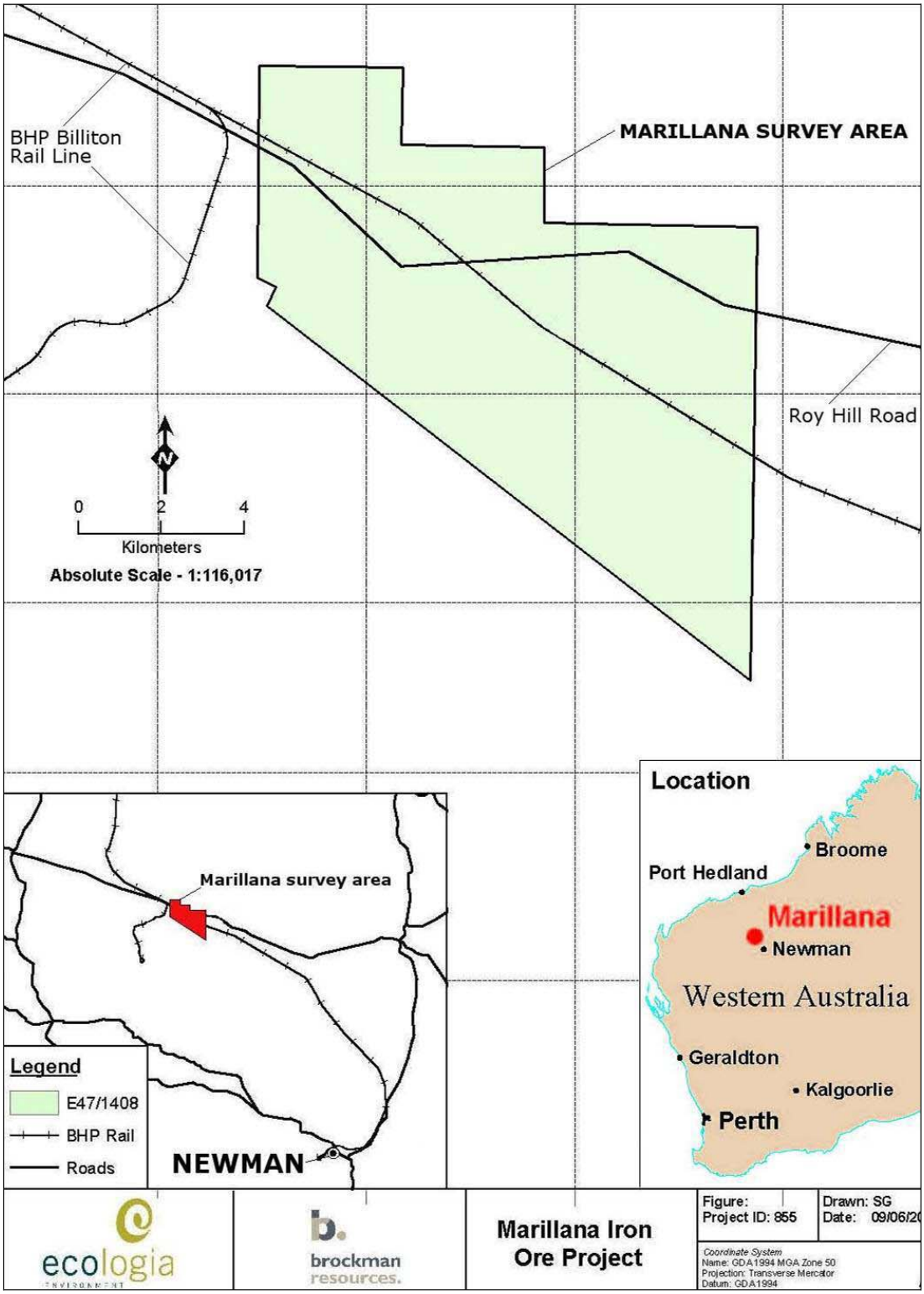

Figure 1.1 Location of the Marillana Project Area

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2.0 BIOPHYSICAL ENVIRONMENT

2.1 CLIMATE

Marillana is situated in the Pilbara region of Western Australia and experiences an arid-tropical climate with two distinct seasons; a hot summer from October to April and a mild winter from May to September. Annual evaporation exceeds rainfall by as much as 500 mm per year. Seasonally low but unreliable rainfall, together with high temperatures and high diurnal temperature variations are also characteristic climate of the region.

The closest Bureau of Meteorology (BOM) weather station to the project area is at Sand Hill (22.78° S, 119.62° E) (BOM 2008). The Sand Hill weather station is located approximately 45 km to the south-east of the Upper Marillana exploration site, providing an indication of climatic conditions experienced within the project area (Figure 2.1).

The average annual rainfall in the study region is 337 mm, occurring over 40 rain days. Most of the rainfall occurs in the summer period, with over 70% of total annual precipitation occurring between December and March.

Mean annual maximum and minimum temperatures for Sand Hill are 32.9°C and 17.5°C respectively. Mean monthly maxima range from 40.5°C during January to 23.7°C in July, while mean monthly minima range from 24.9°C in January to 8.9°C in July (Figure 2.1).

The Sand Hill weather station closed in August 1984, and therefore daily weather conditions during the fauna survey were taken from the Wittenoom BOM weather station (22.24 °S, 118.34 °E), which is the closest currently in operation (BOM 2008). The Wittenoom weather station is located 100 km north-west of the project area.

Daily temperature and rainfall records from the Wittenoom weather station, recorded over both phases of the survey are presented below (Figure 2.2). Ambient air temperatures were higher in the first survey phase, with an average maximum temperature of 34.5 °C and an average minimum of 21.8 °C, compared to the second phase with average maximum and minimum temperatures of 30.6 °C and 15.8 °C, respectively. Ambient air temperatures did not inhibit fauna activity.

The Wittenoom weather station recorded no rainfall during the first phase of the survey, and two very minor rainfall events during the second phase, which were unlikely to have influenced fauna activity. Consequently, mammal, bird and reptile activity remained high throughout the survey, but rainfall was insufficient to stimulate amphibian emergence.

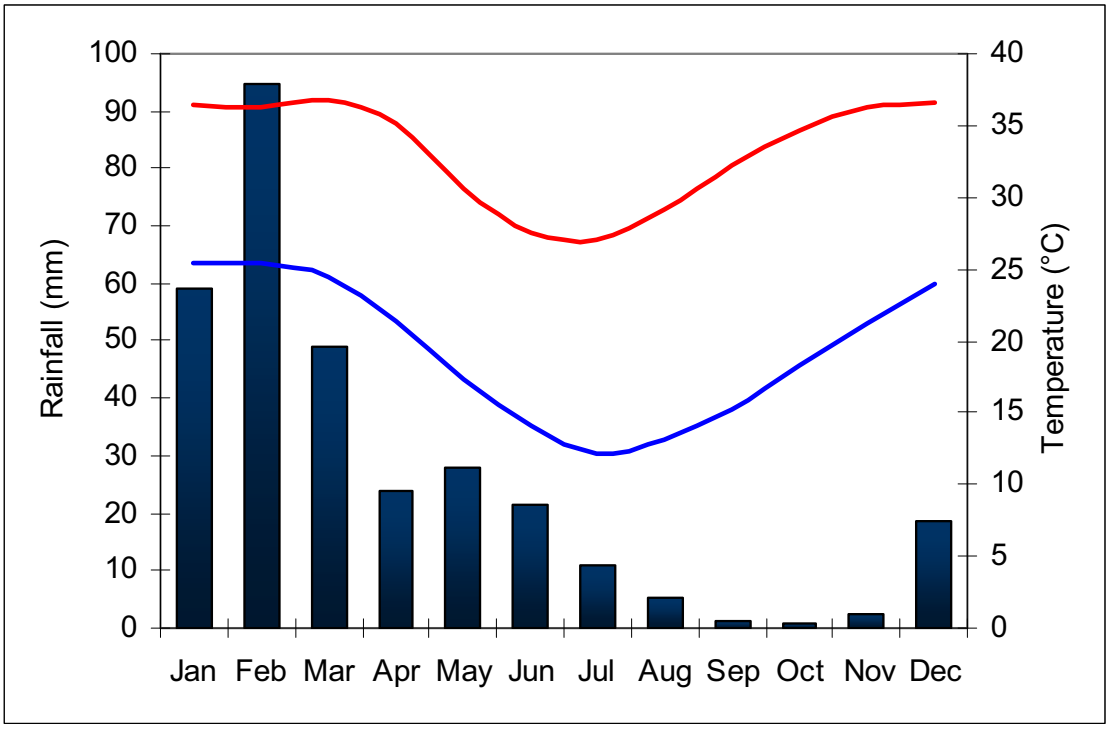


Figure 2.1 Summary of Climatic Data at Sand Hill (BOM 2008). Red line: maximum temperature; blue line: minimum temperature; bars: rainfall

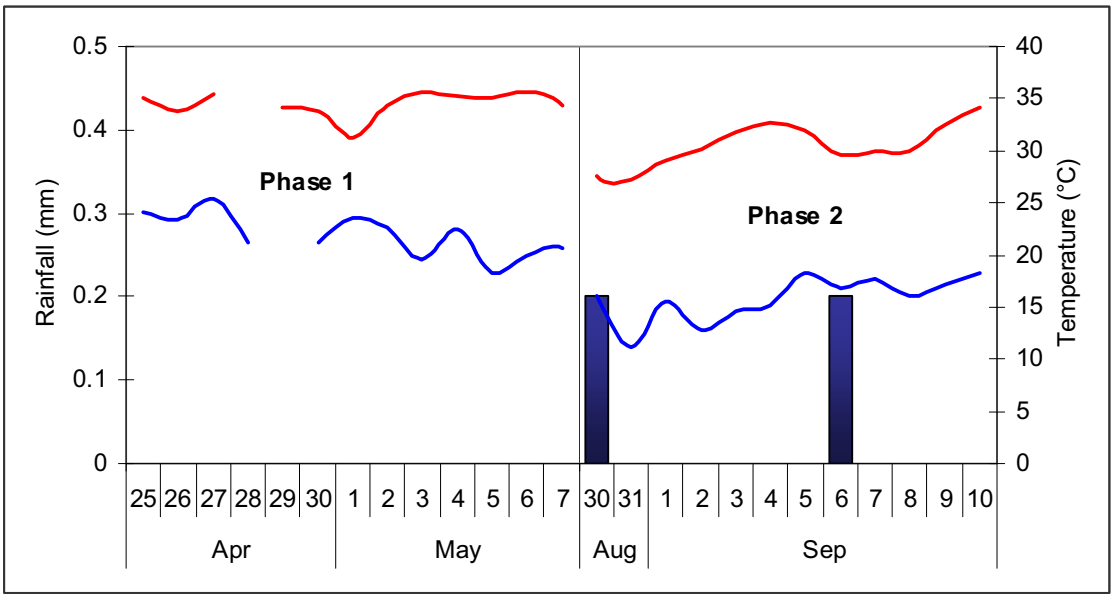


Figure 2.2 Daily Temperature and Rainfall From Wittenoom (BOM 2008). Red line: maximum temperature; blue line: minimum temperature; bars: rainfall.

2.2 LAND SYSTEMS

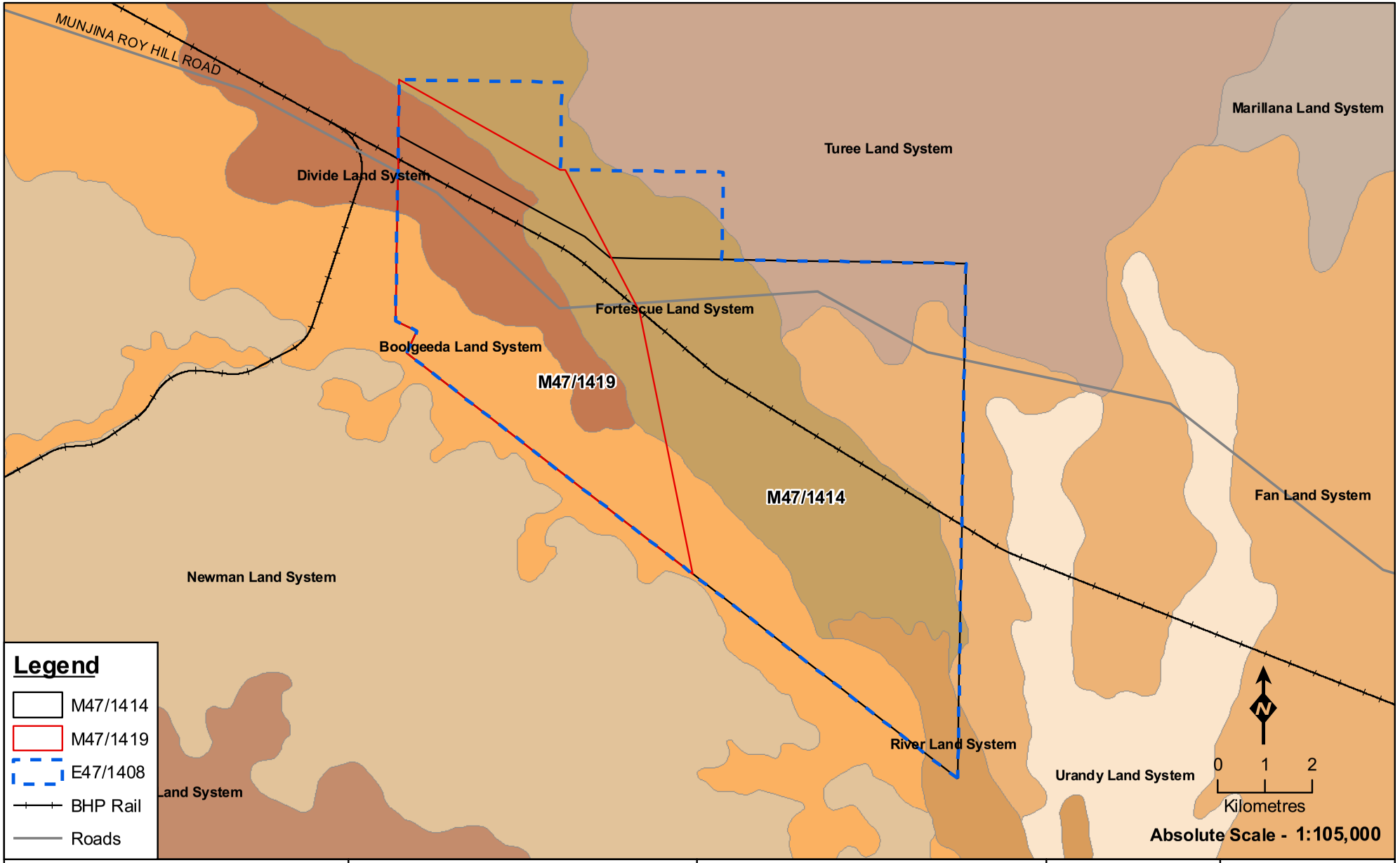
The Marillana Iron Ore Project area includes six land systems (Figure 2.3) as described by Van Vreeswyk *et al*. (2004).

Table 2.1 shows the area of each land system in the project area and in the Pilbara region, and the percentage of the total land system area occurring in the project area.

The exploration tenement as a whole contains 8.31% of the total extent of the Fortescue land system. However, Brockman has commenced studies on the surface hydrology associated with the Fortescue River land systems which has determined that the majority of the Fortescue land system within the tenement is unsuitable for development. Two mining leases have been established within the exploration lease: M47/1414 and M47/1419. The proportion of the Fortescue land system within these mining tenements is therefore lower, and mining is expected to be largely confined to the Boolgeeda land system, hence impacting little of the Fortescue land system.

Table 2.1 Land Systems of the Project Area (van Vreeswyk *et al.* 2004)

LAND SYSTEM	HABITAT	EXPLORATION LEASE (km^2)	MINING LEASE M47/1414 (km^2)	MINING LEASE M47/1419 (km^2)	TOTAL AREA IN PILBARA (km^2)
Fortescue	Alluvial plains and floodplains supporting patchy grassy woodlands, shrublands and tussock grasslands	41.91	32.09	7.48	504
Turee	Stony alluvial plains with gilgaied and non-gilgaied surfaces supporting tussock grasslands and grassy shrublands of mulga and Snakewood.	6.76	5.70	0	581
Fan	Wash plains and gilgai plains supporting groved mulga shrublands and minor tussock grasslands	10.46	10.46	0	1,482
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands	20.56	20.56	12.77	7,748
Divide	Sandplains and occasional dunes supporting shrubby hard spinifex grasslands	12.18	10.04	12.17	5,293
River	Active floodplains and major rivers supporting grassy *Eucalyptus* spp. woodlands, tussock grasslands and soft spinifex grasslands	3.44	3.44	0	4,088



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Marillana Landsystems

Figure: 2.3
Project ID: 936

Drawn: SG
Date: 07/04/09

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

Unique Map ID: M065

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2.3 BIOGEOGRAPHY

A biogeographic regionalisation of Australia, the Interim Biogeographic Regionalisation for Australia (IBRA), has been collaboratively developed by all Australian nature conservation agencies and continues to be refined as more detailed information becomes available. The most current version available is IBRA Version 6.1 (DEWHA 2008).

IBRA represents a landscape-based approach to classifying the land surface of Australia, in which bioregions (broad scale regionalisation) are formally recognised and mapped. Biogeographic regions are defined on the basis of climate, geology, landforms, vegetation and fauna.

IBRA Version 6.1 delineates 85 biogeographic regions, with 403 subregions, each reflecting a unifying set of major environmental influences which shape the occurrence of flora and fauna and their interaction with the physical environment across Australia (Thackway and Cresswell 1995; DEWHA 2008). Subregions are more localised and homogeneous geomorphological units within each bioregion.

Western Australia encompasses 26 IBRA bioregions and 53 subregions, each affected by a range of different threatening processes and with varying levels of sensitivity to impact (DEC 2002). The Environmental Protection Authority (EPA) utilises IBRA regions and subregions as the largest unit for EIA decision-making in relation to the conservation of biodiversity (EPA 2002).

The Marillana Iron Ore Project area is located in the Pilbara Biogeographic Region on the border of the Fortescue Plains (PIL2) and Hamersley (PIL3) subregions (Figure 2.4).

The project area lies in the Fortescue Valley along the north-eastern escarpment of the Hamersley Ranges. The mining operations will focus on the iron rich detrital deposits eroded from this escarpment.

The Fortescue Plains subregion is characterised by alluvial plains, hard pan wash plains and sandplains (with stony plains, floodplains and some salt lakes) on alluvial deposits over sedimentary rocks of the Hamersley Basin (Kendrick 2001). The soils associated with these habitat types include red deep sands, red loamy earths and red-brown non-cracking clays with some red shallow loams and hard cracking clays. These soils support mulga shrublands and spinifex grasslands (with some tussock grasslands and halophytic shrublands (van Vreeswyk *et al.* 2004).

The areas of the Marillana Iron Ore Project area that extend into the hills and dissected plateaus of the Hamersley Ranges have stony soils with red shallow loams, some red-brown non-cracking clays and red-loamy earths. These soils support spinifex grasslands with Snappy Gum (*Eucalyptus leucophloia*) and Kanji (*Acacia inaequilatera*) (Beard 1975).

Thorne and Tyler (1997) mapped the geological units of Western Australia (1:250,000). Locally the Marillana project area is characterised by:

- alluvium and colluvium deposits forming red-brown clayey and sandy soils, on the lower slopes and sheet-wash areas (flat clay pans);
- aeolian sand deposits in sheets and longitudinal dunes (sandy plains and sand dunes);
- alluvium, unconsolidated silt, sand and gravel; in drainage channels and adjacent floodplains (creek lines and floodplains);
- hematite-goethite deposits on banded iron-formations and adjacent scree deposits (rocky hill slopes); and

- banded Iron formation and pelite (as part of the Brockman Iron Formation on the rocky hill slopes).

Figure 2.4 Location of Project Area in IBRA Subregions

2.4 VEGETATION

Beard (1975) classified the are occupied by the Marillana Iron Ore Project as falling within the Fortescue Botanical region of the Pilbara. Beard mapped these vegetation communities (Figure 2.5) and described them as:

- *Acacia aneura* (mulga) in groved patterns with an understorey of *Triodia pungens* (spinifex);
- *Eucalyptus gamophylla* shrub steppe, over *Triodia basedowii* (spinifex) hummock grassland; and
- *Eucalyptus brevifolia* (Snappy Gum) sparse low trees, over *Triodia wiseana* open hummock grassland (*E. brevifolia*, as described by Beard, is a synonym for the species now known as *E. leucophloia*).

In recent botanical surveys of the area, *ecologia* (2008a) identified eight vegetation units, with some units further classified into subunits, totalling seventeen. Identification was on the basis of structure and species composition of the dominant strata and on landform. The vegetation units described were associated with the following landforms: creekline; minor drainage channels on footslope; clay pan; minor channel/depression; floodplain; longitudinal sand dunes; swale between dunes; and sandy plain/minor footslope. Descriptions of each vegetation type are listed in Table 2.2.

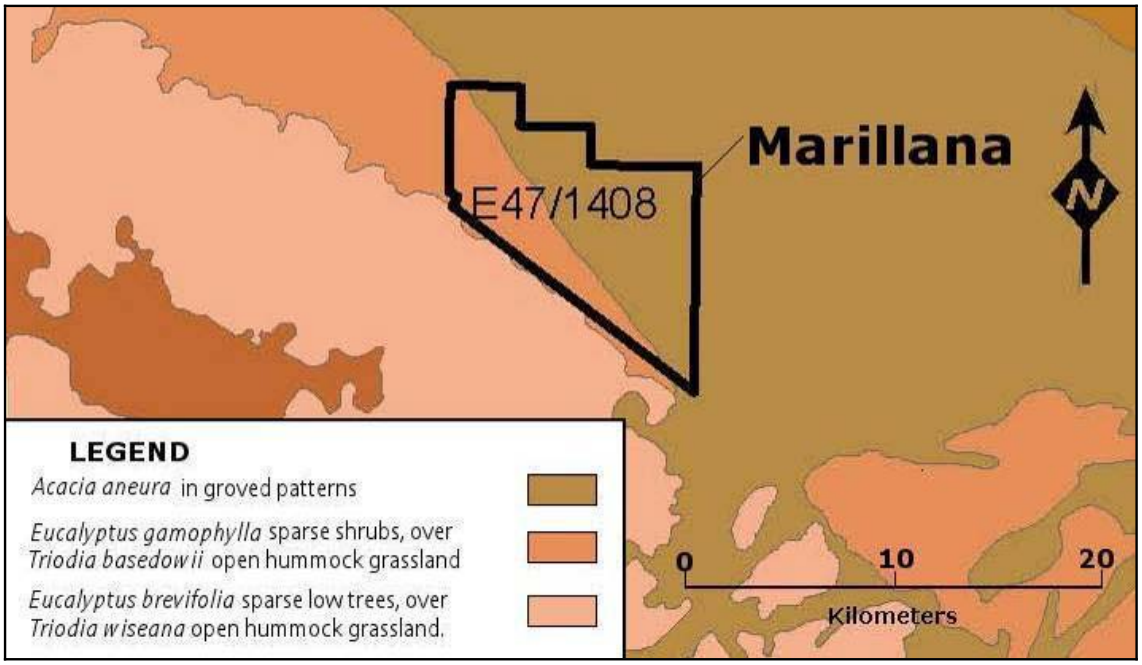

Figure 2.5 Location of Project Area Within Beard Vegetation Units (1975)

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Table 2.2 Vegetation Assemblages Recorded During Botanical Surveys by *ecologia* (2008a)

VEG.UNIT NO.	VEGETATION DESCRIPTION
1 – CREEKLINE: *Eucalyptus victrix* and *Acacia citrinoviridis* low to high woodland.	
1a	*Eucalyptus victrix* low to high woodland, over *Acacia citrinoviridis*, *Atalaya hemiglauca*, *Acacia coriacea* subsp. *pendens* and *Acacia aneura* var. *aneura* high shrubland to low woodland, over **Cenchrus setiger* and **Cenchrus ciliaris* open to closed tussock grassland.
1b	*Acacia citrinoviridis* low open forest, with scattered *Eucalyptus victrix*, *Corymbia hamersleyana* and *Atalaya hemiglauca* low trees, over *Corchorus crozophorifolius* and *Corchorus tectus* low open shrubland, over **Cenchrus ciliaris* and **Cenchrus setiger* open tussock grassland.
2 – MINOR DRAINAGE CHANNEL ON FOOTSLOPE: *Acacia tumida* and *Grevillea wickhamii* high shrubland	
2	*Corymbia hamersleyana* scattered low trees, over *Eucalyptus gamophylla* low open mallee woodland, over *Acacia tumida* var. *pilbarensis* and *Grevillea wickhamii* subsp. *hispidula* high shrubland, over *Grevillea wickhamii* subsp. *hispidula*, *Acacia tumida* var. *pilbarensis* and *Acacia pachyacra* open medium shrubland, over *Indigofera monophylla* and *Tephrosia rosea* var. *glabrior* low shrubland, over *Themeda triandra*, *Paraneurachne muelleri*, **Cenchrus ciliaris* and **Cenchrus setiger* very open tussock grassland and *Triodia epactia* very open hummock grassland.
3 – CLAY PAN: *Acacia aneura* low woodland, over *Acacia synchronicia* high shrubland, over sparse to closed **Cenchrus* spp. tussock grassland	
3a	*Acacia aneura* var. *aneura*, *Acacia pruinocarpa* and *Hakea lorea* subsp. *lorea* scattered high shrubs, over *Acacia synchronicia* low to high open shrubland, over *Sclerolaena cornishiana*, *Senna artemisioides* subsp. *helmsii*, *Senna artemisioides* subsp. *oligophylla*, *Eremophila lanceolata* and *Sida fibulifera* low open shrubland, over *Chrysopogon fallax*, **Cenchrus ciliaris*, *Enneapogon polyphyllus*, *Aristida contorta* and *Eulalia aurea* open tussock grassland.
3b	*Acacia aneura* var. *aneura* low woodland, with scattered *Hakea lorea* subsp. *lorea*, *Acacia pruinocarpa*, *Corymbia hamersleyana* and *Acacia citrinoviridis* low trees, over *Acacia synchronicia* and *Acacia aneura* var. *aneura* (seedlings) high shrubland, over *Sclerolaena cornishiana* and *Eremophila lanceolata* low shrubland, over **Cenchrus ciliaris*, **Cenchrus setiger Enneapogon polyphyllus*, *Chrysopogon fallax* and *Eulalia aurea* open tussock grassland.
4 – MINOR CHANNEL / DEPRESSION: *Acacia aneura* low open to closed forest	
4a	*Acacia aneura* (var. *aneura* and var. *macrocarpa*) low closed forest, over scattered *Acacia synchronicia* and *Acacia sclerosperma* var. *sclerosperma* medium shrubs, over *Abutilon dioicum* and **Malvastrum americanum* low shrubland, over **Cenchrus ciliaris* and **Cenchrus setiger* closed tussock grassland.
4b	*Acacia aneura* var. *aneura*, *Corymbia hamersleyana* and *Eucalyptus victrix* low open forest, over **Cenchrus setiger* and **Cenchrus ciliaris* open tussock grassland.

VEG.UNIT NO.	VEGETATION DESCRIPTION
5 – FLOODPLAIN: *Acacia citrinoviridis*, *Corymbia hamersleyana*, *Acacia aneura* and *Acacia pruinocarpa* open woodland, over *Acacia* spp. high shrubland, over **Cenchrus* spp. closed tussock grassland	
5a	*Corymbia hamersleyana*, *Acacia citrinoviridis*, *Acacia aneura* var. *aneura*, *Acacia pruinocarpa*, *Hakea lorea* subsp. *lorea* and *Eucalyptus victrix* low open woodland, over *Acacia synchronicia*, *Acacia sclerosperma* subsp. *sclerosperma*, *Acacia dictyophleba* and *Acacia inaequilatera* high open shrubland, over *Sclerolaena cornishiana*, *Eremophila lanceolata* and *Sida fibulifera* low scattered shrubs, over **Cenchrus ciliaris* and **Cenchrus setiger* closed tussock grassland.
5b	*Acacia aneura* var. *aneura*, *Acacia citrinoviridis* and *Hakea lorea* subsp. *lorea* low open woodland, over *Acacia synchronicia* and *Acacia sclerosperma* var. *sclerosperma* open high shrubland, over **Cenchrus ciliaris*, **Cenchrus setiger* and *Chrysopogon fallax* closed tussock grassland.
5c	*Corymbia hamersleyana* scattered low trees, over *Acacia dictyophleba* high shrubland, over *Acacia dictyophleba* and *Acacia ancistrocarpa* shrubland, over **Cenchrus ciliaris* tussock and *Triodia basedowii* hummock grassland.
6 – LONGITUDINAL SAND DUNE: *Acacia dictyophleba* high shrubland, over *Triodia schinzii* open hummock grassland	
6	*Eucalyptus gamophylla* scattered mallee trees, over *Acacia dictyophleba* high shrubland, over *Sida cardiophylla* and *Crotalaria cunninghamii* shrubland, over *Corchorus tectus* low shrubland, over *Eragrostis eriopoda* and **Cenchrus ciliaris* open tussock grassland and *Triodia schinzii* open hummock grassland.
7 – SWALE BETWEEN DUNES: *Acacia* spp. medium to high open shrubland, over *Triodia basedowii* and *Triodia schinzii* hummock grassland	
7	*Acacia inaequilatera* and *Hakea lorea* subsp. *lorea* scattered low trees, over *Acacia sclerosperma* subsp. *sclerosperma* and *Acacia pachyacra* medium to high open shrubland, over *Corchorus tectus*, *Petalostylis cassioides* and *Bonamia rosea* low open shrubland, with a mixed *Triodia basedowii* and *Triodia schinzii* hummock grassland.
8 – SANDY PLAIN / MINOR FOOTSLOPE: *Corymbia hamersleyana* scattered trees, over *Acacia* spp., *Eucalyptus gamophylla* and *Grevillea wickhamii* medium to high shrubland, over *Triodia basedowii* hummock grassland	
8a	*Corymbia hamersleyana* scattered low trees, over *Eucalyptus gamophylla* low mallee woodland, over mixed scattered medium shrubs of *Acacia inaequilatera*, *Acacia ancistrocarpa*, *Acacia pachyacra*, *Grevillea wickhamii* subsp. *hispidula*, *Senna artemisioides* subsp. *oligophylla* and *Scaevola spinescens*, over *Triodia basedowii* hummock grassland.
8b	*Acacia pachyacra* medium to high open shrubland, over *Acacia ancistrocarpa*, *Corchorus tectus*, *Bonamia rosea*, *Dicrastylis cordifolia* and *Indigofera monophylla* scattered low shrubs, over *Triodia basedowii* hummock grassland.
8c	*Corymbia hamersleyana* scattered low trees, occasionally over *Eucalyptus gamophylla* mallee trees, over *Acacia inaequilatera* high open shrubland, over *Acacia pachyacra*, *Acacia dictyophleba*, *Petalostylis labicheoides* and *Hakea chordophylla* high to medium shrubland, over *Corchorus tectus*, *Hibiscus sturtii* var. *platychlamys* and *Ptilotus astrolasius* var. *astrolasius* low open shrubland, over *Triodia basedowii* closed hummock grassland, with scattered tussock grasses.
8d	*Acacia pyrifolia* var. *pyrifolia* scattered low trees, over *Acacia tumida* var. *pilbarensis* and *Acacia ancistrocarpa* high open shrubland, over *Petalostylis labicheoides*, *Indigofera monophylla* and *Corchorus parviflorus* low open shrubland, over *Aristida inaequiglumis* and *Aristida holathera* var. *holathera* tussock grassland and *Triodia basedowii* scattered hummock grassland.
8e	*Grevillea wickhamii* subsp. *hispidula* medium to high shrubland, with scattered *Acacia inaequilatera* and *Hakea chordophylla* high shrubs, over *Acacia ancistrocarpa*, *Senna artemisioides* subsp. *oligophylla*, *Gossypium australe*, *Bonamia rosea*, *Indigofera monophylla* and *Corchorus tectus* low shrubland, over *Triodia basedowii* and *Triodia epactia* hummock grassland, with scattered tussock grasses.

3.0 SURVEY METHODS

The survey methods adopted by *ecologia* are aligned with the Environmental Protection Authority's *Guidance Statement No. 56* (EPA 2004) and *Position Statement No. 3* (EPA 2002).

The project area is located in the Pilbara biogeographic region. Based on the location and scale of the development, Guidance Statement No. 56 recommended that a Level 2 survey be undertaken. The purpose of a Level 2 field survey was to enhance the level of knowledge at a local scale, and required:

> "one or more visit/s in each season appropriate to the bioregion and the faunal group being surveyed. Generally, maximum survey will be the season that follows the season of maximum rainfall, but there will be need to time surveys according to seasonal activity patterns of some faunal groups (e.g. molluscs or amphibians)."

3.1 DETERMINATION OF SURVEY SAMPLING DESIGN AND INTENSITY

Prior to the development of survey methods, a review was undertaken of factors likely to influence survey design (Table 3.1).

Table 3.1 Factors Likely To Influence Survey Design (From EPA 2002)

FACTOR	RELEVANCE	COMMENT
Bioregion – level of existing survey/ knowledge of the region and associated ability to predict accurately.	The project area lies on the margin of the Fortescue and Hamersley subregions	The scope of the project requires a Level 2 survey. Coupled with the amount of contextual information, a two season survey was considered sufficient to document fauna of the project area and to determine the presence of conservation significant species. Numerous fauna surveys of similar scope have been conducted in the surrounding areas.
Landform special characteristics/ specific fauna/ specific context of the landform characteristics and their distribution and rarity in the region.	Six land systems occur within the project area.	The land systems are all typical of the surrounding region. Surveys were carried out within all land forms, except the River land system which amounts to 4% of the total project area.
Lifeforms, life cycles, types of assemblages and seasonality (e.g. migration) of species likely to be present.	Fauna activity can vary throughout the year.	Survey phases were chosen to coincide with levels of highest fauna activity, i.e. spring and autumn.
Level of existing knowledge and results of previous regional sampling (e.g. species accumulation curves, species/ area curves).	Reports of previous fauna surveys in project area available. Knowledge from areas surrounding project area is high.	Numerous fauna surveys of similar scope have been conducted in the surrounding areas. Nine surveys were used to determine the regional fauna (Appendix C), and accumulated data were used to help assess survey adequacy.

FACTOR	RELEVANCE	COMMENT
Number of different habitats or degree of similarity between habitats within a survey area.	The project area contained four significantly different fauna habitats.	Five main fauna habitats were identified, as discussed in Section 4.2. Systematic survey sites were established in locations that allowed the assessment of each fauna habitat.
Climatic constraints (e.g. temperature or rainfall that preclude certain sampling methods).	No significant climatic events occurred during the survey.	Climatic factors did not preclude any sampling methods from being used in this survey. However, due to dry conditions, recorded amphibian activity was low.
Sensitivity of the environment to the proposed activities.	Seventeen conservation significant fauna species potentially occur in the project area.	Sensitivity of the environment is assessed by the potential or actual presence of conservation significant fauna in the project area and the effect on the habitat associated with it. It is determined using previous knowledge and Level 2 surveying techniques.
Size, shape and location of the proposed activities.	The project area is approximately 96 km^2 in size, comprising a main pit and relevant infrastructure.	All major and relevant fauna habitats within the lease were systematically surveyed, and opportunistic surveys were conducted in areas of all proposed infrastructure.
Scale and impact of the proposal.	The project proposes to disturb a total of 3,300 ha of land.	The location and scale of the project warrants a Level 2 survey (detailed field survey), in accordance with EPA guidelines. A two phase Level 2 field survey was undertaken as per the guidelines contained in the EPA's *Guidance Statement No. 56*.

3.2 LITERATURE REVIEW AND DATABASE SEARCHES

Several databases were consulted in the preparation of potential fauna (and conservation significant fauna) lists:

- Western Australian Museum FaunaBase;
- Birds Australia Birdata (one degree square containing point 22.49 °S, 119.05 °E);
- Department of the Environment, Water, Heritage and the Arts protected matters database (circle with 50 km radius around the point 22.34 °S, 119.15 °E); and
- DEC Threatened Fauna database (square with NW corner 22.04 °S, 118.45 °E, and SE corner 23.07 °S, 119.46 °E) (Appendix B)

The reports of nine previous biological surveys that have been carried out within 50 km of the project area were also consulted (Table 3.2).

Table 3.2 Previous Surveys within 50 km

SURVEY LOCATION	DISTANCE FROM PROJECT AREA (km)
Marillana (Tenement ML70/270 SA Sec 2) (*ecologia* 2006c)	10
Kurrajura to Yandi (*ecologia* 2008f)	15
Yandicoogina (IES 1981)	20
Yandi Stage II (*ecologia* 1995)	25
Yandi E3, E5, E6, W1, W2 (*ecologia* 2006d)	25
Marillana Creek (HGM 1999)	25
Ministers North (*ecologia* 2006a)	30
Yandi (*ecologia* 2008e)	30
Jirridi (*ecologia* 2006b)	45

3.3 SURVEY TIMING

The survey was conducted in two phases in 2008. Phase one was conducted in autumn, from 25th April to 7th May 2008. Phase two was conducted in spring, from 30th August to 10th September 2008.

Table 3.3 Summary of Survey Duration

SURVEY	DURATION	PERSON DAYS
Phase 1	13 days	52
Phase 2	12 days	44
TOTAL		96

3.4 SITE SELECTION

Trapping sites were pre-selected by reviewing aerial photographs and land system maps. All potential sites were visited at the start of the Phase 1 survey and six trapping sites were selected based on fauna habitat quality and accessibility as systematic survey sites (Figure 3.1), with a focus on sampling the four main fauna habitat types described in Section 4.2. Site descriptions and photographs are given in Table 3.4.

Eighteen opportunistic sites were also selected throughout the project area to assess fauna habitats not covered by the systematic survey and to sample areas of the project footprint more directly associated with proposed infrastructure at time of survey.

Five of the six land systems located within the project area were sampled during the surveys (Table 3.5). The River land system was not surveyed as it made up less than 4% of the total project area. Additionally it did not contain any unique fauna habitat types not already covered by the other systematic and opportunistic survey sites, and there were no tracks present to enable access to this area. All eight major vegetation units were sampled during the survey, including 14 of the 17 vegetation subunits described in Section 0 (Table 2.2).

Existing tracks were used to access all sites including main roads and tracks created during the development of exploration drill pads. The location of each site and the associated land systems and vegetation communities are shown in Table 3.5.

Table 3.4 Site Habitat Descriptions

SITE NUMBER AND DESCRIPTION	SITE PHOTO
Site 1 **Sandy plain / minor footslope (Veg Unit 8a)** Moderate/sparse acacia shrubs and sparse grevillea over dense spinifex and sparse tussock grass on dark red sand. Intersected by shallow creekline.	
Site 2 **Sandy plain / minor footslope (Veg Unit 8c)** Low open shrubland of sparse grevillea and hakea shrubs, over tussock grass and scattered spinifex.	
Site 3 **Creekline (Veg Unit 1b)** Tall eucalypt and corymbia riverine trees over open tussock grassland bordering coarse gravel creekbed.	

SITE NUMBER AND DESCRIPTION	SITE PHOTO
Site 4 **Longitudinal sand dune (Veg Unit 6)** Medium mixed acacia shrubs over moderately dense spinifex and tussock grassland on dark red sand dune system.	
Site 5 **Claypan and minor channel / depression (Veg Unit 3b and 4a)** Medium dense low mulga woodland over mixed shrubs and tussock grass on red clay soil. Area heavily disturbed by cattle.	
Site 6 **Minor channel / depression (Veg Unit 4a)** Dense mulga woodland over sparse mixed shrubs and thick tussock grass on red clay soil. Area heavily disturbed by cattle.	

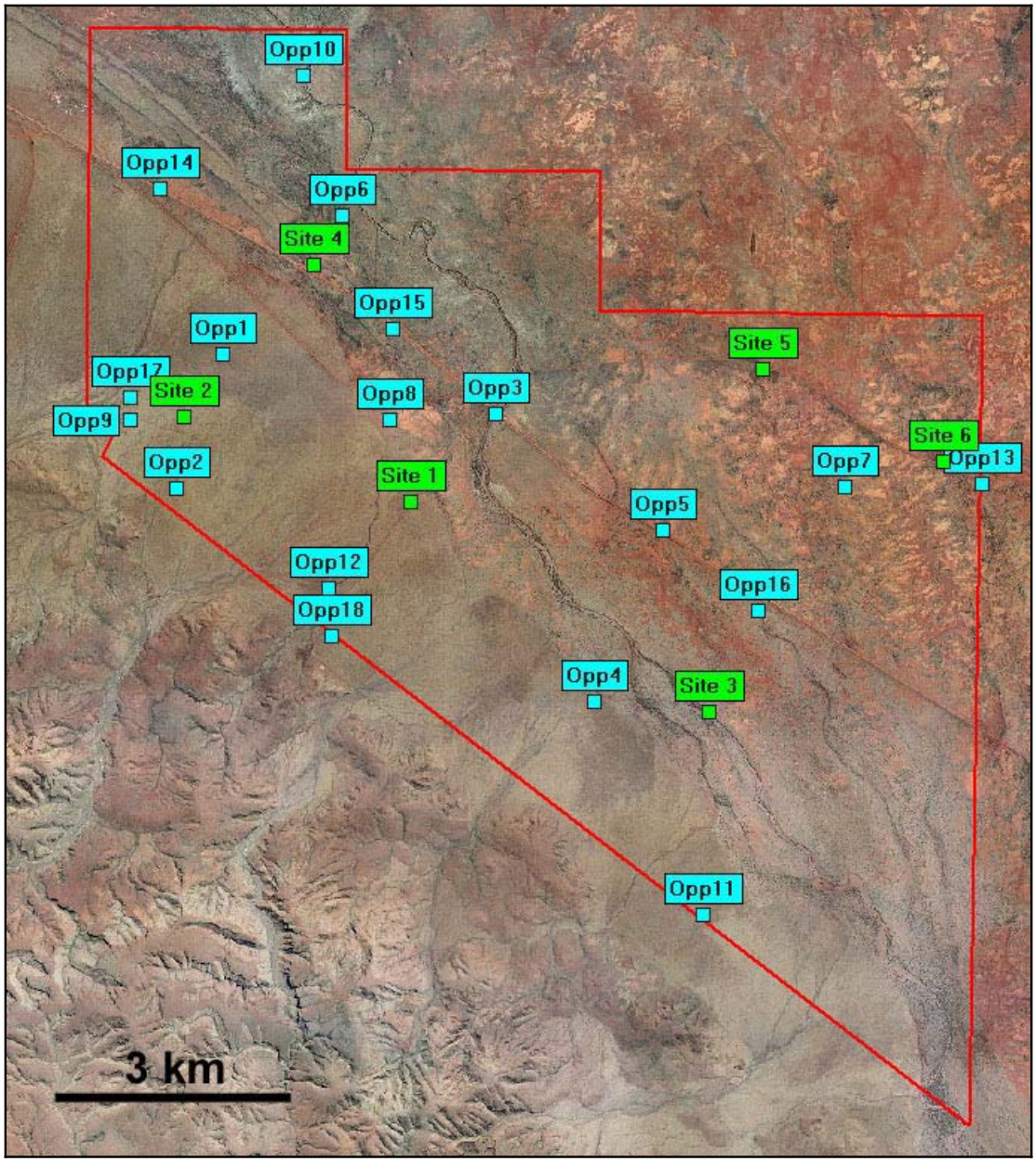

Figure 3.1 Location of Fauna Sites within the Project Area

Key:
— Project Area Boundary
■ Systematic Site Locations
■ Opportunistic Site Locations

Table 3.5 Survey Sites, Land Systems and Vegetation Communities

SITE	LAND SYSTEM	VEGETATION COMMUNITY	LOCATION	
			E	N
Systematic Sampling				
1	Divide	Sandy plain/foot slope (8a)	730553	7500097
2	Boolgeeda	Sandy plain/foot slope (8c)	727521	7501242
3	Fortescue	Creekline (1b)	734566	7497263
4	Fortescue	Longitudinal sand dune (6)	729253	7503271
5	Turee	Claypan (3b) Minor channel/depression (4a)	735279	7501879
6	Fan	Minor channel/depression (4a)	737704	7500642
Opportunistic Sampling				
Opp1	Divide	Sandy plain/foot slope (8b)	728038	7502068
Opp2	Boolgeeda	Sandy plain/foot slope (8e)	727416	7500271
Opp3	Fortescue	Creekline (1a)	731701	7501269
Opp4	Boolgeeda	Sandy plain/foot slope (8c)	733028	7497421
Opp5	Fortescue	Minor channel/depression (4a)	733944	7499722
Opp6	Fortescue	Floodplain (5b)	729636	7503928
Opp7	Fan	Claypan (3b)	736369	7500294
Opp8	Fortescue	Claypan (3b)	730272	7501186
Opp9	Boolgeeda	Sandy plain/foot slope (8e)	726800	7501200
Opp10	Fortescue	Floodplain (5a)	729122	7505821
Opp11	Boolgeeda	Sandy plain/foot slope (8d)	734473	7494558
Opp12	Boolgeeda	Minor drainage channel on footslope (2)	729453	7498933
Opp13	Fan	Claypan (3b)	738217	7500336
Opp14	Divide	Longitudinal sand dune (6) Swale between sand dunes (7)	727205	7504300
Opp15	Fortescue	Floodplain (5a)	730309	7502411
Opp16	Fortescue	Creekline (1b)	735226	7498631
Opp17	Boolgeeda	Sandy plain/foot slope (8e)	726800	7501500
Opp18	Boolgeeda	Sandy plain/foot slope (8e)	729500	7498300

Note: all GPS locations are WGS84, Zone 50K. See Section 0 for vegetation unit descriptions.

3.5 SAMPLING METHODS

The survey was undertaken using a variety of sampling techniques, including systematic and opportunistic sampling. Systematic sampling refers to data methodically collected over a fixed time period in a discrete habitat type, using an equal or standardised sampling effort. The resulting information can be analysed statistically, facilitating comparisons between habitats and seasons. Opportunistic sampling includes data collected non-systematically fixed sampling sites.

Two phases of sampling were completed the first in autumn and the second in spring. Total survey effort is presented in Table 3.7.

3.5.1 Systematic Sampling

3.5.1.1 Terrestrial Mammals and Herpetofauna

Trapping for terrestrial mammals and herpetofauna was undertaken using a standardised trapping format comprising a combination of pit-fall traps, Elliott box traps, funnel traps and Sheffield cage traps.

Survey effort was recorded as the number of trap-nights surveyed at each survey site. A trap-night is defined as a single working trap open for one night. Sites surveyed during each phase were open for 10 consecutive nights.

Trap Specifications:

- Pit-fall traps and drift fences: five PVC pipes (16 cm diameter, minimum 50 cm deep) and five 20 L plastic buckets (30 cm diameter, 40 cm deep) were established at each site. A six metre flywire drift fence (30 cm high) bisected the pits, directing fauna into the traps.
- Elliott box traps: twenty medium sized Elliott box traps (9 x 9 x 32 cm) were placed at each site, and baited with Universal Bait (a mixture of peanut butter, rolled oats and sardines). One trap was placed in association with the pit trap whilst one trap was placed in between pit traps.
- Funnel traps: funnel traps (Ecosystematica Type III) were placed in association with drift fences. Twenty traps were used per site with a trap being placed at each end of the drift fence.
- Sheffield Cage traps: two traps were used per site with one trap placed at each end of the trap line.

3.5.1.2 Avifauna

Twenty-minute surveys were used to document the avifauna present at each of the fauna sites. During each set-time survey an ornithologist recorded the number of individuals of each species seen while actively searching a 2 ha area. This survey method is recommended for the ongoing Birds Australia *Atlas of Australian Birds* project.

Survey effort was concentrated between the three hours post-dawn and three hours pre-dusk, as these were deemed to be the optimal time to record most bird species. Surveys between these times were also conducted, as these surveys may yield species less frequently observed in the early morning or late evening, e.g. diurnal raptors.

3.5.1.3 Bats

Bat echolocation calls were recorded using an Anabat II system (Titley Electronics, Ballina, NSW) and identified by Mr Bob Bullen, an acknowledged expert in the field of bat call acoustic analysis. A recording was made at each site starting just before dusk. A summary of recording duration is presented in Table 3.7.

3.5.2 Opportunistic Sampling

3.5.2.1 Nocturnal Searching

The project area was searched at night using a combination of road transects using vehicle-mounted spotlights and opportunistic ground searches using head torches and hand held spotlights for nocturnal species such as geckos, snakes and nocturnal birds.

3.5.2.2 Diurnal Searching

Opportunistic sites were searched by hand for cryptic species, which comprised searching beneath the bark of dead trees, breaking open old logs, stumps and dead free-standing trees, investigating burrows, recording tracks, diggings and scats, and overturning logs and stones. Sites were selected on the basis of their representative nature of the study area, and also based upon whether they were well represented by the systematic trapping effort.

3.5.2.3 Opportunistic Sightings

Species observed while searching, travelling and during trap establishment within the project area during were recorded. Tracks, diggings, scats, burrows and nests were also recorded where possible.

3.6 ANIMAL ETHICS

Surveying was conducted as per *ecologia's* Animal Ethics Code of Practice, which conforms to Section 5 of the *Australian code of practice for the care and use of animals for scientific purposes* (NHMRC 2004). All fauna were identified in the field and released at the point of capture. No voucher specimens were lodged with the W.A. Museum.

3.7 TAXONOMY AND NOMENCLATURE

Nomenclature for amphibians within this report are as per the W.A. Museum FaunaBase. Nomenclature for mammals follows Van Dyck and Strahan (2008), birds are according to Christidis and Boles (2008) and reptiles follow Wilson and Swan (2008). References used for fauna identification are listed in Table 3.6.

Table 3.6 References Used for Identification

FAUNA GROUP	FIELD GUIDE
Mammals	Menkhorst and Knight (2004), Van Dyck and Strahan (2008)
Bats	Churchill (1998), Menkhorst and Knight (2004)
Birds	Simpson and Day (2004)
Reptiles	Cogger (2000), Wilson and Swan (2008)
Geckos	Storr *et al.* (1990), Wilson and Swan (2008)
Skinks	Storr *et al*. (1999), Wilson and Swan (2008)
Dragons	Storr *et al.* (1983), Wilson and Swan (2008)
Varanids	Storr *et al.* (1983), Wilson and Swan (2008)
Legless Lizards	Storr *et al.* (1990), Wilson and Swan (2008)
Snakes	Storr *et al*. (2002), Wilson and Swan (2008)
Amphibians	Tyler *et al.* (2000), Cogger (2000)

3.8 DATA ANALYSIS

3.8.1 Species Richness

The number of species present (species richness) is the simplest representation of species diversity (Fowler and Cohen 1990; Magurran 2004) and is the primary indicator of diversity used in this survey. Species richness can be defined as the number of species of a given taxon in a given assemblage.

3.8.2 Randomised Species Accumulation Curves

Aspects of the level of survey adequacy and completeness are estimated using species accumulation curves (SACs).

SACs graphically illustrate the accumulation of new species as more individuals are recorded. Ultimately, the asymptote is reached at which no new species are present. The estimators ICE and Chao 1 were used (Magurran 2004) to estimate this theoretical maximum for each fauna group, based on empirical data. This allows the reader to gauge the effectiveness of the survey as the number of species recorded is compared with the number predicted, in order to determine survey adequacy.

3.8.3 Habitat Cluster Analysis

PATN analysis is a method used to identify relationships between sets of objects using quantitative multivariate data. PATN analysis has been used in this report to determine similarities between sites based on the faunal assemblages trapped at each site. The level of similarity between sites with respect to fauna composition indicates similarity in fauna habitat present at these sites. Similarity levels may differ depending on whether terrestrial fauna (mammals, reptiles, amphibians) or birds were surveyed.

The software program PATN was used to identify and describe fauna habitat types based on the faunal assemblages recorded at the sites, using presence / absence of species as the input data (Belbin 1989).

Table 3.7 Survey Effort

SITE	PIT TRAP (TRAP NIGHTS)		FUNNEL (TRAP NIGHTS)		ELLIOTT (TRAP NIGHTS)		CAGE (TRAP NIGHTS)		BIRD CENSUS (MIN)		DIURNAL SEARCH (MIN)		NOCTURNAL SEARCH (MIN)		BAT RECORDINGS (MIN)	
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
Site 1	100	100	200	200	200	200	20	20	140	240	135	180	160	100	75	610
Site 2	100	100	200	200	200	200	20	20	120	240	170	180	120	100	-	610
Site 3	100	100	200	200	200	200	20	20	120	260	120	180	180	60	100	140
Site 4	100	100	200	200	200	200	20	20	140	280	160	180	180	90	90	140
Site 5	100	100	200	200	200	200	20	20	120	320	120	120	120	90	*	*
Site 6	100	100	200	200	200	200	20	20	120	400	120	135	160	90	140	610
Opp Sites	-	-	-	-	-	-	-	-	-	-	950	2290	120	120	100	180
Total	**600**	**600**	**1200**	**1200**	**1200**	**1200**	**120**	**120**	**760**	**1740**	**1775**	**3265**	**1040**	**650**	**505**	**2290**

* Anabat recordings were not made at this site due to the similar habitat type and close proximity to Site 6.

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3.9 SURVEY TEAM

The survey was planned and executed by:

1025 Wellington Street
WEST PERTH WA 6005
Phone: (08) 9322 1944
Mob: 0400 325 891
Fax: (08) 9322 1599

Survey Staff: Dawn Fleming
Elizabeth Fox
Thomas Rasmussen
Jason Nolthenius
George Swann
Dean Bradshaw
Vicky Cartledge
Jarrad Evans

The surveys were conducted under DEC licence SF006308.

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4.0 RESULTS

4.1 FAUNA ASSEMBLAGES

Based on information from database searches and records of previous surveys in or near the project area, 35 native and five introduced mammal species, 114 bird species, 96 reptile species and three amphibian species potentially occur in the project area (Appendix C).

The potential species list represents the maximum number of species that could utilise the project area and includes species likely to be resident, transient (migratory or nomadic) or vagrant. Some resident species, such as burrowing frogs, may be present in an area year-round, but are not readily recorded when dormant (e.g. during dry conditions for amphibians).

Another limitation of the potential species list is that it does not take into account variation in species abundance or presence over time. Because species richness and abundance exhibit seasonal and other cycles, only a proportion of the species potentially utilising an area will be present at any given time. Therefore, a survey typically only samples a subset of the total number of species that could potentially utilise an area over longer timeframes. Multiple season surveys, such as this one, attempt to average out this variation by repeat sampling.

The following sections describe the species recorded during the two-phase *ecologia* survey in the project area (Appendix D).

4.1.1 Mammals

Eighteen species of native mammal (Appendix D) of a potential 35 (Appendix C) were recorded during both phases of the survey.

The mammal species recorded include: three dasyurid species (*Dasykaluta rosamondae*, *Sminthopsis macroura*, and *Sminthopsis youngsoni*); one macropod (*Macropus rufus*); 10 bat species (*Saccolaimus flaviventris*, *Taphozous georgianus*, *Taphozous hilli*, *Chaerephon jobensis*, *Mormopterus beccarii*, *Chalinolobus gouldii*, *Nyctophilus bifax daedalus*, *Nyctophilus geoffroyi*, *Scotorepens greyii* and *Vespadelus finlaysoni*); three rodent species (*Notomys alexis*, *Pseudomys desertor*, and *Pseudomys hermannsburgensis*); and the Dingo (*Canis lupus dingo*).

Six conservation significant mammal species potentially occur in the project area, none of which were recorded during the survey (see Section 5.0).

4.1.2 Birds

There is the potential for 114 bird species from 44 families to occur within the project area (Appendix C). Eighty-two species were recorded in the survey.

The list of potential bird species includes nine species of conservation significance, two of which were recorded in this study. These were the Australian Bustard (*Ardeotis australis*), listed as Priority 4 by DEC and the Rainbow Bee-eater (*Merops ornatus*), listed as Migratory under the EPBC Act.

4.1.3 Reptiles

Of 95 reptile species potentially occurring in the project area, 43 species were recorded during the survey. Seven of the nine potential families were recorded. The skinks (scincidae), geckos (gekkonidae), dragons (agamidae), goannas (varanidae) and venomous land snakes (elapidae) were well represented with 13, nine, seven, six and five

species found from these families respectively. Three legless lizards (Pygopodidae) and one blind snake (Typhlopidae) were also recorded.

Neither of the two reptiles of conservation significance potentially occurring in the project area were recorded during the survey.

4.1.4 Amphibians

Three amphibian species have been identified as potentially occurring in the project area. However, no amphibians were recorded during the survey likely due to dry conditions prior to and during the survey precluding amphibian activity. All of the potential species, except *L. rubella*, are burrowing frogs that can survive long periods of drought by remaining buried deep in the soil substrate. They burrow into moist soil, *Uperoleia russelli* particularly prefer sandy areas, near the river bed or floodplains with long-standing water after floods. Since the Weeli Wolli creek is the only substantial source of water within the project area, frogs are unlikely to be found away from this area, and hence are unlikely to be impacted by the mining developments occurring in the south of the tenement.

4.1.5 Introduced Species

Five introduced mammal species were recorded during the survey. These were the House Mouse (*Mus musculus*), Cat (*Felis catus*), Horse (*Equus caballus*), Cow (*Bos taurus*) and European Rabbit (*Oryctolagus cuniculus*).

4.2 FAUNA HABITATS

Five main fauna habitat types were identified in the project area during site selection, and these were chosen for systematic sampling. Open plain habitat makes up the majority of the project area south-west of Weeli Wolli Creek, covering much of the Hamersley Range alluvium deposits. The open plains fall on two different land systems, Divide and Boolgeeda, providing two similar but sufficiently distinct fauna habitat types: sandy spinifex grassland and stony spinifex plains.

4.2.1 Sandy Spinifex Grassland

This habitat was found in the Divide land system. The soil was sandier in composition and supported much thicker spinifex hummock grassland (*Triodia* sp.) than anywhere else within the project area. Systematic survey Site 1 and opportunistic Site 4 sampled this habitat.

The predominantly sandy substrate, combined with the hummock grassland provided ideal habitat for a number of burrowing mammals and reptiles. The thick spinifex was utilised by goannas such as *Varanus eremius*. The skinks *Ctenotus helenae*, *Ctenotus pantherinus* and the Central Military Dragon (*Ctenophorus isolepis*) were found to be prevalent in this habitat.

Scattered acacia and eucalypts offer a carpet of leaf litter, which provided habitat for legless lizards (pygopods) and fossorial skinks such as *Lerista bipes*.

The Kaluta (*Dasykaluta rosamondae*), a carnivorous marsupial endemic to the Pilbara bioregion (McKenzie *et al.* 2003), is confined to subtropical arid hummock grassland (Menkhorst and Knight 2004). It was recorded primarily where hummock grass was thick and well established. Spinifex Hopping Mouse (*Notomys alexis*) and Sandy Inland Mouse (*Pseudomys hermannsburgensis*) used this habitat.

Spinifex hummocks in this habitat type were also inhabited by ground-dwelling birds such as Spinifexbird (*Eremiornis carteri*). Thick, long-unburnt cover of spinifex had the potential to provide habitat for Night Parrot (*Pezoporus occidentalis*), which is listed Endangered under the EPBC Act and Schedule 1 under the WC Act. A lack of records for the Night

Parrot, due to its extremely secretive behaviour, means that its habitat preferences and distribution are not well known, however this habitat and the longitudinal sand dune habitat discussed below were considered possible, if improbable, areas of occurrence. This consideration was based on the limited available knowledge of its habitat, which suggests that Night Parrots inhabit spinifex (*Triodia* spp.) grasslands on stony or sandy terrain; samphire (*Sarcocornia* spp.) and chenopod shrublands on claypans, floodplains or the margins of saltlakes, and creeks or other water bodies (Higgins 1999).

The relative openness of the Sandy Spinifex Grassland also made this habitat suitable for the Australian Bustard, listed DEC Priority 4. This species was common throughout the project area. The Black Kite (*Milvus migrans*), which prefers to hunt in open plains, was also recorded here.

4.2.2 Stony Spinifex Plains

The Boolgeeda land system occupied the southern edge of the project area and comprised stony lower slopes and plains that supported hard and soft spinifex grasslands and mulga shrublands. It was punctuated by drainage lines from the Hamersley ranges that flowed toward Weeli Wolli Creek. Systematic survey Site 2 and opportunistic Sites 2, 3, 9, 11, 17 and 18 sampled this habitat.

This habitat supported a similar diversity of fauna to the sandy spinifex grassland but with a generally lower abundance of reptiles. *Ctenotus grandis* was an exception, with large numbers of hatchlings recorded during the autumn season survey

Sandy Inland Mouse (*Pseudomys hermannsburgensis*) and the Lesser Hairy-footed Dunnart (*Sminthopsis youngsoni*) were present in this more open habitat. The House Mouse (*Mus musculus*) was also recorded here.

The grassland birds Horsfield's Bushlark (*Mirafra javanica*) and Brown Songlark (*Cinclorhamphus cruralis*) were predominantly recorded in this habitat.

4.2.3 Creekline

Weeli Wolli creek traversed the project area from the north-west to the south-east. This riverine habitat consisted of tall eucalypt species bordering the gravel creekbed, with underlying acacia shrubs and tussock grass covering the floodplains. Systematic survey Site 3 and opportunistic Sites 3 and 16 sampled this habitat.

Accumulations of leaf litter below the eucalypts provided good habitat for the fossorial species such as *Lerista bipes* and *Lerista muelleri.* The Long-nosed Dragon (*Amphibolurus longirostris*) shows preference for this riverine habitat. Geckos such as the Tree Dtella (*Gehyra variegata*) and Bynoe's Gecko (*Heteronotia binoei*) were recorded.

Most of the bat species recorded during the survey were recorded in this fauna habitat type.

Many bird species preferred this habitat, including Red-browed Pardalote (*Pardalotus rubricatus*) and Striated Pardalote (*Pardalotus striatus*). Also recorded was Rainbow Bee-eater (*Merops ornatus*), listed as Migratory under the EPBC Act. Other species recorded in this habitat were White-plumed Honeyeater and Australian Ringneck.

4.2.4 Longitudinal Sand Dune

A longitudinal sand dune was situated in the north-western corner of the tenement and constituted a unique habitat in the project area. The sand dune had similar vegetation coverage to the sandy spinifex grassland, with well established hummock grass (*Triodia* sp.) providing thick shelter for several species. Systematic survey Site 4 and opportunistic Site 14 were established in the longitudinal sand dune fauna habitat.

The skinks *Ctenotus helenae*, Leopard Skink (*Ctenotus pantherinus*) and Central Military Dragon (*Ctenophorus isolepis isolepis*) were all common here. A dense, mid-storey cover of acacia shrubs in areas created thick leaf litter piles, along with thick loose sandy substrate, making ideal conditions for *Lerista bipes*. The Spinifex Slender Blue-tongue (*Cyclodomorphus melanops*) appeared to favour this habitat within the project area.

Low numbers of mammal species were recorded here, with only the Spinifex Hopping Mouse (*Notomys alexis*) and House Mouse (*Mus musculus*) present during the survey.

The dense, low shrubs adjacent to the dune provided suitable habitat for Variegated (*Malurus lamberti*) and White-winged (*Malurus leucopterus*) Fairy-wrens.

Longitudinal Sand Dune habitat also supported several bird of prey species.

4.2.5 Mulga Woodland

Habitat to the east of Weeli Wolli Creek was heavily disturbed by pastoral farming with much of the ground cover eaten or trampled by cattle, and the soil heavily compacted.

Two small patches of mulga woodland were systematically surveyed. Systematic survey Sites 5 and 6, and opportunistic Sites 5, 7, 8 and 13 were established in this habitat. A more extensive patch of mulga woodland was present in the north western corner of the project area. However, accessibility to this area was limited and currently no mining activity is planned there.

Mulga woodland provided habitat for gecko species such as Tree Dtella (*Gehyra variegata*), which inhabited bark and dead trees, and Fat-tailed Gecko (*Diplodactylus conspicillatus*) which inhabited spider burrows. Mulga dragon (*Caimanops amphiboluroides*) was recorded and *Ctenotus uber* was common in this habitat.

Stripe-faced Dunnart (*Sminthopsis macroura*), Red Kangaroo (*Macropus rufus*) and Dingo (*Canis Lupus dingo*) were the only native mammals recorded in this environment. Introduced animals included Cow (*Bos taurus*) and Horse (*Equus caballus*).

Several bird species typically associated with mulga woodlands such as Chestnut-rumped Thornbill (*Acanthiza uropygialis*), Hooded Robin (*Melanodryas cucullata*) and Red-capped Robin (*Petroica goodenovii*) were recorded in this habitat.

Birds of conservation significance observed at these sites were Australian Bustard (listed DEC Priority 4) and Rainbow Bee-eater (listed as Migratory under the EPBC act).

4.3 HABITAT CLUSTER ANALYSIS

The survey aimed to sample all terrestrial and avian fauna by selecting survey sites located in discrete habitats. The similarity of the habitats can be measured by examining the dendrogram produced as a result of multivariate analysis based on the fauna assemblages recorded in each survey site. Similar habitats, and the physical or environmental factors that make up the habitat, are expected to support similar fauna species. Therefore, by analysing the similarity of site faunal assemblages, we are able to examine the similarity of the fauna habitats – assuming that habitat is a major factor determining the fauna assemblage.

Results of multivariate analysis, using PATN, are presented below and are based on systematic data only. Opportunistic records were excluded because the lack of standardisation in the collection method makes the data unsuitable for comparison.

The dendrogram resulting from the PATN analysis grouped habitats as shown in Figure 4.1, and summarised in Table 4.1. The sites are split into three main groups; Sites 5 and 6 (isolated mulga woodland patches), Site 3 (creekline) and Sites 1, 2 and 4 (open habitat). Within the latter group, Sites 1 and 2 had the most overlap in fauna assemblages.

Sites 1 and 2 were closely associated, with the large similarity in fauna assemblages between the sites indicating a parallel habitat. These sites represent the open plains with low vegetation growth. Site 4, the longitudinal sand dune, also closely resembled these two sites, having a low ground cover of thick spinifex which provides habitat for similar species.

Site 3 stands alone in its faunal assemblage but has a closer affinity with Sites 1, 2 and 4, compared to Sites 5 and 6. The creekline provides habitat for some specialised fauna and provides a corridor throughout the project area.

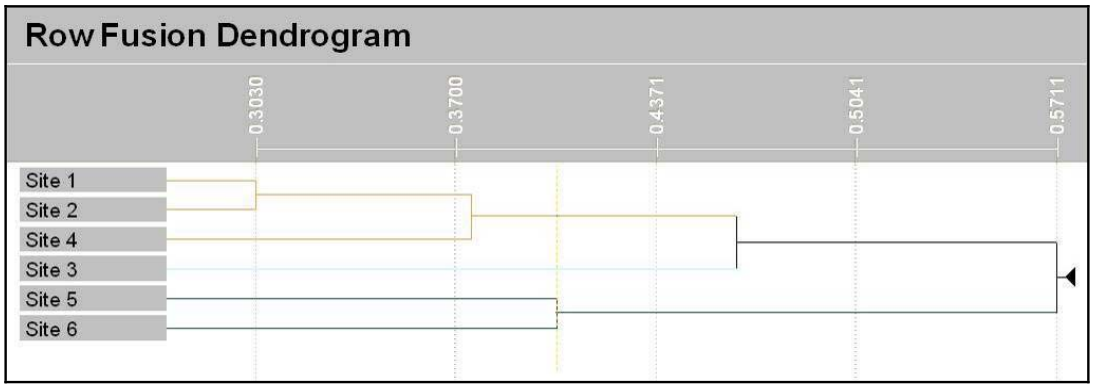

Figure 4.1 Site Habitat Similarity Dendrogram Based on Terrestrial Fauna Assemblages

Table 4.1 Habitat Groupings

SITE	HABITAT GROUP	LAND SYSTEM
1, 2	Sandy spinifex grassland, stony lower plains	Divide, Boolgeeda
4	Longitudinal sand dunes	Fortescue
3	Creekline	Fortescue
5, 6	Mulga woodland	Turee, Fan

4.4 SURVEY ADEQUACY

Survey adequacy can be assessed in two ways. The first is a traditional method that involves comparing the number of species recorded during the survey with the number of species potentially occurring in the project area, according to database searches, literature, previous reports and other references. The second compares the number of species recorded systematically with a theoretical maximum number of species, an estimate, based on the rate of accumulation of species as more individuals are collected during a survey, i.e. by using species accumulation curves to estimate the total number of species.

Using the first method, the number of potential fauna species is the maximum number of species that could potentially use the project area. Appendix C presents the potential species that could inhabit the project area, based on searches of the WAM FaunaBase, Birds Australia Birdata database, DEC rare fauna records and previous biological surveys in the project area and the vicinity (Section 0). Potential species lists include numerous non-residential, vagrant and/or transient species and do not take into consideration population fluctuations; in most cases they significantly overestimate the fauna assemblage inhabiting an area at any given time.

In the second method, randomised species accumulation curves (SACs) show the trend in total number of species recorded (species richness) as the number of individuals sampled increases. The total number of species recorded, represented by *Sobs* (species observed) statistic, approaches a plateau (the asymptote) when the majority of species present in an area have been recorded.

The richness estimator *Chao 1* (Colwell 2005) predicts the total number of species present in the project area at the time of trapping based on recording rates in the field. It estimates the total number of species that would have been recorded if surveying had continued indefinitely. Two other richness estimators, *ACE* and *ICE* were also used as comparison data in the graphics.

SACs are limited in that they only utilise data that are collected systematically (i.e. using trapping grids and fixed-time bird surveys). Consequently, species recorded opportunistically have to be excluded from the data analysed.

The advantage of SACs, however, is that when enough individuals are collected, and the accumulation curve nears the asymptote, a good estimate of the total number of trappable (reptiles, mammals and amphibians) or observable (birds) fauna that were present at the time of surveying can be obtained. Because they are based on empirical data, they are more effective in giving a more accurate representation of the likely total species richness than the traditional, distribution-based assessment. Survey adequacy, measured as that component of the fauna estimated or possibly present that was recorded, is compared using the two methods discussed above in Table 4.2.

SACs were generated for mammals (Figure 4.2), birds (Figure 4.3) and reptiles (Figure 4.4). Data from both phases and all sites were pooled.

As shown in Table 4.2, species accumulation curves suggested that the majority of the fauna were recorded, with the poorest trapping performance being in the reptiles. It would appear that the survey adequacy was high and the majority of mammals and birds were recorded. The SAC for reptiles demonstrates that, although 40 species were trapped, an asymptote was not yet reached, indicating a further 16 trappable species may have been expected. However, in all fauna groups the percent of observed versus expected trappable species was greater than 72%, indicating that survey effort was adequate. SACs were unable to be generated for amphibians as no individuals were recorded.

This contrasts markedly with the traditional method, using distribution to estimate the potential maximum number of species, which suggested that the survey recorded (on average) only approximately 60% of the fauna present. As discussed previously, some of the 'missing' species may be rare, unlikely to inhabit the project area based on the habitats present, or only transiently present. Consequently this method was considered to be less preferable for assessing survey adequacy than using species accumulation curves, but was included here because it has been widely used in the past.

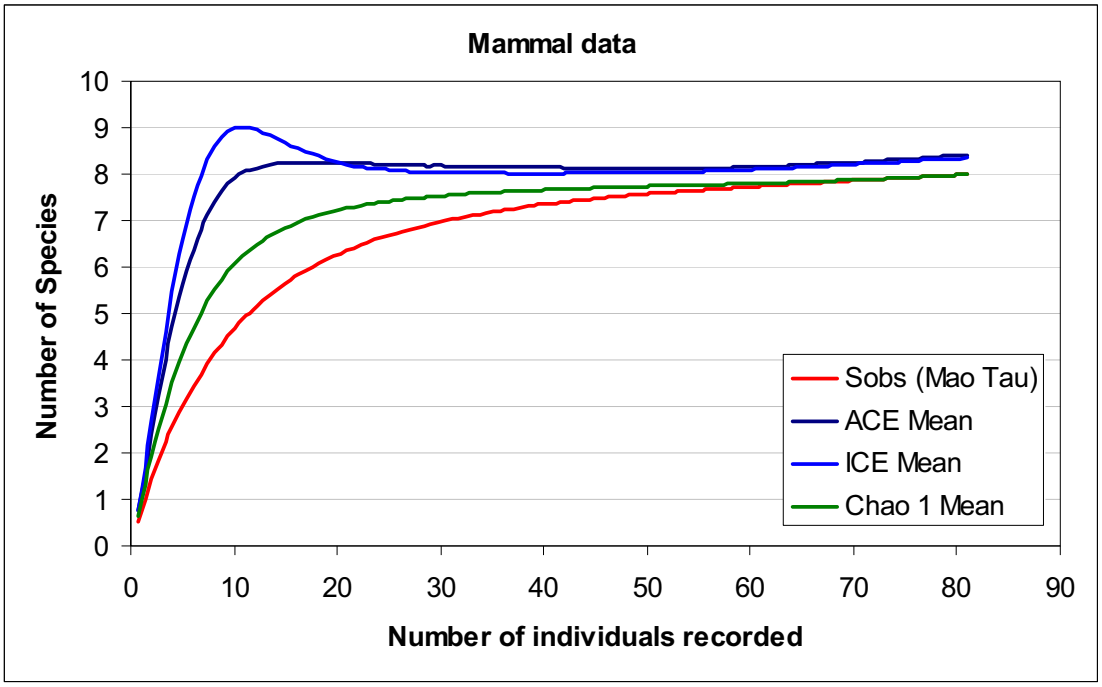

Figure 4.2 Species Accumulation Curve for Mammals

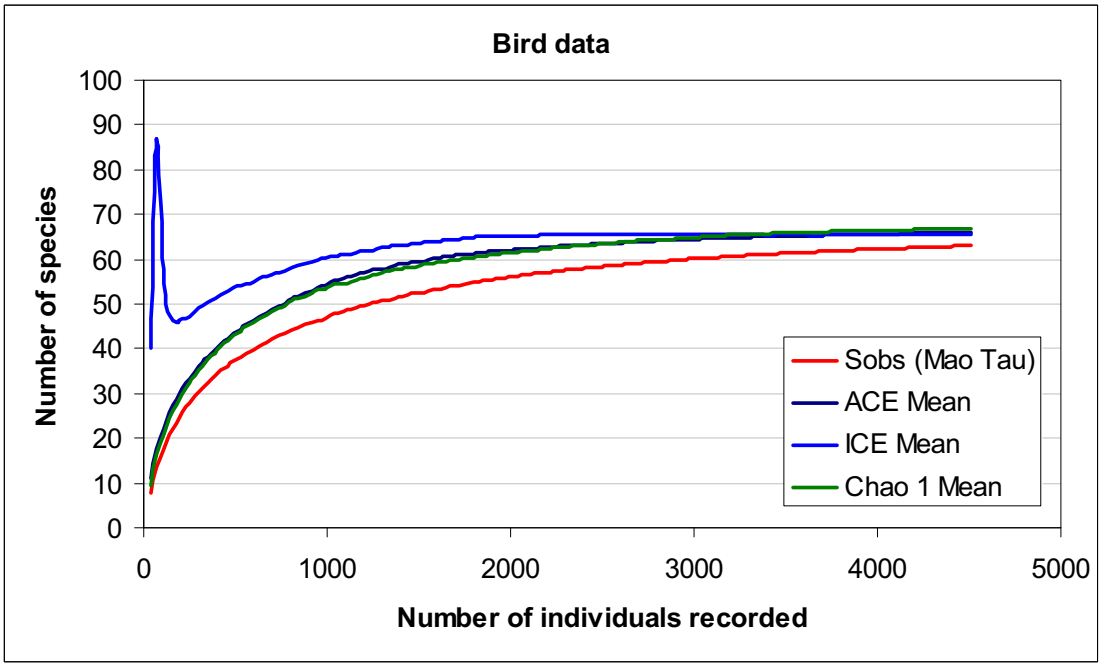

Figure 4.3 Species Accumulation Curve for Birds

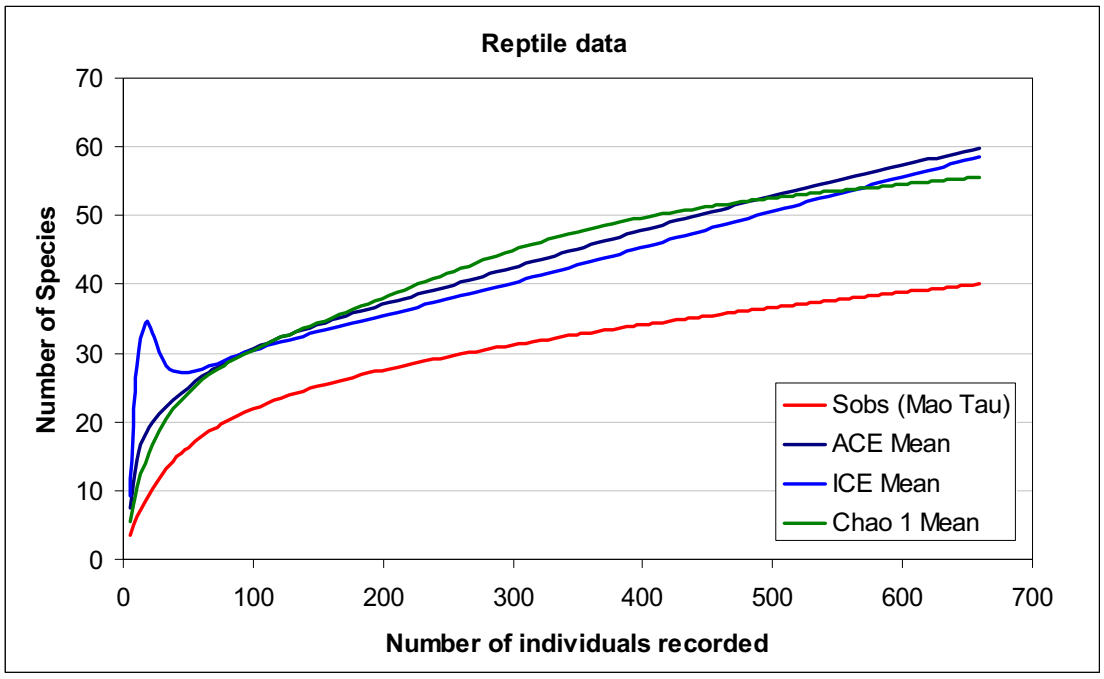

Figure 4.4 Species Accumulation Curve for Reptiles

Table 4.2 Percentage of Fauna Possibly Occurring

TAXON	SPECIES ACCUMULATION CURVES			DATABASES AND REFERENCES		
	OBSERVED SYSTEMATIC	ESTIMATED (*CHAO 1*)	PERCENT	OBSERVED ALL	POTENTIAL	PERCENT
Mammals*	7	8	88%	23	40	58%
Birds	63	67	94%	82	115	71%
Reptiles	40	56	72%	43	96	45%
Amphibians	0	-	-	0	3	0%

* Includes both native and introduced mammal species

4.5 SURVEY LIMITATIONS

Limitations of the current survey are summarised in Table 4.3 below. No significant constraints to the survey were encountered.

Table 4.3 Summary of Survey Limitations

CONSTRAINT	RELEVANT (yes/no)	COMMENT
Competency/ experience of the consultant carrying out the survey.	No	All members of survey team have had appropriate training, experience and mentoring in fauna identification and fauna assemblage surveys.
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No	Sampling methods were employed which were designed to adequately assess all vertebrate fauna groups. All necessary sampling methods were employed without constraints.
Proportion of fauna identified, recorded and/ or collected.	Yes - negligible	Most taxa were well sampled, but no amphibians were recorded due to dry conditions.
Sources of information (previously available information as distinct from new data).	No	Adequate information was available prior to the completion of this report, in the form of several reports of previous biological surveys in the Pilbara. Many of these biological surveys were conducted within 50 km of the project area.
The proportion of the task achieved and further work which might be needed.	No	A two-phase Level 2 comprehensive vertebrate fauna survey of the project area was completed, covering all fauna habitats present. The survey comprised of six systematic trapping sites and 18 opportunistic sites.
Timing/ weather/ season/ cycle.	Yes - negligible	Timing was planned to coincide with ideal seasons for the majority of fauna activity during both phases of the survey. However, lack of rainfall resulted in an under representation of amphibian fauna (no frogs were recorded out of a potential three species).
Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention).	No	No disturbances were experienced.
Intensity (in retrospect was the intensity adequate).	No	Survey intensity was adequate. As recommended by EPA guidelines, a comprehensive two phase fauna survey was conducted in the project area which concentrated on all habitat types.

CONSTRAINT	RELEVANT (yes/no)	COMMENT
Completeness (e.g. was relevant area fully surveyed).	No	The project area was fully surveyed over two seasons deemed to be the most appropriate for sampling vertebrate fauna, using a combination of systematic and opportunistic sampling throughout the project area. Species accumulation curves (Section 0), estimated that 88% of mammals, 94% of birds, and 72% of reptile species present at the time of survey were recorded within the project area. No amphibians were recorded out of a potential 3 species (all frogs).
Resources (e.g. degree of expertise available in animal identification to taxon level).	No	Sufficient expertise and resources were available during the survey (Section 3.9). All species were identified in the field and no voucher specimens were taken.
Remoteness and/ or access problems.	No	Access to all corners of the project area was easy, as the project area was intersected by well used roads and exploratory drill tracks. A minor exception was an extensive patch of mulga woodland in the north western corner, which had limited accessibility. However, smaller patches of mulga woodland were present in more easily accessible areas.
Availability of contextual (e.g. biogeographic) information on the region.	No	Sufficient contextual information was available on the Pilbara region and the project area, in the form of several databases and reports of previous fauna surveys.
Efficacy of sampling methods (i.e. any groups not sampled by survey methods).	Yes - negligible	Survey methods were suitable to record all vertebrate fauna groups. However, a lack of rainfall resulted in an under representation of amphibian fauna.

5.0 CONSERVATION SIGNIFICANT FAUNA

5.1 STATUTORY FRAMEWORK

Fauna species that have been formally recognised as rare, threatened with extinction, or as having high conservation value are protected by law under Commonwealth and State legislation. At the national level, fauna are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In WA, rare fauna are listed under the *Western Australian Wildlife Conservation Act 1950: Wildlife Conservation (Specially Protected Fauna) Notice 2008 (2)* (WC Act). International Agreements include the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA).

Schedule 1 of the Commonwealth EPBC Act contains a list of species that are considered Critically Endangered (CE), Endangered (EN), Vulnerable (VU), Extinct (EX), Extinct in the wild (EW) and Conservation Dependent (CD). Definitions of categories relevant to fauna occurring or potentially occurring in the project area are provided in Appendix A.

Classification of rare and endangered fauna under the WC Act recognises four schedules, as listed in Appendix A. In addition, the Department of Environment and Conservation (DEC) maintains a Priority Fauna list which includes those removed from the WC Act and other species known from only a few populations or in need of monitoring. Five Priority Codes are recognised, as detailed in Appendix A.

5.2 CONSERVATION SIGNIFICANT FAUNA

Seventeen species of conservation significance potentially occur in the Marillana Iron Ore project area. This number includes six mammal species, nine bird species and two reptile species.

Two species of conservation significance, the Australian Bustard (*Ardeotis australis*) and Rainbow Bee-eater (*Merops ornatus*) were recorded in the project area (Figure 5.1).

Table 5.1 provides a summary of the eight conservation significant fauna that were considered likely to occur in the Marillana project area, even if transiently, and more detailed information is given below. Night Parrot was also included for comment as its presence is difficult to ascertain and suitable habitat existed within the project area. Also included in Table 5.1 is a summary of conservation status, preferred habitat, likelihood of occurrence and risk of regional impacts, based on habitat requirements and previous records.

Information on the remaining nine species of conservation significance considered unlikely to occur within the project area is given in Appendix E.

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Table 5.1 Conservation Significant Fauna Potentially Occurring in the Project Area

SPECIES	CONSERVATION SIGNIFICANCE			HABITAT	PREVIOUS RECORDS	LIKELIHOOD OF OCCURRENCE & STATUS IF PRESENT	REGIONAL IMPACTS
	EPBC	WCA	DEC				
Mammals							
Northern Short-tailed Mouse (*Leggadina lakedownensis*)			P4	Spinifex and tussock grassland, acacia shrubland, woodlands, and stony ranges. Wide range of habitats, all on seasonally inundated red or white sandy-clay soils.	Record from Mulga Downs and from approximately 90 km (WAM) Recorded at Chichester Range survey 50 km from project area (*ecologia* 2008c).	**MEDIUM – RESIDENT** Some nearby records and suitable habitat present.	**LOW** Extensive suitable habitat adjacent to project area. Low impact to habitat in project area.
Birds							
Australian Bustard (*Ardeotis australis*)			P4	Open grasslands, chenopod flats and low heathland.	Recorded at several surveys conducted nearby (25 km)including Marillana Creek (HGM 1999).	**RECORDED – NOMADIC VISITOR** Likely to occur within project area at times	**NONE ANTICIPATED** Locally common. Suitable habitat adjacent to project area.
Rainbow Bee-eater (*Merops ornatus*)	M			Open country, most vegetation types, dunes, banks.	Numerous records from local region and recorded within project area.	**RECORDED – PARTIAL MIGRANT OR RESIDENT** Relatively common species. Nomadic and suitable habitat present.	**NONE ANTICIPATED** No impacts to adults anticipated, possible impacts to nest in sand banks. Regional population will not be affected.
Peregrine Falcon (*Falco peregrinus*)		S4		Coastal cliffs, riverine gorges and wooded watercourses.	Recorded at Mulga Downs, 90 km from project area (DEC rare fauna database). Also recorded at Yandi (*ecologia* 1995; *ecologia* 2008b) and at Yandicoogina (IES 1981), respectively 25 and 20 km from project area.	**MEDIUM – HUNTING VISITOR** Although this species may occasionally hunt within the project area, there is no suitable breeding habitat due to the absence of any rocky ridges within the project area.	**NONE ANTICIPATED** Foraging area much larger than area impacted by the project, no breeding habitat.
Grey Falcon (*Falco hypoleucos*)			P4	Lightly wooded coastal and riverine plains.	Recorded at Yandicoogina (*ecologia* 2008c) and Repeater 5 near Chichester Range (Integrated Environmental Services 1981), 50 km north-west.	**MEDIUM** The Grey Falcon is widespread but scarce in the Pilbara. There are some records of this species within range of the project area (*ecologia* 2008c; *ecologia* 2009) and potential breeding areas.	**NONE ANTICIPATED** Foraging area much larger than area impacted by the project. Breeding area at Weeli Wolli Creek will not be impacted.
Fork-tailed Swift (*Apus pacificus*)	M			Almost entirely aerial lifestyle. Nomadic.	Recorded at Jirridi (*ecologia* 2006b).	**MEDIUM – OVERFLYING VISITOR** Fork-tailed Swifts are likely to occasionally overfly the project area, since they are highly nomadic and associated with storm fronts that sweep through the Pilbara.	**NONE ANTICIPATED** **Entirely aerial, infrequent and** will not directly use habitat within project area.
Night Parrot (*Pezoporus occidentalis*)	EN	S1		Triodia hummock grassland or chenopod shrublands. Thick, long-time unburnt vegetation most suitable	Recorded from Minga well, approximately 35 km north-east of the project area (Davis and Metcalf 2008), and Mulga Downs approximately 90 km from project area (DEC rare fauna database).	**UNKNOWN** Paucity of records for this very elusive species results in lack of understanding of exact habitat preferences and distribution. The sandy spinifex grasslands and longitudinal sand dune habitats present in the project area may provide suitable habitat. However, because of its elusive nature, presence is difficult to ascertain.	**NONE ANTICIPATED** **Possible habitats for Night Parrot occur extensively outside of the lease**
Reptiles							
Pilbara Olive Python (*Liasis olivaceus barroni*)	VU	S1		Gorges and escarpments, Areas of permanent water.	Numerous records from local region Yandicoogina (IES 1981), Yandi (*ecologia* 1995; *ecologia* 2006d; *ecologia* 2008b) and Marillana Creek (HGM 1999).	**MEDIUM – TRANSIENT VISITOR** This species may utilise the creek area for hunting or dispersal if water is present.	**LOW** Generally restricted to gorges and escarpments, occurrence in project area should be limited.

Note: Description of conservation significance codes provided in Appendix A. EPBC = Environment Protection and Biodiversity Conservation Act 1999; WCA = *Wildlife Conservation Act 1950 Specially Protected Fauna Notice 2008(2)* DEC = DEC Priority fauna.

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5.2.1.1 Northern Short-tailed Mouse (*Leggadina lakedownensis*) – DEC Priority 4

Northern Short-tailed Mouse is distributed across northern Australia. The species has been recorded from diverse habitats ranging from the monsoon tropical coast to semiarid climates, including spinifex and tussock grasslands, samphire and sedgelands, acacia shrublands, tropical eucalyptus and melaleuca woodlands and stony ranges. Most habitats are seasonally inundated on red or white sandy-clay soils (Richards *et al.* 2008).

Populations fluctuate greatly, sometimes reaching plague proportions. Breeding is suggested to occur during the dry season (April to October)(Moro and Kutt 2008). This species is nocturnal and spends its days in simple, single-chambered burrows (Moro and Kutt 2008).

Studies of this species in Queensland suggest that grazing pressure from pastoral and feral animals may threaten population sizes of *L. lakedownensis* in local areas. However, these populations can re-establish themselves after grazing pressure has been lessened (Moro and Kutt 2008). These impacts were present within the project area, which was situated on a pastoral station.

This species was recorded in the Chichester Range to the north during recent *ecologia* surveys (*ecologia* 2008c), where they were recorded on several occasions. It has a medium potential to occur within the project area but was not recorded during the surveys.

Impact to the regional population of the species would be considered low as it occurs widely outside of the project area.

5.2.2 Birds

5.2.2.1 Australian Bustard (*Ardeotis australis*) – DEC Priority 4

Australian Bustards are large ground-dwelling birds that occur throughout Australia, utilising a wide range of open habitats, including open or lightly-wooded grasslands, chenopod flats, plains and heathlands (Johnstone and Storr 1998). The species is unmistakeable in the field, being the only bird of its size and shape, and is usually encountered either singly or in small single-sex groups. Occasionally it occurs in flocks of more than 30 in remote areas (Johnstone and Storr 1998).

Australian Bustards are nomadic, ranging over very large areas, and their abundance varies locally and seasonally from scarce to common, depending on rainfall and food availability. Breeding occurs when conditions are favourable. In northern Australia, this is generally late in the wet season or early in the dry (January to March).

Although the population size is still substantial, there has been a large historical decline in abundance, particularly south of the tropics, but also across northern Australia (Blakers *et al.* 1984). This is a result of hunting, degradation of its grassland habitat by sheep and rabbits and predation by foxes and cats (Garnett and Crowley 2000). Bustards will also readily desert nests in response to disturbance by humans, sheep or cattle (Frith 1976; Garnett and Crowley 2000).

Australian Bustards were directly and indirectly recorded at Site 2 and Site 5 and also by four opportunistic sightings within the project area (Figure 5.1). This species appears to be relatively common in the project area. With the exception of Site 2 all observations were made north of the existing rail line.

Even though the Australian Bustard was recorded within the project area, it is a nomadic species which is relatively common in the Pilbara. Suitable habitat is widespread and common in surrounding areas and the regional population will not be significantly impacted.

5.2.2.2 Rainbow Bee-eater (*Merops ornatus*) – EPBC Act Migratory

The Rainbow Bee-eater is a strikingly colourful bird that lives almost anywhere suitable for hawking insects - principally bees, flies, dragonflies and grasshoppers. They are scarce to common throughout much of Western Australia, except for the arid interior, preferring lightly wooded, preferably sandy, country near water (Johnstone and Storr 1998). Rainbow Bee-eaters can occur as a resident, breeding visitor, postnuptial nomad, passage migrant or winter visitor. They are common in the Pilbara.

Rainbow Bee-eaters nests in burrows dug usually at a slight angle on flat ground, sandy banks or cuttings, and often at the margins of roads or tracks (Johnstone and Storr 1998). Eggs are laid at the end of the metre long tunnel from August to January and the young fledge after approximately 30 days.

Rainbow Bee-eaters were recorded at Sites 3, 4, 5, and 6. Survey records of this species were concentrated around the Weeli Wolli Creek system, and also the longitudinal sand dune in the NW of the project area. Individuals were also recorded opportunistically throughout the project area (Figure 5.1).

The most likely place for this species to breed within the project area, if it does, would be at Weeli Wolli Creek, where ideal sandy embankments occur. Neither the creek nor longitudinal sand dune is currently under threat from the proposed mining.

The Rainbow Bee-eater is common in the Pilbara, suggesting that proposed mining activity is unlikely to impact local or regional populations.

5.2.2.3 Peregrine Falcon (*Falco peregrinus*) – WC Act Schedule 4

This nomadic or sedentary falcon is widespread in many parts of Australia and some of its continental islands, but absent from most deserts and the Nullarbor Plain. It most commonly occurs near cliffs along coasts, rivers and ranges and around wooded watercourses and lakes. Peregrines feed almost entirely on birds, especially parrots and pigeons.

Peregrines primarily nest on ledges in cliffs, granite outcrops and in quarries, but may also nest in tree hollows around wetlands. Eggs are predominantly laid in September (Johnstone and Storr 1998). The species is considered to be moderately common in the Stirling Range, uncommon in the Kimberley, Hamersley and Darling Ranges, and rare or scarce elsewhere (Johnstone and Storr 1998).

Although this species may occasionally hunt within the project area, there is no suitable breeding habitat within it due to the absence of any rocky ridges. No impacts to the regional population of Peregrine Falcon are likely.

5.2.2.4 Grey Falcon (*Falco hypoleucos*) – DEC Priority 4

Grey Falcons are a rare, nomadic raptor species, sparsely distributed across much of arid and semi-arid Australia. In Western Australia, the current distribution is now thought to be restricted to north of 26°S (Johnstone and Storr 2004). Because the species is scarce, and occurs over a large area, sightings are very uncommon.

Grey Falcons prey primarily on birds, although reptiles and mammals are also taken (Johnstone and Storr 1998). Two to three eggs are laid in winter in the nests of other birds of prey and ravens, typically in tall eucalypt trees near water (Johnstone and Storr 1998).

The Grey Falcon is widespread but scarce in the Pilbara. There are a few records of this species in proximity to the project area (*ecologia* 2008c; *ecologia* 2009), and suitable hunting and breeding habitat (at Weeli Wolli Creek) does exist. Although the species therefore has potential to inhabit or breed within the project area, this conspicuous species

was not recorded during the surveys. It is therefore thought to be absent and the risk to the regional population minimal.

5.2.2.5 Fork-tailed Swift (*Apus pacificus*) – EPBC Act Migratory

The Fork-tailed Swift is a small insectivorous species with an almost entirely aerial lifestyle. This species is distributed from central Siberia and throughout Asia, breeding in north-east and mid-east Asia, and wintering in Australia and south New Guinea. It is a relatively common trans-equatorial migrant from October to April throughout mainland Australia (Simpson and Day 2004). In Western Australia the species begins to arrive in the Kimberley in late September, the Pilbara in November and in the South-west by mid-December (Simpson and Day 2004). In Western Australia, the Fork-tailed Swift is considered uncommon to moderately common near the north-west, west and south-east coasts, common in the Kimberley and rare or scarce elsewhere (Johnstone and Storr 1998).

Fork-tailed swifts are nomadic in response to broad-scale weather pattern changes. They are attracted to thunderstorms where they can be seen in flocks, occasionally up to 2,000 birds. They rarely land, living almost exclusively in the air and feeding entirely on aerial insects, especially nuptial swarms of beetles, ants, termites and native bees (Johnstone and Storr 1998).

Fork-tailed Swifts are likely to occasionally overfly the project area, since they are highly nomadic and associated with storm fronts that sweep through the Pilbara. However, they are almost entirely aerial and will not utilise habitat within project area.

5.2.2.6 Night Parrot (*Pezoporus occidentalis*) – EPBC Act Endangered, WC Act Schedule 1

The Night Parrot is a medium-sized, nocturnal parrot that spends much of its time on the ground. Historical evidence indicates that Night Parrots were distributed over much of semi-arid and arid Australia. Extremely secretive and difficult to flush, there are only 6 accepted records of Night Parrot since 1935, with three from the Pilbara region (Start 2008). The most recent record is from Minga well, located about 35 km north-east of the project area (Davis and Metcalf 2008).

Although biological information on this species is limited, Night Parrots are thought to inhabit a variety of habitats, the common element of which is dense, low vegetation near bodies of water. These habitats include *Triodia* (spinifex) grasslands in stony or sandy environments and samphire and chenopod shrublands.

Two fauna habitat types present in the project area, sandy spinifex grassland and longitudinal sand dune, have the potential to support Night Parrots, as they both have a thick and long unburnt cover of spinifex hummocks. Furthermore, there are several active bores present within and adjacent to the project area, potentially providing the drinking water required by the species.

The probability of Night Parrots occurring in the project area is difficult to estimate, as the species is unlikely to be recorded even in areas where it may be common. If the Night Parrot occurs in the project area, the sandy spinifex grassland and longitudinal sand dune habitats have the greatest potential to support this species, especially since similar suitable habitat occurs in the surrounding areas nearby.

Due to lack of nearby records and general scarcity of the species, the likelihood of Night Parrots occurring within the project areas is regarded as low. However, this estimate may be revised, should new records of the species near the project area emerge.

It is worth noting that of numerous targeted searches for this species, none has been successful, underlining the difficultly of detecting the species.

Under the current mining scope, the sandy spinifex grassland habitat, south of the Weeli Wolli Creek is likely to be heavily impacted by the proposed project. This may result in negative impacts for any Night Parrots that may be resident in this area. No mining activity is currently planned to impact the longitudinal sand dune habitat, suggesting no negative effects on the Night Parrot in this habitat.

5.2.3 Reptiles

5.2.3.1 Pilbara Olive Python (*Liasis olivaceus barroni*) – EPBC Act Vulnerable, WC Act Schedule 1

The Pilbara subspecies of the Olive Python only occurs in the ranges of the Pilbara region of Western Australia. It is a dull olive-brown or pale fawn python that can grow to 2.5 m. In the Pilbara it inhabits watercourses and areas of permanent water in rocky gorges and gullies (Garnett and Crowley 2000). This subspecies is an adept swimmer, regularly hunting in water, with which it is often associated. It feeds on a variety of vertebrates including rock wallabies, fruit bats and birds.

Radiotelemetry has found that individuals spend the cooler winter months sheltering in caves and rock crevices. In the warmer months the pythons can move widely, usually in close proximity to water and rock outcrops (Pearson 2006). In late winter or early spring males will travel large distances to find and mate with females. Eggs are laid in November and hatch approximately two months later.

Population size estimates are difficult due to the species cryptic nature and lack of a reliable trapping or census technique (TSSC 2008). The main threats to this subspecies are likely to come from predation from feral cats and foxes (particularly of juvenile pythons) competition with foxes for food, and destruction of habitat, principally due to gas and mining development (TSSC 2008).

The species prefers to inhabit the gorges and escarpments more typically found in the nearby Hamersley Range, but may attracted to the Weeli Wolli Creek for hunting, or as a conduit to dispersal, when water is present. For most of the year the species is unlikely to be affected by mining activities in the project area, but individuals may enter the area when the creek is in flood.

Pilbara Olive Pythons are widespread in the Pilbara and the impact to the regional population is expected to be negligible.

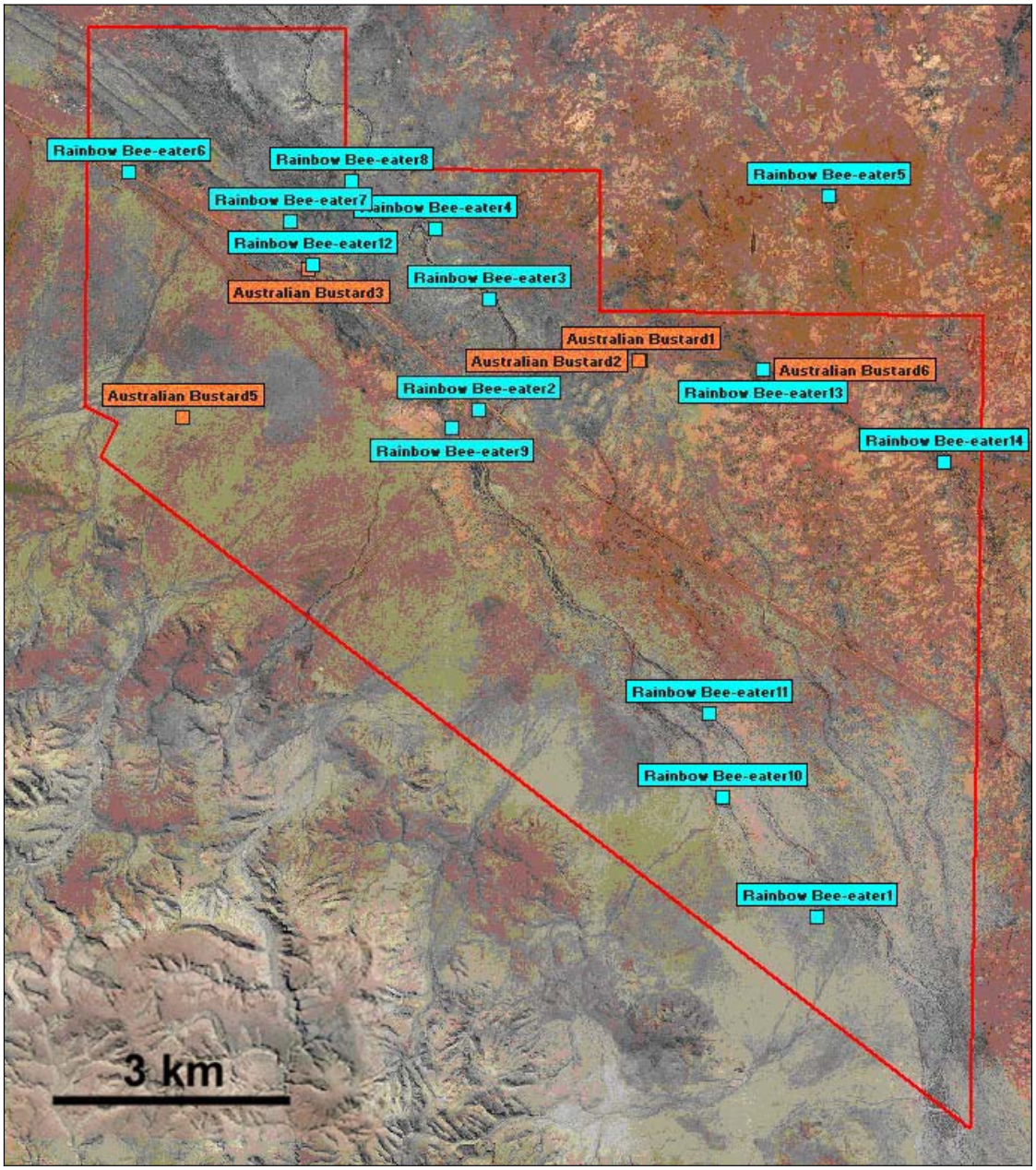

Figure 5.1 Locations of Conservation Significant Fauna Recorded

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6.0 IMPACT ASSESSMENT

6.1 IMPACTS ON FAUNA HABITATS

Five fauna habitats were recognised in the project area: sandy spinifex grassland, stony spinifex plains, creekline, longitudinal sand dune and mulga woodland.

6.1.1 Sandy Spinifex Grassland

The sandy spinifex plains habitat was concentrated on the Divide land system and supports thick, well-established spinifex clumps creating the suitable habitat for Little Red Kaluta (*Dasykaluta rosamondae*), a Pilbara endemic.

Some disturbance to this habitat is expected during implementation of mining infrastructure and the Divide land system (south of the Weeli Wolli Creek), which includes this habitat, is likely to be impacted by the proposed project.

Minimising disturbance to this habitat would reduce potential impacts to Night Parrot (*Pezoporus occidentalis*), which is thought to inhabit areas of mature spinifex.

6.1.2 Stony Spinifex Plains

This habitat is the most likely to be affected by the proposed project. One systematic and several opportunistic survey sites were located in this habitat (Figure 3.1). 'Open Plains' habitat incorporates some of the Divide land system and most of the Boolgeeda land system which is formed from the detrital alluvial deposits brought down from the Hamersley Ranges. Mining operations are concentrated within this area.

The Australian Bustard (*Ardeotis australis*) – DEC Priority 4 was recorded in this habitat. However, more sightings were recorded across the project area and this species not restricted to this habitat alone.

6.1.3 Creekline

The Weeli Wolli Creek system dissects the entire project area and constitutes the majority of the creekline habitat. It is located in the Fortescue Land System. Of the six land systems that occur in the Marillana project area, the Fortescue land system is the least represented in the Fortescue Plains (PIL2) bioregion. It has the largest proportion of its total area in the project area (8.31%) and stretches from the north-west corner towards the south-east.

Current mining operations are not expected to affect the Weeli Wolli Creek and therefore impacts to the Fortescue land system and associated habitats are expected to be minimal.

6.1.4 Longitudinal Sand Dune

A Longitudinal Sand Dune, situated in the north-west, was a unique habitat within the project area and surroundings. Like the Sandy Spinifex Grassland, it is located in the Divide land system and supports thick, well-established spinifex hummocks as well as moderately dense, low shrubs. It shows reasonably close affinity with Sites 1 and 2 in its terrestrial fauna assemblage and a close avian assemblage association with the creekline site (Site 3). It is suitable habitat for many mammal, bird and reptile species including, potentially, Night Parrot.

It is worth noting that mining activity is not expected to impact this habitat. If possible, impacts to this habitat should be avoided in the future.

6.1.5 Mulga Woodland

Mulga woodland was scarce and patchy throughout the project area. The two areas systematically sampled (Sites 5 and 6) were isolated pockets of this type of habitat. Surrounding areas are heavily disturbed by pastoral activity. Mulga woodland supports species unlikely to be found in other habitats. For example, *Ctenotus uber* was found in high numbers only at these sites and species like Mulga Dragon (*Caimanops amphiboluroides*) occur mainly in mulga woodlands.

Impact to these areas may reduce local biodiversity. However, there were no records of the conservation significant species *C. u. johnstonei* which would potentially favour this habitat, and mulga woodlands are widespread outside of the project area.

Currently there is no mining activity planned in this fauna habitat.

6.2 IMPACTS ON FAUNA ASSEMBLAGES

6.2.1 Biodiversity

The diversity of fauna assemblages of the Fortescue Plains (PIL3) IBRA subregion as a whole is unlikely to be significantly affected by the project. Most terrestrial fauna are expected to be able to move to adjacent areas of suitable habitat. However, sedentary fauna, e.g. burrowing species or species using leaf-litter or wood to shelter in, are likely to be impacted.

Vegetation communities may also experience secondary impacts from the mining activity, such as fire, dust and weeds, reducing the quality of local fauna habitats available and thereby reducing local diversity in the short term.

In the case of fire, there is the potential for large areas to be affected.

Weeds may be a problem in terms of over-competition for resources, leading to a reduction of biodiversity. For instance Buffel Grass (**Cenchrus ciliaris*) is readily spread by cattle, forming a single-species ground layer, and potentially with time excluding the recruitment of larger shrubs and trees.

Ultimately, biodiversity and ecological function are expected to recover as vegetation communities regenerate in rehabilitated areas and stabilise, allowing native fauna to re-colonise from adjacent areas. However, adequate weed management, including regular monitoring for exotic weeds, is important for revegetation to succeed in re-creating some of the original fauna habitats present prior to the project.

Those vegetation types that take the longest to fully regenerate are the ones containing mature eucalypts with hollows. In the project area these occur primarily along the Weeli Wolli Creek which as a whole is not expected to be impacted by mining.

6.2.2 Ecological Function

Localised reduction in ecological function can be expected as a result of habitat loss, fragmentation, traffic, noise, and pollution. However, ecological function at the regional scale is not expected to be significantly impacted, principally due to the small size of the impact area and the continuity of the fauna habitats with those in surrounding areas.

6.3 OTHER IMPACTS

Fauna are most likely to be affected by clearing and disturbance associated with construction and ongoing operations of the proposed mine. Minimising clearing and prompt rehabilitation will help reduce impacts associated with habitat loss. Secondary impacts to native fauna include feral fauna, dust, weeds, fire, light pollution and noise pollution. These impacts affect several other aspects of the project, not only fauna, and are

discussed in the Environmental Management Plan (EMP) for the project (currently being prepared by *ecologia*).

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Appendix A Conservation Codes

Appendix A1 Definitions of Relevant Categories under the *Environment Protection and Biodiversity Conservation Act 1999*

CATEGORY	DEFINITION
Endangered (EN)	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable (VU)	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Migratory (M)	Species are defined as migratory if they are listed in an international agreement approved by the Commonwealth Environment Minister, including: the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals) for which Australia is a range state; The Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA); or The Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Appendix A2 Definition of Schedules under the *Wildlife Conservation Act 1950*

SCHEDULE	DEFINITION
Schedule 1 (S1)	Fauna which are Rare or likely to become extinct, are declared to be fauna that is in need of special protection.
Schedule 2 (S2)	Fauna which are presumed to be extinct, are declared to be fauna that is in need of special protection.
Schedule 3 (S3)	Birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction are declared to be fauna that is in need of special protection.
Schedule 4 (S4)	Declared to be fauna that is in need of special protection, otherwise than for the reasons mentioned above.

Appendix A3 Definition of DEC Priority Codes

PRIORITY	DEFINITION
Priority One (P1)	Taxa with few, poorly known populations on threatened lands. Taxa which are known from few specimens or sight records from one or a few localities, on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority Two (P2)	Taxa with few, poorly known populations on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities, on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority Three (P3)	Taxa with several, poorly known populations, some on conservation lands. Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority Four (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 if present circumstances change. These taxa are usually represented on conservation lands.
Priority Five (P5)	Taxa in need of monitoring Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

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Appendix B DEC Rare Fauna Search Results

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Appendix C Regional Fauna Data

Legend

EPBC	EPBC Act List of Threatened Fauna
WCA	WA Wildlife Conservation Act
DEC	Declared Priority and Threatened Fauna List 2008
Birdata	Birds Australia Birdata database (www.birdata.com.au)
WAM	WA Museum FaunaBase (www.museum.wa.gov.au/FaunaBase)
Previous surveys consulted:	
A	Yandicoogina (IES1981)
B	Yandi (*ecologia* 1995; *ecologia* 2006d; *ecologia* 2008b; *ecologia* 2008e)
C	Marillana Creek (HGM 1999)
D	Marillana (Tenement ML70/270 SA Sec 2) (*ecologia* 2006c)
E	Jirridi (*ecologia* 2006b)
F	Ministers North (*ecologia* 2006a)
G	Yandi to Kurrajura (*ecologia* 2008f)
H	DEC Priority Fauna search

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Appendix C1 Mammals Potentially Occurring

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	A	B	C	D	E	F	G	H
NATIVE MAMMALS													
CANIDAE													
Canis lupus dingo	Dingo					✓	✓	✓		✓			
DASYURIDAE													
Dasykaluta rosamondae	Little Red Kaluta				✓	✓	✓						
Dasyurus hallucatus	Northern Quoll	EN	S1		✓								✓
Ningaui timealeyi	Pilbara Ningaui				✓	✓	✓	✓	✓	✓			
Planigale sp.	Common Planigale				✓	✓	✓						
Pseudantechinus macdonnellensis	Fat-tailed Antechinus						✓						
Pseudantechinus woolleyae	Woolley's False Antechinus				✓								
Sminthopsis macroura	Stripe-faced Dunnart				✓	✓	✓			✓			
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart				✓								
EMBALLONURIDAE													
Saccolaimus flaviventris	Yellow-bellied Sheath-tail Bat				✓	✓	✓			✓	✓	✓	
Taphozous georgianus	Common Sheath-tail Bat						✓			✓	✓		
Taphozous hilli	Hill's Sheath-tail Bat						✓						
HIPPOSIDERIDAE													
Rhinonicteris aurantia	Pilbara Leaf-nosed bat	VU	S1									✓	
MACROPODIDAE													
Macropus robustus	Euro				✓	✓	✓	✓	✓	✓	✓	✓	
Macropus rufus	Red Kangaroo					✓	✓		✓	✓			
Petrogale rothschildi	Rothschild's Rock-wallaby					✓	✓					✓	

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	A	B	C	D	E	F	G	H
MEGADERMATIDAE													
Macroderma gigas	Ghost Bat			**P4**						✓		✓	
MOLOSSIDAE													
Chaerephon jobensis	Northern Mastiff-bat				✓	✓	✓	✓		✓	✓	✓	
Mormopterus beccarii	Beccari's Freetail-bat				✓	✓	✓			✓	✓	✓	
Mormopterus planiceps	Little Mastiff-bat						✓						
Tadarida australis	White-striped Mastiff-bat						✓	✓					
MURIDAE													
Leggadina lakedownensis	Northern Short-tailed Mouse			**P4**									✓
Notomys alexis	Spinifex Hopping-mouse				✓	✓			✓				
Pseudomys chapmani	Western Pebble-mouse			**P4**	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pseudomys desertor	Desert Mouse				✓		✓			✓			
Pseudomys hermannsburgensis	Sandy Inland Mouse				✓	✓	✓	✓	✓	✓			
Zyzomys argurus	Common Rock-rat				✓		✓		✓				
THYLACOMYIDAE													
Macrotis lagotis	Greater Bilby	VU	S1										✓
VESPERTILIONIDAE													
Chalinolobus gouldii	Gould's Wattled Bat				✓	✓	✓	✓		✓	✓	✓	
Chalinolobus morio	Chocolate Wattled Bat				✓								
Nyctophilus bifax	Eastern Long-eared Bat				✓					✓	✓		
Nyctophilus geoffroyi	Lesser Long-eared Bat				✓	✓	✓			✓	✓	✓	
Nyctophilus major	Greater Long-eared Bat					✓							
Scotorepens greyii	Little Broad-nosed Bat				✓	✓	✓			✓	✓	✓	
Vespadelus finlaysoni	Finlayson's Cave Bat				✓	✓				✓	✓	✓	

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	A	B	C	D	E	F	G	H
INTRODUCED MAMMALS													
BOVIDAE													
Bos taurus	Cow						✓	✓		✓			
CAMELIDAE													
Camelus dromedarius	Camel					✓							
CANIDAE													
Canis familiaris	Dog						✓						
FELIDAE													
Felis catus	Cat					✓	✓			✓			
MURIDAE													
Mus musculus	House Mouse				✓	✓	✓	✓		✓			

Appendix C2 Birds Potentially Occurring

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	Birdata	A	B	C	D	E	F	G	H
CASUARIIDAE														
Dromaius novaehollandiae	Emu					✓	✓	✓	✓					
ANATIDAE														
Anas gracilis	Grey Teal					✓	✓	✓	✓					
Anas superciliosa	Pacific Black Duck					✓	✓	✓	✓				✓	
Cygnus atratus	Black Swan						✓							
COLUMBIDAE														
Geopelia cuneata	Diamond Dove					✓	✓	✓		✓	✓	✓	✓	
Geopelia striata	Peaceful Dove					✓		✓						
Geophaps plumifera	Spinifex Pigeon					✓	✓	✓		✓	✓	✓	✓	
Ocyphaps lophotes	Crested Pigeon					✓	✓	✓		✓	✓	✓	✓	
Phaps chalcoptera	Common Bronzewing					✓	✓	✓			✓	✓	✓	
PODARGIDAE														
Podargus strigoides	Tawny Frogmouth					✓		✓	✓		✓	✓		
EUROSTOPODIDAE														
Eurostopodus argus	Spotted Nightjar					✓	✓		✓		✓	✓	✓	
AEGOTHELIDAE														
Aegotheles cristatus	Australian Owlet-Nightjar					✓				✓	✓	✓	✓	
APODIDAE														
Apus pacificus	Fork-tailed Swift	**M**									✓			
PHALACROCORIDAE														
Phalacrocorax melanoleucos	Little Pied Cormorant					✓	✓		✓					
Phalacrocorax sulcirostris	Little Black Cormorant					✓	✓	✓						
PELECANIDAE														
Pelecanus conspicillatus	Australian Pelican						✓							
ARDEIDAE														
Ardea ibis	Cattle Egret	**M**				✓								

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	Birdata	A	B	C	D	E	F	G	H
Ardea modesta	Eastern Great Egret	**M**				✓	✓							
Ardea pacifica	White-necked Heron					✓	✓	✓	✓					
Egretta novaehollandiae	White-faced Heron					✓	✓	✓	✓				✓	
Nycticorax caledonicus	Nankeen Night-Heron							✓						
ACCIPITRIDAE														
Accipiter cirrhocephalus	Collared Sparrowhawk					✓	✓	✓	✓					
Accipiter fasciatus	Brown Goshawk					✓	✓	✓	✓		✓			
Aquila audax	Wedge-tailed Eagle					✓	✓	✓		✓	✓			
Circus assimilis	Spotted Harrier						✓	✓	✓	✓	✓			
Elanus axillaris	Black-shouldered Kite						✓	✓						
Haliastur sphenurus	Whistling Kite					✓	✓	✓					✓	
Hamirostra melanosternon	Black-breasted Buzzard							✓			✓			
Hieraaetus morphnoides	Little Eagle					✓		✓	✓				✓	
Lophoictinia isura	Square-tailed Kite					✓					✓			
Milvus migrans	Black Kite					✓	✓	✓					✓	
FALCONIDAE														
Falco berigora	Brown Falcon					✓	✓	✓	✓		✓	✓	✓	
Falco cenchroides	Nankeen Kestrel					✓	✓	✓		✓	✓			
Falco hypoleucos	Grey Falcon			**P4**			✓							
Falco longipennis	Australian Hobby					✓	✓	✓	✓		✓		✓	
Falco peregrinus	Peregrine Falcon		**S4**			✓		✓						✓
OTIDIDAE														
Ardeotis australis	Australian Bustard			**P4**		✓	✓	✓	✓		✓			✓
RECURVIROSTRIDAE														
Himantopus himantopus	Black-winged Stilt						✓							
CHARADRIIDAE														
Elseyornis melanops	Black-fronted Dotterel					✓	✓	✓	✓					

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	Birdata	A	B	C	D	E	F	G	H
TURNICIDAE														
Turnix velox	Little Button-quail				✓	✓	✓	✓	✓	✓	✓			
CACATUIDAE														
Cacatua sanguinea	Little Corella					✓	✓	✓	✓				✓	
Eolophus roseicapillus	Galah					✓	✓	✓	✓		✓		✓	
Nymphicus hollandicus	Cockatiel					✓	✓	✓	✓		✓			
PSITTACIDAE														
Barnardius zonarius	Australian Ringneck					✓	✓	✓		✓	✓	✓	✓	
Melopsittacus undulatus	Budgerigar					✓	✓	✓	✓	✓	✓	✓	✓	
Neopsephotus bourkii	Bourke's Parrot						✓							
Pezoporus occidentalis	Night Parrot	**EN/M**	**S1**											✓
Psephotus varius	Mulga Parrot										✓			
CUCULIDAE														
Cacomantis pallidus	Pallid Cuckoo					✓	✓	✓	✓	✓	✓	✓		
Chalcites basalis	Horsfield's Bronze-Cuckoo					✓	✓	✓	✓	✓	✓	✓		
Chalcites osculans	Black-eared Cuckoo							✓						
STRIGIDAE														
Ninox novaeseelandiae	Southern Boobook				✓	✓	✓	✓	✓				✓	
TYTONIDAE														
Tyto javanica	Eastern Barn Owl					✓					✓		✓	
HALCYONIDAE														
Dacelo leachii	Blue-winged Kookaburra					✓		✓	✓				✓	
Todirhamphus pyrrhopygia	Red-backed Kingfisher					✓	✓	✓	✓		✓		✓	
Todirhamphus sanctus	Sacred Kingfisher					✓	✓	✓	✓				✓	
MEROPIDAE														
Merops ornatus	Rainbow Bee-eater	**M**				✓	✓	✓	✓		✓	✓	✓	
CLIMACTERIDAE														
Climacteris melanura	Black-tailed Treecreeper						✓	✓	✓					

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	Birdata	A	B	C	D	E	F	G	H
PTILONORHYNCHIDAE														
Chlamydera guttata	Western Bowerbird				✓	✓	✓	✓	✓	✓	✓	✓	✓	
MALURIDAE														
Amytornis striatus	Striated Grasswren					✓		✓	✓		✓	✓	✓	
Malurus lamberti	Variegated Fairy-wren					✓	✓	✓	✓	✓	✓	✓	✓	
Malurus leucopterus	White-winged Fairy-wren					✓	✓	✓	✓		✓	✓	✓	
Stipiturus ruficeps	Rufous-crowned Emu-wren							✓		✓	✓			
ACANTHIZIDAE														
Acanthiza apicalis	Inland Thornbill					✓					✓			
Acanthiza robustirostris	Slaty-backed Thornbill										✓			
Acanthiza uropygialis	Chestnut-rumped Thornbill					✓	✓				✓			
Gerygone fusca	Western Gerygone					✓		✓			✓			
Smicrornis brevirostris	Weebill					✓	✓	✓		✓	✓	✓	✓	
PARDALOTIDAE														
Pardalotus rubricatus	Red-browed Pardalote					✓		✓	✓	✓	✓	✓	✓	
Pardalotus striatus	Striated Pardalote					✓	✓	✓	✓	✓	✓	✓	✓	
MELIPHAGIDAE														
Acanthagenys rufogularis	Spiny-cheeked Honeyeater					✓	✓	✓		✓	✓	✓		
Certhionyx variegatus	Pied Honeyeater							✓	✓				✓	
Epthianura tricolor	Crimson Chat					✓	✓	✓	✓	✓	✓	✓		
Lichenostomus keartlandi	Grey-headed Honeyeater					✓	✓	✓	✓	✓	✓	✓	✓	
Lichenostomus penicillatus	White-plumed Honeyeater					✓	✓	✓	✓				✓	
Lichenostomus virescens	Singing Honeyeater					✓	✓	✓	✓	✓	✓		✓	
Lichmera indistincta	Brown Honeyeater					✓	✓	✓	✓	✓	✓	✓		
Manorina flavigula	Yellow-throated Miner					✓	✓	✓	✓	✓	✓	✓	✓	
Melithreptus gularis	Black-chinned Honeyeater						✓	✓		✓			✓	
Purnella albifrons	White-fronted Honeyeater							✓						
Sugomel niger	Black Honeyeater						✓	✓	✓			✓		

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	Birdata	A	B	C	D	E	F	G	H
POMATOSTOMIDAE														
Pomatostomus superciliosus	White-browed Babbler					✓	✓				✓			
Pomatostomus temporalis	Grey-crowned Babbler					✓	✓	✓	✓		✓	✓	✓	
NEOSITTIDAE														
Daphoenositta chrysoptera	Varied Sittella												✓	
CAMPEPHAGIDAE														
Coracina maxima	Ground Cuckoo-shrike										✓			
Coracina novaehollandiae	Black-faced Cuckoo-shrike					✓	✓	✓	✓	✓	✓	✓	✓	
Lalage sueurii	White-winged Triller					✓	✓	✓	✓	✓	✓	✓		
PACHYCEPHALIDAE														
Colluricincla harmonica	Grey Shrike-thrush					✓	✓	✓	✓	✓	✓	✓	✓	
Oreoica gutturalis	Crested Bellbird					✓	✓	✓	✓	✓	✓	✓	✓	
Pachycephala rufiventris	Rufous Whistler				✓	✓	✓	✓	✓	✓	✓		✓	
ARTAMIDAE														
Artamus cinereus	Black-faced Woodswallow					✓	✓	✓	✓	✓	✓	✓	✓	
Artamus minor	Little Woodswallow					✓	✓	✓		✓	✓	✓	✓	
Artamus personatus	Masked Woodswallow					✓					✓	✓		
Cracticus nigrogularis	Pied Butcherbird					✓	✓	✓	✓	✓	✓	✓	✓	
Cracticus tibicen	Australian Magpie					✓	✓	✓	✓		✓		✓	
Cracticus torquatus	Grey Butcherbird					✓	✓	✓			✓		✓	
RHIPIDURIDAE														
Rhipidura leucophrys	Willie Wagtail					✓	✓	✓	✓	✓	✓	✓	✓	
CORVIDAE														
Corvus bennetti	Little Crow					✓	✓	✓		✓	✓		✓	
Corvus orru	Torresian Crow					✓	✓	✓	✓		✓	✓		
MONARCHIDAE														
Grallina cyanoleuca	Magpie-lark					✓	✓	✓	✓		✓			
PETROICIDAE														

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	Birdata	A	B	C	D	E	F	G	H
Melanodryas cucullata	Hooded Robin					✓	✓	✓	✓	✓	✓	✓	✓	
Petroica goodenovii	Red-capped Robin					✓	✓	✓						
ALAUDIDAE														
Mirafra javanica	Horsfield's Bushlark					✓				✓	✓			
MEGALURIDAE														
Cinclorhamphus cruralis	Brown Songlark					✓		✓	✓					
Cinclorhamphus mathewsi	Rufous Songlark					✓	✓	✓	✓					
Eremiornis carteri	Spinifexbird						✓	✓	✓		✓	✓	✓	
HIRUNDINIDAE														
Cheramoeca leucosternus	White-backed Swallow						✓							
Petrochelidon ariel	Fairy Martin					✓		✓	✓					
Petrochelidon nigricans	Tree Martin					✓		✓	✓					
NECTARINIIDAE														
Dicaeum hirundinaceum	Mistletoebird					✓		✓				✓		
ESTRILDIDAE														
Emblema pictum	Painted Finch					✓	✓	✓	✓	✓	✓	✓	✓	
Neochmia ruficauda subclarescens	Star Finch			**P4**										✓
Taeniopygia guttata	Zebra Finch					✓	✓	✓	✓	✓	✓	✓	✓	
MOTACILLIDAE														
Anthus novaeseelandiae	Australasian Pipit					✓	✓	✓	✓		✓			

Appendix C3 Reptiles Potentially Occurring

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	A	B	C	D	E	F	G	H
CHELUIDAE													
Chelodina steindachneri	Steindachner's Turtle					✓							
GEKKONIDAE													
Crenadactylus ocellatus	Clawless Gecko										✓		
Diplodactylus conspicillatus	Fat-tailed Gecko				✓	✓	✓		✓				
Diplodactylus pulcher					✓								
Diplodactylus savagei					✓					✓			
Gehyra pilbara					✓	✓							
Gehyra punctata					✓	✓	✓	✓	✓	✓	✓	✓	
Gehyra purpurascens					✓								
Gehyra variegata					✓		✓	✓	✓	✓	✓	✓	
Heteronotia binoei	Bynoe's Gecko				✓	✓	✓	✓	✓	✓			
Heteronotia spelea	Desert Cave Gecko				✓					✓		✓	
Lucasium stenodactylum	Sand-plain Gecko				✓		✓		✓	✓			
Lucasium wombeyi					✓				✓	✓			
Nephrurus wheeleri	Banded Knob-tailed Gecko				✓	✓				✓			
Oedura marmorata	Marbled Velvet Gecko				✓		✓		✓	✓	✓	✓	
Rhynchoedura ornata	Beaked Gecko				✓	✓	✓	✓	✓				
Strophurus ciliaris	Northern Spiny-tailed Gecko					✓							
Strophurus elderi	Jewelled Gecko				✓	✓	✓			✓			
Strophurus jeanae					✓	✓			✓	✓			
Strophurus wellingtonae									✓	✓			
PYGOPODIDAE													
Delma elegans										✓			
Delma haroldi					✓								
Delma nasuta					✓	✓	✓		✓	✓			
Delma pax					✓	✓	✓		✓		✓		
Delma tincta					✓	✓			✓	✓			

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	A	B	C	D	E	F	G	H
Lialis burtonis	Burton's Snake-Lizard				✓	✓	✓	✓	✓	✓	✓		
SCINCIDAE													
Carlia munda					✓	✓	✓	✓		✓			
Cryptoblepharus ustulatus					✓	✓	✓		✓			✓	
Ctenotus ariadnae					✓								
Ctenotus duricola					✓	✓	✓	✓	✓				
Ctenotus grandis					✓				✓				
Ctenotus hanloni					✓		✓			✓			
Ctenotus helenae					✓	✓	✓			✓			
Ctenotus leonhardii							✓						
Ctenotus pantherinus	Leopard Ctenotus				✓	✓	✓	✓	✓	✓			
Ctenotus piankai									✓				
Ctenotus quattuordecimlineatus	Fourteen-lined Ctenotus								✓				
Ctenotus rubicundus					✓		✓				✓		
Ctenotus rutilans					✓		✓			✓			
Ctenotus saxatilis	Rock Ctenotus				✓	✓	✓		✓	✓	✓	✓	
Ctenotus serventyi					✓	✓	✓	✓					
Ctenotus uber					✓								
Ctenotus uber Johnstonei				**P2**									✓
Cyclodomorphus melanops	Spinifex Slender Blue-tongue				✓	✓	✓	✓		✓			
Egernia depressa	Pygmy Spiny-tailed Skink									✓			
Egernia formosa						✓				✓			
Egernia pilbarensis											✓		
Lerista bipes					✓				✓				
Lerista labialis					✓	✓							
Lerista muelleri					✓		✓			✓	✓		
Lerista neander					✓	✓							
Lerista zietzi					✓		✓	✓		✓	✓		
Menetia greyii					✓				✓	✓			
Menetia surda					✓								

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	A	B	C	D	E	F	G	H
Morethia ruficauda					✓	✓	✓		✓	✓	✓		
Notoscincus ornatus					✓								
Proablepharus reginae					✓	✓							
Tiliqua multifasciata	Centralian Blue-tongue				✓	✓	✓		✓	✓			
AGAMIDAE													
Amphibolurus longirostris	Long-nosed Dragon				✓	✓	✓	✓	✓	✓		✓	
Caimanops amphiboluroides	Mulga Dragon				✓					✓			
Ctenophorus caudicinctus	Ring-tailed Dragon				✓	✓	✓	✓	✓	✓	✓	✓	
Ctenophorus isolepis	Central Military Dragon				✓	✓	✓	✓	✓				
Ctenophorus nuchalis	Central Netted Dragon				✓	✓							
Ctenophorus reticulatus	Western Netted Dragon				✓								
Pogona minor	Dwarf Bearded Dragon				✓		✓		✓	✓			
VARANIDAE													
Varanus acanthurus	Spiny-tailed Monitor				✓	✓	✓	✓	✓	✓			
Varanus brevicauda	Short-tailed Pygmy Monitor				✓	✓							
Varanus bushi							✓	✓		✓			
Varanus caudolineatus	Stripe-tailed Monitor				✓	✓	✓						
Varanus eremius	Pygmy Desert Monitor				✓				✓				
Varanus giganteus	Perentie				✓	✓	✓			✓	✓		
Varanus gouldii	Sand Goanna				✓	✓	✓			✓			
Varanus panoptes	Yellow-spotted Monitor				✓	✓	✓	✓			✓		
Varanus pilbarensis	Pilbara Rock Monitor										✓		
Varanus tristis	Black-headed Monitor				✓	✓	✓			✓		✓	
TYPHLOPIDAE													
Ramphotyphlops ammodytes					✓	✓							
Ramphotyphlops grypus	Beaked Blind Snake				✓	✓			✓	✓			
Ramphotyphlops hamatus							✓			✓			
Ramphotyphlops waitii					✓								

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	A	B	C	D	E	F	G	H
PYTHONIDAE													
Antaresia perthensis	Pygmy Python				✓	✓	✓			✓			
Antaresia stimsoni	Stimson's Python					✓	✓						
Aspidites melanocephalus	Black-headed python									✓			
Liasis olivaceus barroni	Pilbara Olive Python	**VU**	**S1**		✓	✓	✓	✓					
ELAPIDAE													
Acanthophis pyrrhus	Desert Death Adder					✓							
Acanthophis wellsi	Pilbara Death Adder				✓		✓						
Brachyurophis approximans	North-western Shovel-nosed Snake				✓	✓			✓	✓			
Demansia psammophis	Yellow-faced Whipsnake				✓	✓	✓	✓		✓			
Demansia rufescens	Rufous Whipsnake						✓	✓					
Furina ornata	Moon Snake						✓						
Parasuta monachus	Monk Snake				✓	✓	✓						
Pseudechis australis	Mulga Snake				✓	✓	✓	✓		✓	✓		
Pseudonaja modesta	Ringed Brown Snake				✓	✓							
Pseudonaja nuchalis	Gwardar				✓	✓	✓			✓			
Suta fasciata	Rosen's Snake				✓	✓							
Suta punctata	Little Spotted Snake				✓								

Appendix C4 Amphibians Potentially Occurring

Scientific Name	Common Name	EPBC	WCA	DEC	WAM	A	B	C	D	E	F	G	H
HYLIDAE													
Cyclorana maini	Main's Frog				✓	✓	✓			✓			
Litoria rubella	Desert Tree Frog				✓	✓	✓			✓	✓	✓	
MYOBATRACHIDAE													
Uperoleia russelli	Russell's Toadlet				✓	✓	✓					✓	

Appendix D Fauna Recorded

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Appendix D1 Mammal species recorded

Scientific Name	Common Name	Site													
		1	2	3	4	5	6	OPP	1	2	3	4	5	6	OPP
		Phase 1							Phase 2						
NATIVE MAMMALS															
DASYURIDAE															
Dasykaluta rosamondae	Kaluta	9	2						4						
Sminthopsis macroura	Stripe-faced Dunnart	1		1			4								
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart								1	3					
MACROPODIDAE															
Macropus rufus	Red Kangaroo		2			7	8	6							
EMBALLONURIDAE															
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat			A					A	A		A		A	
Taphozous georgianus	Common Sheath-tailed Bat	A*		A*								A		A	
Taphozous hilli	Hill's Sheath-tailed Bat								A						
MOLLOSIDAE															
Chaerephon jobensis	Northern Free-tailed Bat	A		A				A	A						
Mormopterus beccarii	Beccari's Free-tailed Bat				A			A				A			
VESPERTILIONIDAE															
Chalinolobus gouldii	Gould's Wattled Bat	A		A				A	A	A	A	A		A	
Nyctophilus bifax daedalus												A			
Nyctophilus geoffroyi	Lesser Long-eared Bat			A			A		A		A			A	
Scotorepens greyi	Little Broad-nosed Bat	A		A	A		A	A	A	A	A	A		A	
Vespadelus finlaysoni	Finlayson's Cave Bat	A		A	A		A	A	A	A	A	A		A	
MURIDAE															
Notomys alexis	Spinifex Hopping-mouse	14	4		2			4	6						1
Pseudomys desertor	Desert Mouse	3							1						
Pseudomys hermannsburgensis	Sandy Inland Mouse	2	1						2	4					
CANIDAE															
Canis lupus dingo	Dingo			1			2	6							

Scientific Name	Common Name	Site													
		1	2	3	4	5	6	OPP	1	2	3	4	5	6	OPP
		Phase 1							Phase 2						
INTRODUCED MAMMALS															
MURIDAE															
Mus musculus	House Mouse		7	5	1		2	3	1						
FELIDAE															
Felis catus	House Cat	1						2							8
EQUIDAE															
Equus caballus	Horse						1								
BOVIDAE															
Bos taurus	Cow	1				2	2	5							
LEPORIDAE															
Oryctolagus cuniculus	European Rabbit							1							

A = Anabat recording

* *T. georgianus* and *T. hilli* could not be distinguished on Anabat recording

Appendix D2 Bird species recorded

Scientific Name	Common Name	Site													
		1	2	3	4	5	6	OPP	1	2	3	4	5	6	OPP
		Phase 1							Phase 2						
CASUARIIDAE															
Dromaius novaehollandiae	Emu														4
PHASIANIDAE															
Coturnix ypsilophora	Brown Quail							5							
ANATIDAE															
Chenonetta jubata	Australian Wood Duck							14							
COLUMBIDAE															
Phaps chalcoptera	Common Bronzewing							1							
Ocyphaps lophotes	Crested Pigeon	8	10	8	20	2		44	27	11	58	33	15	17	133
Geophaps plumifera	Spinifex Pigeon														1
Geopelia cuneata	Diamond Dove		3					7							
PODARGIDAE															
Podargus strigoides	Tawny Frogmouth							1							
EUROSTOPODIDAE															
Eurostopodus argus	Spotted Nightjar							5							2
ARDEIDAE															
Egretta novaehollandiae	White-faced Heron														1
THRESKIORNITHIDAE															
Threskiornis spinicollis	Straw-necked Ibis							131							
ACCIPITRIDAE															
Elanus axillaris	Black-shouldered Kite														1
Hamirostra melanosternon	Black-breasted Buzzard				3			1				3			1
Haliastur sphenurus	Whistling Kite				1	3		10	1		3	8	1	2	13
Milvus migrans	Black Kite	1			2			9	1						1
Accipiter fasciatus	Brown Goshawk			1		1	1	6							1
Accipiter cirrocephalus	Collared Sparrowhawk							2					1		1
Circus assimilis	Spotted Harrier							5							
Aquila audax	Wedge-tailed Eagle					1	1	2					3		1

Scientific Name	Common Name	Site													
		1	2	3	4	5	6	OPP	1	2	3	4	5	6	OPP
		Phase 1							Phase 2						
Hieraaetus morphnoides	Little Eagle							1			2	2		1	1
FALCONIDAE															
Falco cenchroides	Nankeen Kestrel							10	1	1	4	2			9
Falco berigora	Brown Falcon				4		1	10				4	1	1	3
Falco longipennis	Australian Hobby	2						2			1	1			2
OTIDIDAE															
Ardeotis australis	Australian Bustard					1		6		1			2		2
TURNICIDAE															
Turnix velox	Little Button-quail			1					1	2	1				1
CACATUIDAE															
Eolophus roseicapillus	Galah	2		15	4	4	28	143	6	4	57	53	1	47	207
Cacatua sanguinea	Little Corella			2				21			14	12			12
Nymphicus hollandicus	Cockatiel		14			2		84						13	
PSITTACIDAE															
Barnardius zonarius	Australian Ringneck			7				23	3		7	15			32
Melopsittacus undulatus	Budgerigar	104	116	59	25	25	52	231	6	6	24	50	9	7	53
CUCULIDAE															
Centropus phasianinus	Pheasant Coucal														1
Chalcites basalis	Horsfield's Bronze-Cuckoo		1					2				2			
Cacomantis pallidus	Pallid Cuckoo							1							4
STRIGIDAE															
Ninox novaeseelandiae	Southern Boobook							1							
TYTONIDAE															
Tyto javanica	Eastern Barn Owl														1
HALCYONIDAE															
Dacelo leachii	Blue-winged Kookaburra							2			3	6			8
Todiramphus pyrrhopygius	Red-backed Kingfisher	2	3					2		3	10	7			5
Todiramphus sanctus	Sacred Kingfisher							1				1			1

Scientific Name	Common Name	Site													
		1	2	3	4	5	6	OPP	1	2	3	4	5	6	OPP
		Phase 1							Phase 2						
MEROPIDAE															
Merops ornatus	Rainbow Bee-eater			8	2	9		26			33	10		3	32
CLIMACTERIDAE															
Climacteris melanura	Black-tailed Treecreeper							1							
MALURIDAE															
Malurus leucopterus	White-winged Fairy-wren	10			12			18		7		9	7		8
Malurus lamberti	Variegated Fairy-wren	9						52	2			12	4	4	9
ACANTHIZIDAE															
Smicrornis brevirostris	Weebill							10				2			6
Gerygone fusca	Western Gerygone												1	2	1
Acanthiza uropygialis	Chestnut-rumped Thornbill						7	4			2	17	2	7	
PARDALOTIDAE															
Pardalotus rubricatus	Red-browed Pardalote								4	3	4	1			6
Pardalotus striatus	Striated Pardalote										1				3
MELIPHAGIDAE															
Certhionyx variegatus	Pied Honeyeater							2							
Lichenostomus virescens	Singing Honeyeater	4	8		2	6	6	13	20	57	26	68	25	29	55
Lichenostomus keartlandi	Grey-headed Honeyeater		1					7		3		1			3
Lichenostomus penicillatus	White-plumed Honeyeater			34	1			34			94	79			69
Manorina flavigula	Yellow-throated Miner	12		46		2		53	2	30	43	39	14		33
Acanthagenys rufogularis	Spiny-cheeked Honeyeater									2		14			
Epthianura tricolor	Crimson Chat							1		8				8	
Sugomel niger	Black Honeyeater									10		1			1
Lichmera indistincta	Brown Honeyeater						1		1	4		35		3	11
POMATOSTOMIDAE															
Pomatostomus temporalis	Grey-crowned Babbler	16		8				16			22	6			36
CAMPEPHAGIDAE															
Coracina novaehollandiae	Black-faced Cuckoo-shrike	4	6	5		2		19	3	1	3	8	5		17
Lalage sueurii	White-winged Triller					6	1		4		9	10	6	39	12

Scientific Name	Common Name	Site													
		1	2	3	4	5	6	OPP	1	2	3	4	5	6	OPP
		Phase 1							Phase 2						
PACHYCEPHALIDAE															
Pachycephala rufiventris	Rufous Whistler	2		3		6	6	21	3	1	9	55	32	45	22
Colluricincla harmonica	Grey Shrike-thrush										1				1
Oreoica gutturalis	Crested Bellbird							1	4	4	3	1	8	25	7
ARTAMIDAE															
Artamus personatus	Masked Woodswallow	42				125	55	297	2		7	4	3	8	
Artamus cinereus	Black-faced Woodswallow	10	15			6	2	66	38	41	26	56	60	23	48
Cracticus torquatus	Grey Butcherbird							1				7		1	1
Cracticus nigrogularis	Pied Butcherbird								6	14	17	16	3	4	7
Cracticus tibicen	Australian Magpie							1							
RHIPIDURIDAE															
Rhipidura leucophrys	Willie Wagtail	5	6	7	1	11	10	38		2	10	14	9	6	17
CORVIDAE															
Corvus orru	Torresian Crow		2	3			10	24			6	5	2	20	5
MONARCHIDAE															
Grallina cyanoleuca	Magpie-lark							27			3	7			12
PETROICIDAE															
Petroica goodenovii	Red-capped Robin				1	1	11	5			1	6	8	7	2
Melanodryas cucullata	Hooded Robin						2				2			3	2
ALAUDIDAE															
Mirafra javanica	Horsfield's Bushlark		1		1			9		4	2	1	2		8
MEGALURIDAE															
Cincloramphus mathewsi	Rufous Songlark			7				5		4	11	14	4	4	6
Cincloramphus cruralis	Brown Songlark									1					1
Eremiornis carteri	Spinifexbird	2													2
HIRUNDINIDAE															
Hirundo neoxena	Welcome Swallow							1							
Petrochelidon ariel	Fairy Martin										6	6			
Petrochelidon nigricans	Tree Martin			2				5			2				

Scientific Name	Common Name	Site													
		1	2	3	4	5	6	OPP	1	2	3	4	5	6	OPP
		Phase 1							Phase 2						
NECTARINIIDAE															
Dicaeum hirundinaceum	Mistletoebird							1				1			1
ESTRILDIDAE															
Taeniopygia guttata	Zebra Finch	39	176	4	51	128	57	602	39	86	361	121	107	37	1295
MOTACILLIDAE															
Anthus novaeseelandiae	Australasian Pipit														1

Appendix D3 Herpetofauna recorded

Scientific Name	Common Name	Site													
		1	2	3	4	5	6	OPP	1	2	3	4	5	6	OPP
		Phase1							Phase2						
GEKKONIDAE															
Diplodactylus conspicillatus	Fat-tailed Gecko	4	2			5	16	1	7	4		4	4	5	
Gehyra punctata								1							
Gehyra variegata		2	1	7	2	3	2	9	2	1	4	3	2	1	1
Heteronotia binoei	Bynoe's Gecko			9	1			2			6				1
Lucasium stenodactylum	Sand-plain Gecko	1	1			2	1			2					1
Nephrurus wheeleri cinctus	Banded Knob-tailed Gecko		1								1				
Rhynchoedura ornata	Beaked Gecko		1												
Strophurus strophurus	Western Spiny-tailed Gecko	1													
Strophurus wellingtonae												1			
PYGOPODIDAE															
Delma pax		1				1	2		3	1		2			
Delma tincta			2			3	1						1		1
Lialis burtonis	Burton's Snake-lizard											1			
SCINCIDAE															
Carlia munda				1				1							
Ctenotus ariadnae		9	3						1						
Ctenotus grandis		5	14		1		1		1	2		3			
Ctenotus helenae		14	14	3	8		5	1	2	3					
Ctenotus pantherinus	Leopard Ctenotus	10	7	1	12	1	6	4	15	6		8		3	
Ctenotus saxatilis				1											
Ctenotus uber						3	33	4				1	6	8	11
Cyclodomorphus melanops	Spinifex Slender Blue-tongue				1						1	3			
Lerista bipes		14		14	35			1	2	1	3	16			
Lerista muelleri		1	2	5	1	6		2			4	1			
Menetia greyii		2		2	1	2	2		1	2		3	3	2	1
Tiliqua multifasciata	Centralian Blue-tongue							1							
AGAMIDAE															

Scientific Name	Common Name	Site													
		1	2	3	4	5	6	OPP	1	2	3	4	5	6	OPP
		Phase1							Phase2						
Amphibolurus longirostris	Long-nosed Dragon		1	27	2	1		5			6				
Caimanops amphiboluroides	Mulga Dragon						1								
Ctenophorus caudicinctus	Ring-tailed Dragon							2							
Ctenophorus isolepis	Central Military Dragon	17	6	1	10		1	36	19	14		20	2	9	50
Ctenophorus nuchalis	Central Netted Dragon							1					1	1	2
Pogona minor	Dwarf Bearded Dragon								1						
Tympanocryptis cephala	Pebble Dragon					1									
VARANIDAE															
Varanus acanthurus	Spiny-tailed Monitor							1							
Varanus brevicauda	Short-tailed Pygmy Monitor		1												
Varanus bushi												1			1
Varanus caudolineatus	Stripe-tailed Monitor						2	1					1		
Varanus eremius	Pygmy Desert Monitor	2	3		2				2						
Varanus gouldii	Gould's Monitor		2				1								
TYPHLOPIDAE															
Ramphotyphlops ammodytes			1									1			
ELAPIDAE															
Demansia psammophis	Yellow-faced Whipsnake	1			1	1	5	1		1		1	4	2	
Parasuta monachus	Monk Snake			1											
Pseudechis australis	Mulga Snake		2									1			
Pseudonaja nuchalis	Gwardar	2		2	3							1			1
Suta punctata	Little Spotted Snake					2									

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Appendix E Conservation Significant Fauna Unlikely to Inhabit the Project Area

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Appendix E1 Conservation Significant Fauna Unlikely to Occur Within the Project Area

SPECIES	CONSERVATION SIGNIFICANCE			HABITAT	PREVIOUS RECORDS	LIKELIHOOD OF OCCURRENCE
	EPBC	WCA	DEC			
Mammals						
Northern Quoll (*Dasyurus hallucatus*)	EN	S1		Rocky areas, also eucalypt forest and woodland.	Records from Nullagine and north of Chichester Ranges (*ecologia* 2008d) approximately 100 km from project area (DEC rare fauna database).	LOW Known from Hamersley range area to the south of project area (Van Dyck and Strahan 2008). However no suitable habitat within project area.
Greater Bilby (*Macrotis lagotis*)	VU	S1		Spinifex hummock grassland and acacia scrub.	Regional records from within 90 km of project area, at Mulga Downs Station (DEC rare fauna database). Also Yandicoogina rail corridor (Ninox Wildlife Consulting 1995), 20-75 km south-west.	LOW Nearby records of the species, but the project area does not contain suitable habitat for the species, and no burrows were recorded in the project area.
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	VU	S1		Roosts in warm, humid caves.	Record from Yandi-Kurrajura, 15 km from project area.	LOW Several nearby records. No suitable roosting or breeding habitat. May occasionally forage in area.
Ghost Bat (*Macroderma gigas*)			P4	Caves, rockpiles and abandoned mines.	Record from Jirridi and Yandi-Kurrajura, 45 km and 15 km, respectively, from project area.	LOW Recorded in surrounding region. No roosting habitat within project area. Distance from nearest locations suggests that presence unlikely.

SPECIES	CONSERVATION SIGNIFICANCE			HABITAT	PREVIOUS RECORDS	LIKELIHOOD OF OCCURRENCE
	EPBC	WCA	DEC			
Western Pebble-mouse (*Pseudomys chapmani*)			P4	Spurs and rocky hills with many small pebbles vegetated by hummocks of large spinifex.	Recorded in the surroundings during previous surveys (HGM 1999; *ecologia* 2006c), and numerous records from local region. No mice or mounds recorded during this survey.	LOW This species is resident throughout the Pilbara but no suitable habitat was found in the project area to support it.
Birds						
Cattle Egret (*Ardea ibis*)	M			Occur typically in small flocks in grassy habitats and wetlands, particularly damp pastures.	Recorded in wetland near Newman, 110 km SE and in Fortescue Marsh, 60 km E of project area (Birds Australia 2009)	LOW The cattle egret is only a casual visitor to the Pilbara and there is little suitable habitat present within the project area, resulting in a low likelihood of occurrence.
Eastern Great Egret (*Ardea modesta*)	M			Mainly inhabit shallow water bodies; both fresh (lakes, lagoons, swamps and floodwaters) and saline (mangrove creeks, estuaries and tidal pools) (Johnstone and Storr 1998)	Recorded at Yandicoogina (IES 1981) 20 km from project area.	LOW Suitable habitat for this species within the project area will only occur while the creeks contain water.
Star Finch (Western) (*Neochmia ruficauda subclarescens*)			P4	Vegetation around watercourses, particularly thick reedbeds	Recorded from Chichester Range (IES 1981) and Newman (DEC Rare fauna database)	LOW No suitable habitat available.
Reptiles						
Ctenotus uber johnstonei			P2	Small rock outcrops on open sandy and stony plains	This subspecies is only known to occur on the western edge of the Tanami Desert.	LOW No local records