OCTOBER 2012

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FORTESCUE METALS GROUP LIMITED
CENTRAL PILBARA PROJECT: MINE
VERTEBRATE FAUNA ASSESSMENT

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Document Status						
Rev.	**Author**	**Reviewer/s**	**Date**	**Approved for Issue**		
				Name	**Distributed To**	**Date**
A	T. McKenna A. Nowicki A Heidrich B Greatwich	D Cancilla L Roque-Albelo	18/11/11	D Cancilla	M Dowling T Edwards	18/11/11
B	A Heidrich	D Cancilla	30/10/12	D Cancilla	M Dowling T Edwards	30/10/12

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ACRONYMS

ANOSIM	Analysis of Similarity
CAMBA	China-Australia Migratory Bird Agreement
CPP	Central Pilbara Project
DEC	Department of Environment and Conservation
DEWHA	Department of Environment, Heritage, Water and the Arts
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EIA	Environmental Impact Assessment
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
IBRA	Interim Biogeographic Regionalisation of Australia
IUCN	International Union for the Conservation of Nature
JAMBA	Japan-Australian Migratory Bird Agreement
MDS	(non-metric) Multidimensional Scaling
NHMRC	National Health and Medical Research Centre
SAC	Species Accumulation Curve
WC Act	*Wildlife Conservation Act 1950*

EXECUTIVE SUMMARY

Fortescue Metals Group Limited (Fortescue) is developing the Central Pilbara Iron Ore and Infrastructure Project, which involves a series of iron ore mines in the Central Pilbara region of Western Australia, approximately 50 km north-west of Tom Price.

As part of the environmental approvals process for the Project, a vertebrate fauna survey was required to assess any potential impacts and to identify appropriate management strategies.

Fortescue commissioned a two-phase Level 2 assessment of the fauna of the Central Pilbara Mine area and rail spur. In February 2008, Coffey Environments Pty Ltd conducted a single phase Level 2 survey, installing 20 trap sites along Serenity Valley. In March 2011 *ecologia* Environment conducted a supplementary Phase 1 survey with 4 additional trap sites at Serenity Valley and 12 trap sites spread throughout the rest of the Project area (Holek, Sheila, Sheila east). Phase 2 of the Level 2 survey was completed by *ecologia* Environment in March, August and October 2011 with a total of 24 trap sites within the Project area. The initial Phase 1 data collected by Coffey Environments Pty Ltd in February 2008 is included in this fauna assessment of the Central Pilbara Mine area and rail spur. The purpose of the assessment is to provide detailed information regarding the fauna of the Kings Mine area, with special interest focussed on fauna species of conservation significance.

During the survey a total of 23 native and five introduced mammal species, 100 bird species, 84 species of reptile and four species of amphibian were recorded from the Project area. Of these, 13 species of conservation significance were recorded and an additional two species (Short-tailed Mouse and Star Finch) have a high likelihood to occur in the Project area. In addition, eleven species were assessed to have a low likelihood to occur in the Central Pilbara Project. Conservation significant fauna species recorded include: Northern Quoll (secondary evidence), Pilbara Leaf-nosed Bat, Long-tailed Dunnart, Ghost Bat, Western Pebble-mound Mouse, Fork-tailed Swift, Rainbow Bee-eater, Peregrine Falcon, Australian Bustard, Bush Stone-curlew, Pilbara Olive Python, *Ramphotyphlops ganei* and *Notoscincus butleri.*

A total of six fauna habitat types were identified during the survey: Rocky Spinifex plains and hills, rocky ridges and breakaway, major creeklines with fringing eucalypt, alluvial plains with cracking clays, snakewood shrubland and acacia woodland. Rocky spinifex plains and hills comprise the majority of the Project area (86.1%). All habitat types are well represented outside the Project area. Creeklines with fringing eucalypt and rocky ridges / breakaways are considered the fauna habitat type that is most sensitive to disturbance due to their limited extent and the long time that large trees require to regrow once cleared.

Any impacts to fauna as a result of the proposed project will be from blasting activities, clearing and disturbance associated with construction of the mine and rail, with additional minor on-going impacts from disturbance due to noise and light, increased feral fauna and weeds, and vehicle strikes.

The main conclusions of the terrestrial vertebrate fauna assessment of the Central Pilbara Project: Mine are:

- The survey methods were consistent with the EPA's Guidance Statement No. 56, Position Statement No. 3 and *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* to sample for terrestrial fauna. Species accumulation curves showed that survey adequacy from the current survey was moderate, but when previous surveys in the area are taken into account, adequacy overall is sufficient.

- The vertebrate fauna survey conducted at the Central Pilbara Project: Mine area found that the land systems, vegetation communities and habitats supported a diverse group of fauna, including conservation significant fauna, but they were not restricted to the Project area.

- Thirteen conservation significant vertebrate fauna species were recorded within, or in close proximity to the Project area, an additional two species of conservation significance have a medium or high likelihood and 11 conservation significant species have a low likelihood to occur within the Project area

- No limitations on survey techniques were experienced

- Six fauna habitat types were recorded within the Project area. The majority of these (rocky spinifex plains and hills, major creeklines and rocky ridges and breakaways) occur extensively surrounding the Project area and are continuous with it. The major creeklines with fringing eucalypt is considered the most sensitive fauna habitat type to disturbance.

- The DEC listed Long-tailed Dunnart (Priority 4) is the only species known to occur within the Project area with the potential for impact at a regional Level as the knowledge about the species' distribution and ecology is very limited. For this reason it is the impact on this species has a potential to be moderate on a regional Level.

- Targeted surveys for species of conservation significance were conducted in September 2011 and November 2011. No significant roost colonies of Pilbara Leaf-nosed Bat, Ghost Bat and no Northern Quoll individuals were encountered during these surveys.

1 INTRODUCTION

1.1 PROJECT OVERVIEW

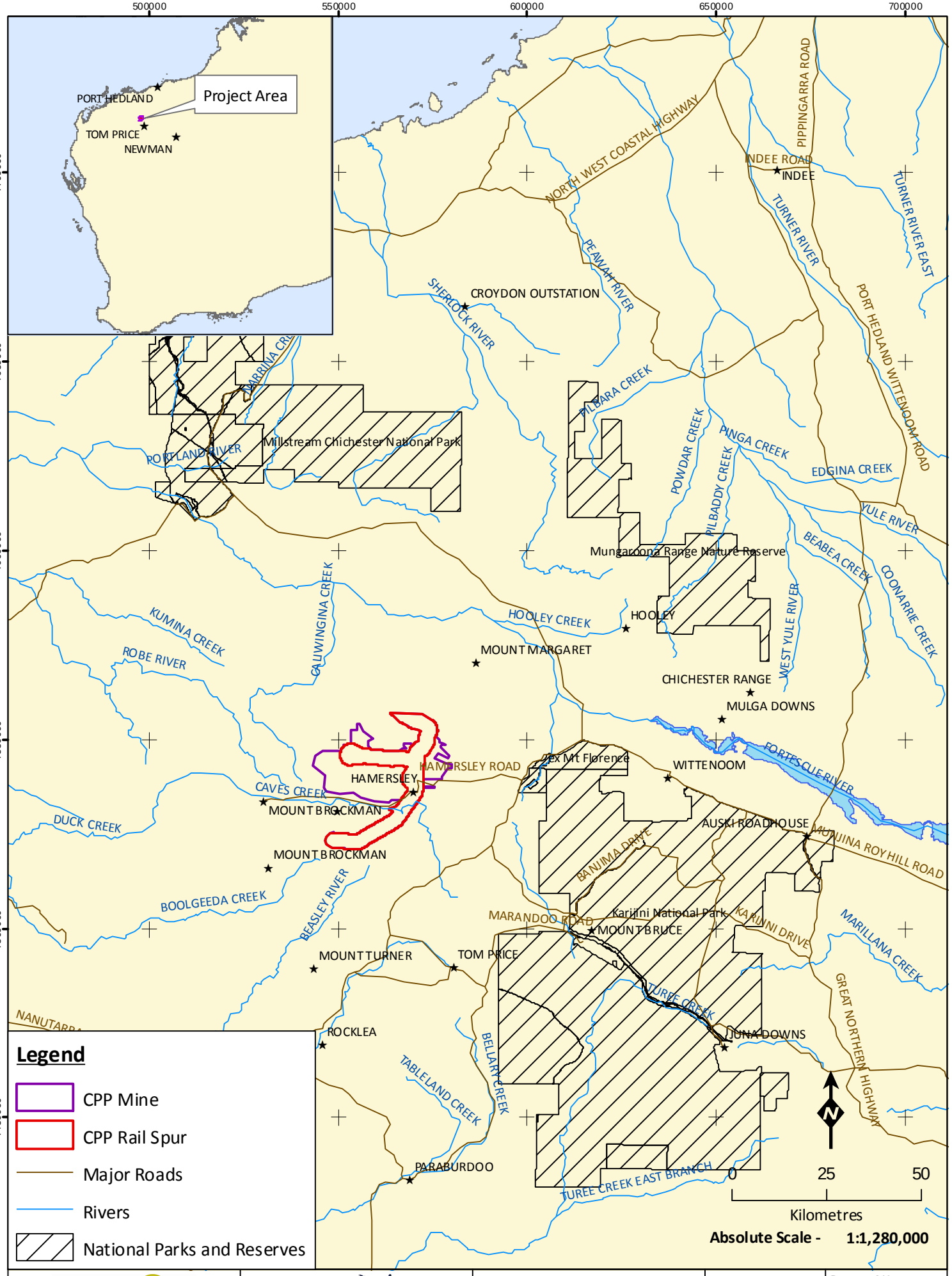
Fortescue Metals Group Limited (Fortescue) is developing the Pilbara Iron Ore and Infrastructure Project, which involves a series of iron ore mines in the Pilbara region of Western Australia (Figure 1.1).

Fortescue intends to expand its current operations to include the development of new mine sites within the Solomon Project area, together with support infrastructure such as rail and road access. In addition to the Solomon Mine Project, the Central Pilbara Project: Mine (the Project) is proposed to the west, of which there are three main ore bodies (Holek, Serenity and Sheila East). A new rail line, Central Pilbara Project: Rail, approximately 230 km in length, is also proposed, and will transport ore from these deposits to a port facility located near Karratha, at Anketell Point.

As part of the environmental approvals process for the Project, baseline vertebrate fauna and fauna habitat surveys of the proposed area are required to assess potential impacts and identify appropriate management strategies. Results from these surveys will also assist with environmental approvals for proposed exploration and development.

Fortescue commissioned *ecologia* Environment (*ecologia*) to undertake a two-phase Level 2 assessment of the vertebrate fauna of the Project area, which incorporates the Serenity Valley, Sheila and Holek tenements as well as the rail spur (Figure 1.1). The total size of the Project area is approximately 590.55 km^2. An initial Phase 1 survey of parts of the Serenity ore body was completed by Coffey Environments Pty Ltd (Coffey) in March 2008 (Coffey 2008). A complimentary Phase 1 survey of the remaining areas and a Phase 2 survey of the entire area were completed by *ecologia* in March and October 2011.

To complement the current survey, Fortescue also commissioned *ecologia* to conduct a series of targeted conservation significant fauna surveys focussing on Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python. The results of the targeted surveys are presented in a separate report (*ecologia* 2011) and relevant results from these surveys are included within this reports discussions.



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Location of the Project Area

Figure: 1.1
Project ID: 1304

Drawn: AH
Date: 09/11/11

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

Unique Map ID: AH406

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1.2 LEGISLATIVE FRAMEWORK

The *Environmental Protection Act 1986* is "an Act to provide for an Environmental Protection Authority, 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.

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

Native flora and fauna in Western Australia that are formally recognised as rare, threatened with extinction, or as having high conservation value 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). International agreements include the Japan-Australian Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA).

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 to 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 EPBC 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. Schedule 1 of the EPBC Act contains a list of species that are considered Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable and Conservation Dependent. Definitions of categories relevant to fauna occurring or potentially occurring in the Project area are provided in Appendix A.

The WC Act was developed to provide for the conservation and protection of wildlife in Western Australia. Under Section 14 of this Act, all flora and fauna within Western Australia is protected; however, the Minister may, via a notice published in the *Government Gazette*, declare a list of fauna identified as rare, likely to become extinct, or otherwise in need of special protection (Appendix A). The current listing was gazetted in August 2010.

In addition, the Department of Environment and Conservation (DEC) maintains a Threatened Fauna and Priority Fauna list. Threatened fauna that is listed as Schedule 1 under the WC Act are further ranked by the DEC according to their Level of threat using IUCN Red List criteria. Species can be listed as Critically Endangered (CR), Endangered (EN) and Vulnerable (VU). Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are listed as Priorities 1, 2 or 3, which are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as 'Threatened Fauna'. Species that are adequately known, are rare but not threatened, or meet criteria for 'Near Threatened', or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5. The three Threatened Fauna Codes and five Priority Codes are summarised in Appendix A.

1.3 SURVEY OBJECTIVES

Fortescue commissioned *ecologia* to undertake a comprehensive biological survey of the vertebrate fauna of the Project area as part of the EIA for the project.

The EPA's objectives with regard 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 study 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 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 Project 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 description of fauna habitats occurring in the Project 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 that are relevant to the current study; and
- a review of regional and biogeographical significance, including the conservation status of species recorded in the Project area.

2 BIOPHYSICAL ENVIRONMENT

2.1 CLIMATE AND WEATHER OBSERVATIONS

The Project area is located in the Pilbara Biogeographic region of Western Australia where the climate is semi-arid to arid with two distinct seasons: a hot summer from October to April and a mild winter from May to September. Rainfall in the Pilbara generally occurs between the months of December to March but can be unpredictable due to cyclonic activity bringing heavy sporadic rainfall. Nearly 75% of the annual rainfall is associated with thunderstorms and cyclonic activity between the months of December and March. Cold fronts continue to bring somewhat less rain to the region until June.

Average rainfall and temperature data for the Project area were obtained from the Bureau of Meteorology (BOM) Wittenoom weather station (station number 5026, dates 1951-2010), located at 22.27° S, 118.31° E (BOM 2011). The weather station is located approximately 65 km west of the Project area. Average rainfall and maximum and minimum temperatures are displayed in Figure 2.1.

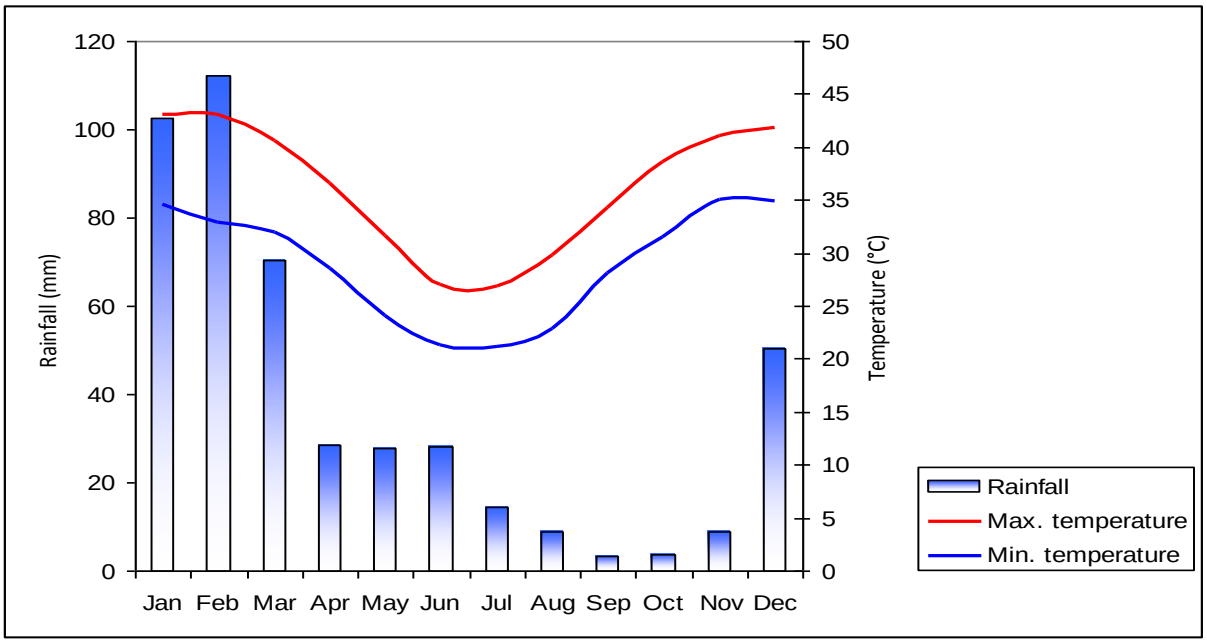


Figure 2.1 – Rainfall and temperature statistics for Wittenoom (BOM 2011).

Average annual rainfall for the Project area is 457.3 mm. Figure 2.1 shows January, February and March being the dominant months of rainfall for the Project area. In the months preceding the first phase survey, sufficient rainfall was received within the Project area, with January receiving a total of 142.2 mm and February 203.6 mm, which is well above average (BOM 2011).

The weather conditions observed during the survey were hot during the first phase of surveying with minimum temperatures of 20.4°C to 26.4°C maximum temperatures of 31.4°C to 38.5°C and some rain fall (19.2mm) during the survey. (Appendix B) Dry and warm weather conditions were experienced during Phase 2 of surveying with mimum temperatures of 10.1°C to 18.1°C and maximum temperatures of 25.4°C to 35.9°C (Appendix B).

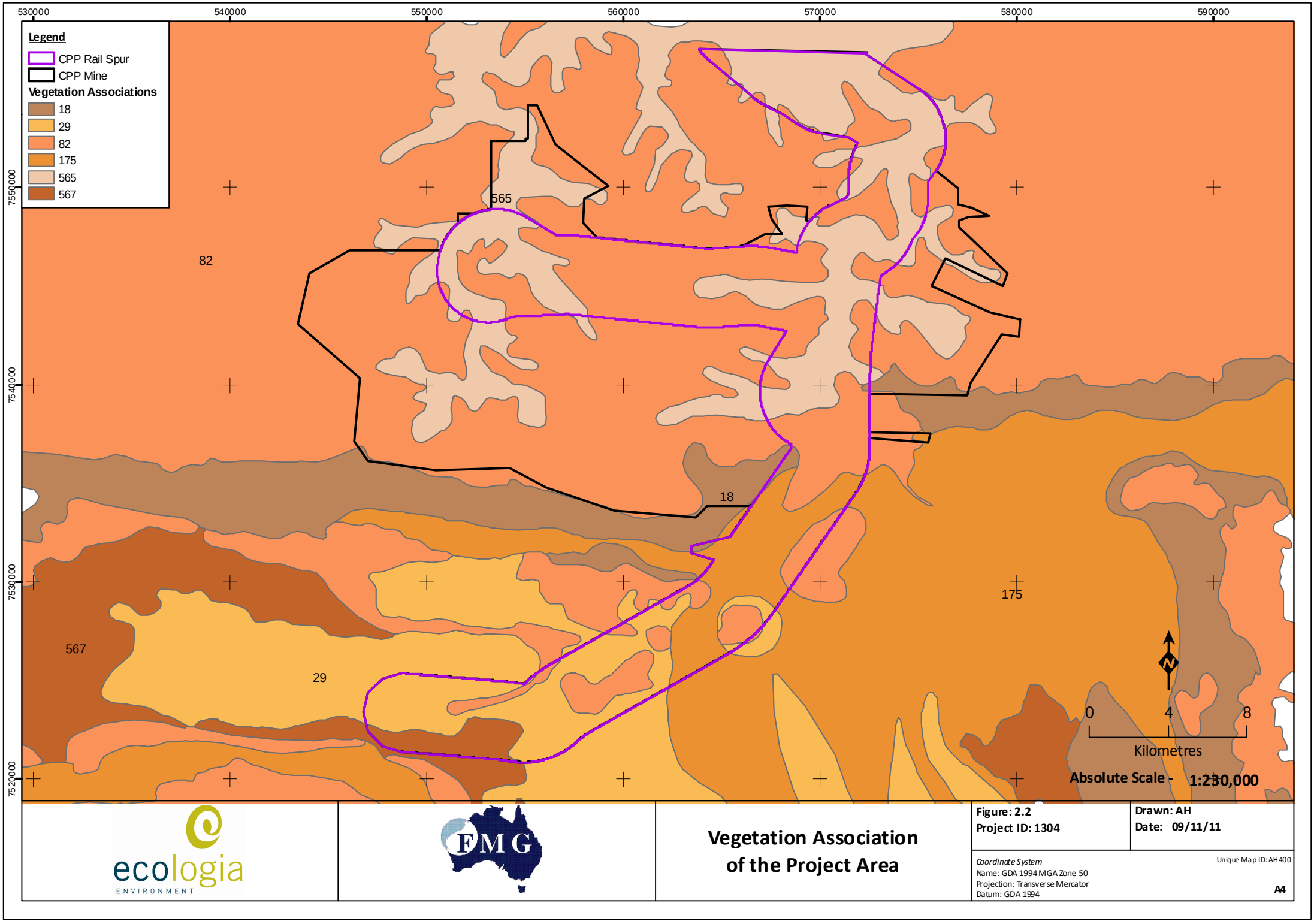
2.2 VEGETATION

The vegetation of Western Australia was originally mapped at the 1:1,000,000 scale by Beard (1979), and was subsequently reinterpreted and updated to reflect the National Vegetation Information System standards (Shepherd *et al.* 2002). The Project area lies within the Eremaean Botanical Province of the Pilbara (Beard 1975). Six vegetation associations have been mapped which occur in the Project area (Shepherd *et al.* 2001), described in Table 2.1 and displayed in Figure 2.2.

Hummock grassland with low tree steppe and either snappy gum or bloodwood over soft spinifex is the most dominant vegetation type (82 and 565) accounting for 82.5% of the total vegetation type. The remaining 15% is represented by low mulga woodland (18), sparse low woodland with patches of mulga (29), plains with grassland (175) and hummock grasslands with shrub steppe consisting of mulga and kanji over soft spinifex and *Triodia basedowii* (567). The majority of vegetation types are well-represented outside of the Project area with little more than 10.7% of their total extent within the Project area. One exception is the vegetation association type 82 of which 32.1% of its total extent lie within the Project area.

Table 2.1 – Vegetation association values of the Project area.

Vegetation Association	Vegetation Description	Total Area in Western Australia (km^2)	Area in Project area (km^2)	Percent of Total Vegetation Association (%)
567	Hummock grasslands, shrub steppe; mulga & kanji over soft spinifex & *Triodia basedowii*	7,769.98	10.13	0.13
18	Low woodland; mulga (*Acacia aneura*)	247,512.39	15.04	<0.001
29	Sparse low woodland; mulga, discontinuous in scattered groups	7,914,567.02	45.45	<0.001
82	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	1,036.62	332.74	32.1
565	Hummock grasslands, low tree steppe; bloodwood over soft spinifex	1,440.64	154.46	10.72
175	Short bunch grassland - savanna/grass plain	685,791.27	32.34	0.005



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Vegetation Association of the Project Area

Figure: 2.2
Project ID: 1304

Drawn: AH
Date: 09/11/11

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

Unique Map ID: AH400

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2.3 LAND SYSTEMS

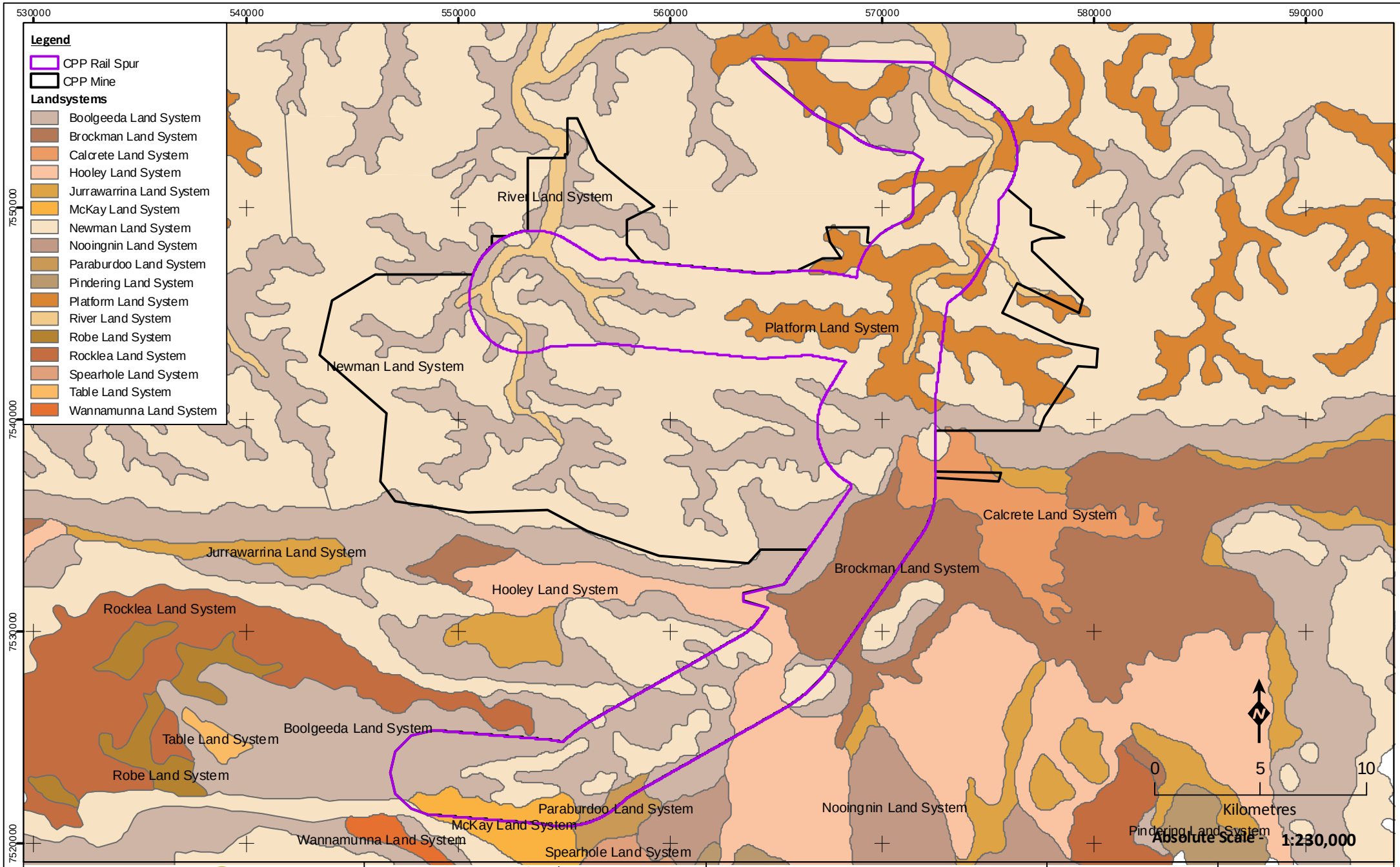
Land systems are described using the biophysical characteristics of geology, landforms, vegetation and soils(van Vreeswyk *et al.* 2004). Van Vreeswyk *et al.* (2004) undertook a regional inventory of the Pilbara region to document land systems present and the condition of each. The area surveyed by Van Vreeswyk *et al.* (2004) covered 181,723 km², bounded by the Indian Ocean and Roebourne Plains to the north and west, extending to Broome in the north-east and the Ashburton River catchment in the south.

The Project area comprises nine of the land systems mapped by Van Vreeswyk *et al.* (2004) (Table 2.2, Figure 2.3). The largest land system within the Project area is the Newman land system, occupying 50.6% of the Project area. This land system typically consists of rugged ridges and mountains supporting hard spinifex grasslands. Other major land systems of the Project area include Boolgeeda (26.5%), Platform (10.1%), Brockman (4.6%) and River (3.7%), all of which typically consist of tussock and spinifex grasslands. All land systems are well-represented outside of the Project area, with less than 1% of each land system within the Project area.

Table 2.2 – Land systems of the Project area.

Land System	Description	Total Area in Western Australia (km^2)	Area in the Project area (km^2)	Percent of Total Area in Western Australia (%)
Land type 2 - Hills and ranges with spinifex grasslands				
McKay (MCK)	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands.	427,470.89	8.02	<0.001
Newman (NEW)	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	1,999,771.38	298.69	0.015
Land type 16 - Stony plains with acacia shrublands				
Paraburdoo (PAR)	Basalt derived stony gilgai plains and stony plains supporting snakewood and mulga shrublands with spinifex, chenopods and tussock grasses.	1,447.56	2.28	0.158
Land type 18 - Stony plains with spinifex grasslands				
Boolgeeda (BGD)	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	999,608.61	156.25	0.016
Platform (PLA)	Dissected slopes and raised plains supporting hard spinifex grasslands.	237,111.99	59.61	0.025
Land type 34 - Alluvial plains with acacia shrublands				
Hooley (HOY)	Alluvial clay plains supporting a mosaic of snakewood shrublands and tussock grasslands.	59,081.10	10.54	0.018
Land type 39 - Alluvial plains with tussock grasslands				
Brockman (BRO)	Gilgai alluvial plains with cracking clay soils supporting tussock grasslands.	74,108.06	26.93	0.036

Land System	Description	Total Area in Western Australia (km^2)	Area in the Project area (km^2)	Percent of Total Area in Western Australia (%)
Land type 41 - Calcrete plains with spinifex grasslands				
Calcrete (CAL)	Low calcrete platforms and plains supporting shrubby hard spinifex grasslands.	167,041.86	5.90	0.004
Land type 42 - River plains with grassy woodlands and tussock grasslands				
River (RIV)	Active flood plains, major rivers and banks supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands.	130,704.41	21.86	0.017



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Landsystems of the Project Area

Figure: 2.3
Project ID: 1304

Drawn: AH
Date: 09/11/11

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

Unique Map ID: AH399

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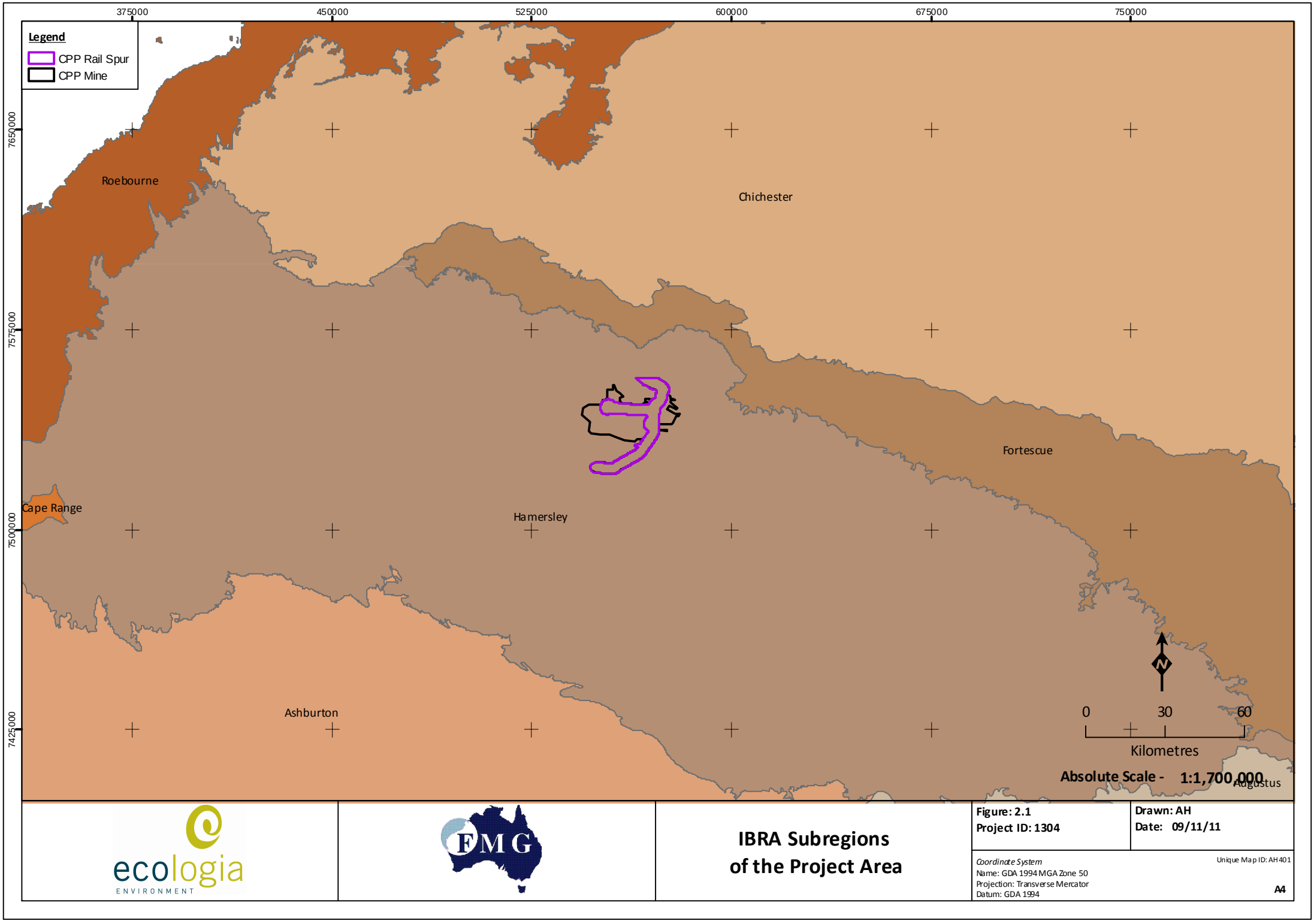
2.4 BIOGEOGRAPHY

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the Australian continent into regions (bioregions) of similar geology, landform, vegetation, fauna and climate characteristics (DSEWPaC 2010). According to IBRA (version 6.1), the Project area is located in the Pilbara bioregion.

Dominant limiting factors and constraints for the Pilbara bioregion listed by Thackway and Creswell (1995) include extinction of critical weight range animals, wildfire, feral animals, weeds and grazing or pastoral activities. The reservation status of the bioregion is 1-5%, which is relatively low (some bioregions have a greater than 10% reservation status).

With an area of 179,287 km², the Pilbara bioregion is in the largest area class. Other bioregions vary from 2,372 to 423,751 km², most being between 14,000 and 200,000 km². The size of the Pilbara bioregion is fairly typical of bioregions situated in remote arid and semi-arid areas (Thackway and Cresswell 1995). The Pilbara bioregion is further divided into the Chichester (PIL1), Fortescue Plains (PIL2), Hamersley (PIL3) and Roebourne (PIL4) subregions.

The Project area is located entirely within the Hamersley (PIL3) subregion (Figure 2.4). The Hamersley subregion covers approximately 35% of the Pilbara bioregion. The dominant land uses are grazing and Crown reserves. This subregion features mountainous areas of sedimentary ranges and plateaux, dissected by gorges. Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges (Kendrick 2001).



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IBRA Subregions of the Project Area

Figure: 2.1
Project ID: 1304

Drawn: AH
Date: 09/11/11

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

Unique Map ID: AH401

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3 METHODS

The survey methods adopted by *ecologia* are aligned with the EPA's Guidance Statement No. 56 (EPA 2004), Position Statement No. 3 (EPA 2002) and *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA and DEC 2010).

3.1 DETERMINATION OF SURVEY SAMPLING DESIGN AND INTENSITY

A review of Guidance Statement No. 56 showed that, based on the Level of disturbance, a Level 2 survey was recommended, incorporating a desktop assessment and a two-season (two-phase) trapping survey. 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 2004).

Factor	Relevance
Bioregion – Level of existing survey-knowledge of the region and associated ability to predict accurately.	Previous biological surveys have been conducted within 100 km of the Project area. Numerous published literature and unpublished survey reports were available when developing the survey design. The survey was structured to focus on all identified fauna habitats and their potential for supporting conservation significant fauna.
Landform special characteristics/specific fauna/specific context of the landform characteristics and their distribution and rarity in the region.	The Project area covers nine land systems (Table 2.2, Figure 2.3), which are not exclusive to the Project area.
Lifeforms, life cycles, types of assemblages and seasonality (e.g. migration) of species likely to be present.	The best survey time for birds and amphibians is following seasonal rain events. Best survey timing for reptiles is from September to April. Survey timing for mammals is not constrained with the exception of the Northern Quolls and Pilbara Leaf-nosed Bat. Targeted surveys for these two species were conducted during recommended season (June-August for Northern Quoll, July and November/December for Pilbara Leaf-nosed Bat).
Level of existing knowledge and results of previous regional sampling (e.g. species accumulation curves, species/area curves).	Nine previous terrestrial vertebrate fauna surveys have been carried out within 100 km of the Project area. Regional and local knowledge for the area is available; however, a two-phase Level 2 survey was deemed suitable to document the fauna of the Project area.
Number of different fauna habitats or degree of similarity between habitats within a Projectarea.	The Project area comprised a variety of fauna habitat types: rocky spinifex plain and hills, rocky ridges and breakaways, major creeklines with fringing eucalypt, alluvial plains with cracking clays, snakewood shrubland and acacia woodland.
Climatic constraints (e.g. temperature or rainfall that preclude certain sampling methods).	The Pilbara region experiences hot summers with occasional cyclonic rain events, followed by warm winters with little rain. Rainfall is highly unpredictable.
Sensitivity of the environment to the proposed activities.	The majority of the impact for the Project area will be on valley floors with stony spinifex plains and creekline habitat which is well represented in the surrounding area.
Size, shape and location of the proposed activities.	The Project area incorporates the Serenity, Sheila and Holek mining tenements as well as the proposed rail line area, and is located in the Pilbara region of Western Australia. The total size of the Project area is approximately 590.55 km^2.
Scale and impact of the proposal.	The Project area covers approximately 590.55 km^2.

3.2 LITERATURE REVIEW AND DATABASE SEARCHES

Several databases were consulted in the preparation of the regional fauna appendix and potential conservation significant fauna lists (Table 3.2). In addition, 6 publications reporting on vertebrate fauna surveys conducted within 50 km of the Project area were consulted (Table 3.3). The results of all database searches and previous surveys are presented in Appendix C.

Table 3.2 – Databases searched to determine the potential vertebrate fauna assemblage.

Database	Search Details
DEC Threatened Fauna Database	Records within 50 km of the Project area
DEC NatureMap	Records within 40 km of the Project area
Birds Australia Birdata	Records within one degree square of the Project area
Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) protected matters database	Records within 10 km of the Project area
ecologia internal database	Records within 60 km of the Project area, comprising 2 single phase Level 2 surveys, 1 Level 1 survey

Table 3.3 – Previous biological survey reports with 100 km of the Project area.

Survey Location and Author(s)	Distance to Project area (km)	Comments
Solomon Project area (Coffey Environments 2008)	10	Single phase Level 2 survey
Solomon Project area (*ecologia* 2010)	10	Single phase Level 2 survey
Firetail mining area (Ecoscape 2010)	20	Single-phase Level 2 vertebrate fauna assessment
Brockman 2 Detritals (Mattiske and Ninox 1990)	20	Level 1 assessment
Brockman Syncline (Biota 2005)	40	Two phase Level 2 fauna assessment
West Turner Section 10 (Biota 2009)	47	Two phase Level 2 fauna assessment
Marandoo to Great Northern Hwy Rd (Kendrick 1995)	50	Two phase Level 2 fauna assessment
Hamersley Range (Muir 1983)	65	Information was removed as some species were either misidentified or species have been subsequently separated

3.3 SURVEY TIMING

Coffey Environments conducted the first phase of surveying in autumn from 29th February to 6th March 2008. ecologia Environment conducted the following phases of surveying in autumn 2011, between the 3rd March 2011 and 15th March 2011 (Phase 1), and in spring, from 25th August 2011 to 6th September 2011 (Phase 2 survey 1), and from 23rd September 2011 to 5th October 2011 (Phase 2 survey 2). Table 3.4 presents a summary of survey timing and duration for the project.

Table 3.4 – Summary of survey timing and duration.

Survey	Duration (days)	Person Days
Coffey Environments		
Phase 1 (2008)	13	52
***ecologia* Environment**		
Phase 1 (2011)	13	130
Phase 2 (2011)	13	156
Total	**39**	**338**

3.4 SITE SELECTION

Sites were selected to represent the full range of habitats present in the Project area. Land system maps and aerial photos were used along with on-site reconnaissance to aid site selection. All trapping sites were set within the proposed Project area (Figure 3.1) with trapping sites located to cover all land systems and four out of five fauna habitat types within the Project area.

Coffey Environments installed a total of 20 trapping sites within the Serenity area during the first phase of surveying in 2008. During the complimentary Phase 1 survey conducted by *ecologia* in 2011 an additional 18 trapping sites were installed in areas not covered during the Coffey Environmenst survey. The Phase 2 survey conducted by *ecologia* installed an additional four trapping sites in the area surveyed by Coffey Environment to cover that area with a second phase of surveys, and a further two sites were added to areas near Sheila East. A total of 24 sites were surveyed by *ecologia* in 2011.

Thirteen survey sites were located on rocky spinifex plains and hills, six survey sites were set up in the vicinity of major creeklines with fringing eucalypt trees, one survey site was in snakewood shrubland, two site were along rocky ridges and breakaways and the remaining two sites were in acacia woodland. One site (CPP15) was set up along a creekline which crosses through alluvial plain with cracking clays. The adjacent cracking clays are a unique habitat type but were used as paddock for live stock and therefore the establishment of a trap site was avoided. Recordings of bat calls were made at all trapping sites and in habitats that could potentially support conservation significant bat species such as creeklines and caves along ridges. Sampling sites information is presented below in Table 3.5.

Opportunistic searches were conducted in less accessible habitat such as rocky ridges and breakaway habitat that were expected to potentially support conservation significant fauna such as Pilbara Olive Python, Pilbara Leaf-nosed Bat, Ghost Bat and Northern Quoll, rocky spinifex plain that were expected to support Western Pebble-mound Mouse, and creeklines potentially supporting Bush Stone-curlew, Rainbow Bee-eater. Additional habitat assessments were conducted at 24 sites to aid habitat mapping and to verify that the habitats surveyed by systematic and opportunistic sites are representative of those found throughout the Project area.

The details of each survey site are described in Table 3.5 and Appendix D.

Table 3.5 – Location of survey sites.

Site	Location		Land System	Vegetation Community[1]	Habitat type
	Easting	Northing			
***ecologia* Trapping Sites**					
CPP1	554339	7551675	River	565	Major creekline with fringing eucalypt
CPP2	557904	7549716	Boolgeeda	565	Rocky spinifex plain and hills
CPP3	558322	7545325	Boolgeeda	82	Rocky spinifex plain and hills
CPP4	550539	7538370	Boolgeeda	565	Major creekline with fringing eucalypt
CPP5	565268	7534258	Boolgeeda	18	Acacia woodland
CPP6	567855	7537466	Newman	82	Rocky spinifex plain and hills
CPP7	563146	7540259	Newman	82	Rocky spinifex plain and hills
CPP8	562101	7542532	Newman	82	Rocky ridge and breakaway
CPP9	570642	7545130	Platform	565	Rocky spinifex plain and hills
CPP10	572177	7544393	Platform	565	Major creekline with fringing eucalypt
CPP11	574349	7541963	Newman	82	Rocky ridge and breakaway
CPP12	575682	7542109	Platform	565	Rocky spinifex plain and hills
CPP13	568254	7535860	Boolgeeda	18	Acacia woodland
CPP14	571401	7539125	Calcrete	82	Rocky plain and hills
CPP15	568614	7529787	Brockman	82	Major creekline with fringing eucalypt/alluvial plain with cracking clay
CPP16	565787	7528574	Brockman	82/29	Rocky spinifex plain and hills
CPP17	563909	7531259	Hooley	175	Snakewood shrubland/ Major creekline with fringing eucalypt
CPP18	565801	7544725	Platform	565	Major creekline with fringing eucalypt
CPP19	547300	7543528	Boolgeeda	82	Rocky spinifex plain and hills
CPP20	556368	7538748	Boolgeeda	82	Rocky spinifex plain and hills
CPP21	552990	7540198	Boolgeeda	565	Rocky spinifex plain and hills
CPP22	553304	7543395	Boolgeeda	565	Rocky spinifex plain and hills
CPP23	570194	7541399	Platform	565	Rocky spinifex plain and hills
CPP24	570991	7546895	Platform	565	Rocky spinifex plain and hills
Coffey Environments Trapping Sites					
BD1	552661	7539797	Boolgeeda	565	Adjacent creekline with fringing eucalypt
BD2	553719	7539797	Boolgeeda	565	Rocky spinifex plain and hills
BD3	553044	7541403	Boolgeeda	82	Adjacent creekline with fringing eucalypt
BD4	553908	7541404	Boolgeeda	565	Rocky spinifex plain and hills
BD5	553123	7542207	Boolgeeda	565	Adjacent creekline with fringing eucalypt

Site	Location		Land System	Vegetation Community[1]	Habitat type
	Easting	Northing			
BD6	553815	7542190	Boolgeeda	565	Rocky spinifex plain and hills
BD7	553306	7543007	Boolgeeda	565	Rocky spinifex plain and hills
BD8	553809	7542991	Boolgeeda	565	Rocky spinifex plain and hills
BD9	551657	7544260	Boolgeeda	565	Rocky spinifex plain and hills
BD10	551818	7544416	Boolgeeda	565	Rocky spinifex plain and hills
BD11	550489	7545404	Boolgeeda	565	Rocky spinifex plain and hills
BD12	551309	7545407	River	565	Adjacent creekline with fringing eucalypt
BD13	550612	7546202	River	565	Rocky spinifex plain and hills
BD14	550910	7546203	Boolgeeda	565	Adjacent creekline with fringing eucalypt
BD15	552199	7547985	River	565	Adjacent creekline with fringing eucalypt
BD16	552182	7547490	River	565	Adjacent creekline with fringing eucalypt
BD17	553406	7547717	Boolgeeda	565	Rocky spinifex plain and hills
BD18	553403	7547213	River	565	Rocky spinifex plain and hills
BD19	553664	7548212	River	565	Adjacent creekline with fringing eucalypt
BD20	553916	7548209	River	565	Adjacent creekline with fringing eucalypt
Opportunistic Sites					
Opp 1	554270	7542745	Newman	82	Rocky ridge and breakaway
Opp 2	564370	7545169	Newman	565	Rocky ridge and breakaway
Opp 3	556867	7550478	Newman	565	Rocky ridge and breakaway
Opp 4	556139	7550960	Newman	565	Rocky ridge and breakaway
Opp 5	576465	7539377	Boolgeeda	18	Rocky ridge and breakaway
Opp 6	572604	7537985	Calcrete	82	Major creekline with fringing eucalypt
Opp 7	555037	7536757	Newman	82	Rocky spinifex plain and hills
Opp 8	557027	7536388	Newman	82	Rocky spinifex plain and hills
Opp 9	574619	7541843	Newman	82	Rocky ridge and breakaway
Opp 10	575086	7541794	Newman	82	Rocky ridge and breakaway
Opp 11	561523	7542211	Newman	82	Rocky ridge and breakaway
Opp 12	563782	7536992	Boolgeeda	18	Rocky spinifex plain and hills
Opp 13	554177	7538526	Newman	82	Rocky spinifex plain and hills
Opp 14	555995	7536781	Newman	82	Rocky spinifex plain and hills
Opp 15 (Regional)	517575	7540681	Boolgeeda	565	Major creekline with fringing eucalypt

Site	Location		Land System	Vegetation Community[1]	Habitat type
	Easting	Northing			
Opp 16	554447	7536847	Boolgeeda	82	Rocky spinifex plain and hills
Opp 17	559701	7539997	Newman	82	Rocky ridge and breakaway
Opp 18	551160	7537805	Boolgeeda	82	Rocky spinifex plain and hills
Opp 19	547316	7537066	Newman	82	Major creekline with fringing eucalypt
Opp 20	561174	7546102	Newman	82	Rocky ridge and breakaway
Opp 21	569734	7543946	Platform	82	Rocky spinifex plain and hills
Opp 22	572872	7556370	River	565	Major creekline with fringing eucalypt
Opp 23	568985	7546711	Newman	82	Rocky spinifex plain and hills
Opp 24	577080	7547837	Newman	82	Rocky ridge and breakaway
Opp 25	569406	7539910	Boolgeeda	565	Rocky spinifex plain and hills
Opp 26	570067	7534195	Brockman	175	Alluvial plain with cracking clays
Opp 27	575119	7544245	Platform	565	Rocky spinifex plain and hills
Opp 28	577002	7543611	Platform	565	Rocky spinifex plain and hills
Opp 29	564345	7536077	Boolgeeda	18	Rocky spinifex plain and hills
Opp 30	547154	7536696	Newman	82	Major creekline with fringing eucalypt
Opp 31	573798	7543451	Platform	565	Rocky spinifex plain and hills
Opp 32	561479	7542295	Newman	82	Rocky ridge and breakaway
Opp 33	547522	7542477	Newman	82	Rocky ridge and breakaway
Opp 34	548085	7537879	Newman	565	Rocky ridge and breakaway
Motion Sensing Camera					
Motion Camera 1	568861	7546477	Newman	82	Rocky ridge and breakaway
Motion Camera 2	568846	7546782	Newman	82	Rocky ridge and breakaway
Motion Camera 3	570162	7541517	Platform	565	Rocky spinifex plain and hills
Motion Camera 4	577286	7544058	Newman	82	Rocky ridge and breakaway
Motion Camera 5	561519	7542315	Newman	82	Rocky ridge and breakaway
Motion Camera 6	547522	7542477	Newman	82	Rocky ridge and breakaway
SM2 Bat recorder					
Bat recorder 1	556880	7550380	Newman	565	Rocky ridge and breakaway
Bat recorder 2	554370	7551661	River	565	Adjacent major creekline with fringing eucalypt
Bat recorder 3	557930	7549600	Boolgeeda	565	Rocky spinifex plain and hills
Bat recorder 4	558422	7545525	Boolgeeda	82	Rocky spinifex plain and hills
Bat recorder 5	550339	7538270	Boolgeeda	565	Adjacent major creekline with fringing eucalypt
Bat recorder 6	565468	7534158	Boolgeeda	18	Acacia woodland
Bat recorder 7	567755	7537266	Newman	82	Rocky spinifex plain and hills
Bat recorder 8	563246	7540359	Newman	82	Rocky spinifex plain and hills
Bat recorder 9	562201	7542632	Newman	82	Rocky ridge and breakaway
Bat recorder 10	570442	7545230	Platform	565	Rocky spinifex plain and hills
Bat recorder 11	572277	7544593	Platform	565	Adjacent major creekline with

Site	Location		Land System	Vegetation Community[1]	Habitat type
	Easting	Northing			
					fringing eucalypt
Bat recorder 12	574249	7541863	Newman	82	Rocky spinifex plain and hills
Bat recorder 13	575782	7542209	Platform	565	Rocky ridge and breakaway
Bat recorder 14	568354	7535960	Boolgeeda	18	Acacia woodland
Bat recorder 15	571501	7539025	Calcrete	82	Adjacent creekline with fringing eucalypt/ rocky plain and hills
Bat recorder 16	568514	7529687	Brockman	82	Major creekline with fringing eucalypt/alluvial plain with cracking clay
Bat recorder 17	565687	7528674	Brockman	82/29	Rocky spinifex plain and hills / Acacia woodland
Bat recorder 18	563809	7531359	Hooley	175	Snakewood shrubland/ Major creekline with fringing eucalypt
Bat recorder 19	565701	7544825	Platform	565	Major creekline with fringing eucalypt
Bat recorder 20	547200	7543428	Boolgeeda	82	Rocky spinifex plain and hills
Bat recorder 21	556268	7538648	Boolgeeda	82	Rocky spinifex plain and hills
Bat recorder 22	552890	7540298	Boolgeeda	565	Adjacent major creekline with fringing eucalypt/ rocky plain and hills
Bat recorder 23	553404	7543295	Boolgeeda	565	Adjacent major creekline with fringing eucalypt/ rocky plain and hills
Bat recorder 24	570294	7541299	Platform	565	Rocky spinifex plain and hills
Bat recorder 25	570891	7546795	Platform	565	Adjacent creekline with fringing eucalypt/ rocky plain and hills
Bat recorder 26	555135	7532859	Hooley	18	Major creekline with fringing eucalypt
Bat recorder 27	548185	7537752	Boolgeeda	82	Major creekline with fringing eucalypt
Bat recorder 28	561579	7542195	Newman	82	Rocky ridge and breakaway
Bat recorder 29	553313	7540991	Boolgeeda	83	Rocky spinifex plain and hills

Datum: GDA94565
Zone: 50K
[1] Refer to Table 2.1 for vegetation association descriptions

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530000 540000 550000 560000 570000 580000

7550000

7540000

7530000

Legend

- CPP Rail Spur
- CPP Mine

Fauna Survey Sites_new

- Trapping Site
- Trapping Site (Coffey)

Fauna Habitat types

- Alluvial plain with cracking clays
- Major creekline with fringing eucalypt
- Mulga/Acacia woodland
- Rocky ridge and breakaway
- Rocky spinifex plain and hills
- Snakewood shrubland

CPP S1
CPP S2
BD19 BD20
BD17
BD16
BD18
BD13 BD14
BD11 BD12
BD10 BD9
CPP19
CPP22
BD7 BD8
BD5 BD6
BD3 BD4
CCP21
BD1 BD2
CPP S4
CPP20
CPP S3
CPP24
CPP18
CPP S9
CPP S10
CPP S8
CPP23
CPP S7
CPP S11
CPP S12
CPP S14
CPP S6
CPP S13
CPP S5
CPP S17
CPP S15
CPP16

N

0 5 10

Kilometres

Absolute Scale - 1:150,000

ecologia ENVIRONMENT

FMG

Locations of Fauna Trapping Sites

Figure: 3.1
Project ID: 1304

Drawn: AH
Date: 17/10/12

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

Unique Map ID: AH404

A3

530000 540000 550000 560000 570000 580000

7550000

7540000

7530000

Legend

- CPP Rail Spur
- CPP Mine
- Bat recorder
- Motion Camera
- Opportunistic Site

Fauna Habitat types

- Alluvial plain with cracking clays
- Major creekline with fringing eucalypt
- Mulga/Acacia woodland
- Rocky ridge and breakaway
- Rocky spinifex plain and hills
- Snakewood shrubland

Bat recorder 2
Opp 4
Bat recorder 1
Opp 3
Bat recorder 3
Opp 22
Opp 24
Motion Camera 2
Opp 23
Bat recorder 25
Motion Camera 1
Opp 20
Bat recorder 4
Bat recorder 10
Bat recorder 19
Bat recorder 11
Opp 27
Opp 21
Bat recorder 20
Bat recorder 23
Opp 31
Opp 28
Motion Camera 6
Opp 33
Opp 11
Opp 32
Bat recorder 13
Bat recorder 9
Bat recorder 12
Opp 9
Motion Camera 5
Bat recorder 28
Motion Camera 3
Bat recorder 24
Opp 10
Bat recorder 29
Bat recorder 22
Bat recorder 8
Opp 17
Opp 25
Opp 5
Bat recorder 15
Opp 13
Bat recorder 21
Bat recorder 27
Opp 34
Opp 18
Opp 6
Bat recorder 5
Opp 19
Opp 30
Opp 16
Opp 7
Opp 8
Opp 14
Opp 12
Bat recorder 7
Opp 29
Bat recorder 14
Bat recorder 6
Opp 26
Bat recorder 26
Bat recorder 18
CPP S17
Bat recorder 16
Bat recorder 17

0 3 6
Kilometres

Absolute Scale - 1:150,000

ecologia ENVIRONMENT

FMG

Locations of Bat Recorders, Motion Cameras and Opportunistic Sites

Figure: 3.2
Project ID: 1304

Drawn: AH
Date: 17/10/12

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

Unique Map ID: AH404b

A3

3.5 SAMPLING METHODS

The survey was undertaken using a variety of sampling techniques, both systematic and opportunistic (non-systematic). 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. Opportunistic sampling includes data collected non-systematically from both fixed sampling sites and as opportunistic records from chance encounters with fauna.

Survey effort expended within the Project area included the following:

- trapping grids were open for 6 nights (coffey Environment) and 8 nights (*ecologia* Environment), totalling 23,952 trapnights;
- approximately 84 hours were spent surveying for birds;
- 128 hours were spent on opportunistic diurnal searching;
- 75 hours were spent on opportunistic nocturnal searching;
- 469 hours of recordings were analysed to determine bat assemblage and distribution.
- Camera trapping was deployed for over 100 hours;

Total survey effort per site is presented in Table 3.6.

3.5.1 Systematic Sampling

The terrestrial vertebrate fauna assessment present in this report incorporates the results of a survey conducted by Coffey environment, as well as those of *ecologia*'s survey. The methods for each survey differed slightly and are described below.

3.5.2 Coffey Environment Survey (Phase 1 in 2008)

3.5.2.1 Terrestrial Mammals and Herpetofauna

Coffey Environment conducted the first phase of surveying in early March 2008. The trapping program in the Serenity Valley consisted of 20 sites. Each trapping site consisted of the following (Figure 3.3):

- Pitfall trap and drift fence: Three 20-L PVC buckets and three 150 x 500 mm PVC pipes as pit-traps were established at each site, evenly spaced along a 30 m fly-wire drift fence (250 mm high). Four drift fences were established at each trapping site, resulting in 24 pitfall traps per site.
- Elliott box traps: Three Elliott traps (two small: 100 x 90 x 330 mm and one large: 380 x 120 x 110 mm) were set along each drift fence resulting in 12 Elliott traps per site. Elliott traps were baited with a mixture of sardines, rolled oats and peanut butter.
- Funnel traps: Six funnel traps were placed in pairs along each drift fence with each pair located between a pair of bucket and PVC pitfall traps.

Trap lines were arranged parallel to each other.

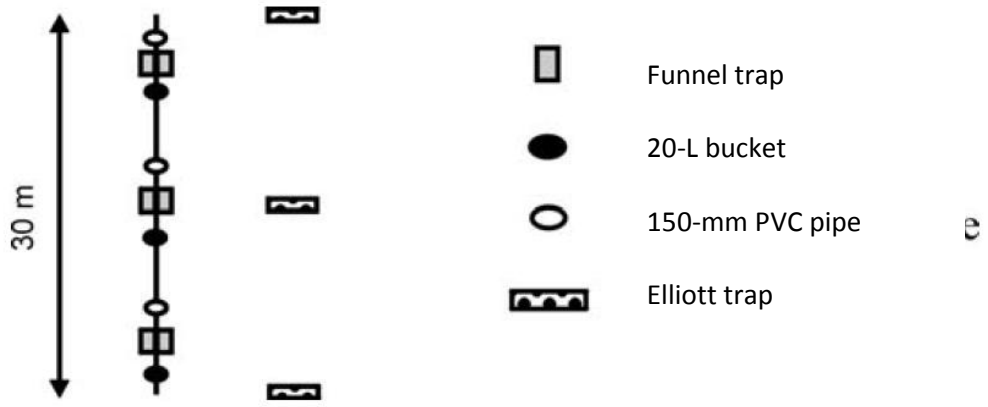

Figure 3.3 – Diagram of Coffey Environment's systematic sampling trap arrangement (Phase 1).

3.5.2.2 Avifauna

Avian surveys were conducted in the Serenity Valley at thirteen sites. A single wandering transect survey was conducted by an ornithologist at each site, where the number of individuals of each species observed was recorded. Survey length varied between 30 – 60 minutes.

3.5.2.3 Bats

Bat echolocation calls were detected using the Anabat II recording device (CF-ZCAIM and Anabat SD1). Anabat recorders were left over night (approximately 10 hours) in areas likely to attract bats. Two sites in Serenity Valley were surveyed (Site 6: 547250e, 7536932n and Site 19: 553056e, 7546954n). Recorded calls were analysed using AnalookW 3.3f software. Representative call sequences were imported into the software Analyze (Jolly 1997) where three call variables were measured on good quality search phase pulses: pulse duration (milliseconds), maximum frequency (kHz) and end frequency (equivalent to characteristic frequency; kHz). Species were identified based on information in McKenzie and Muir (2000) and Milne (2002).

3.5.3 *ecologia* Environment Survey (Phase 2 in 2011)

3.5.3.1 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 cage traps.

Each trapping site consisted of the following (Figure 3.4):

- Pit-trap and drift fence: Five PVC pipe (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 10 m 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 and one trap was placed in between pit traps.
- Funnel traps: Funnel traps (Ecosystematica Type III) were placed in association with drift fences. Twenty funnel traps were used per site, with a trap being placed at each end of the drift fence.
- Cage traps: Two traps were used per site with one trap placed at each end of the trap line.

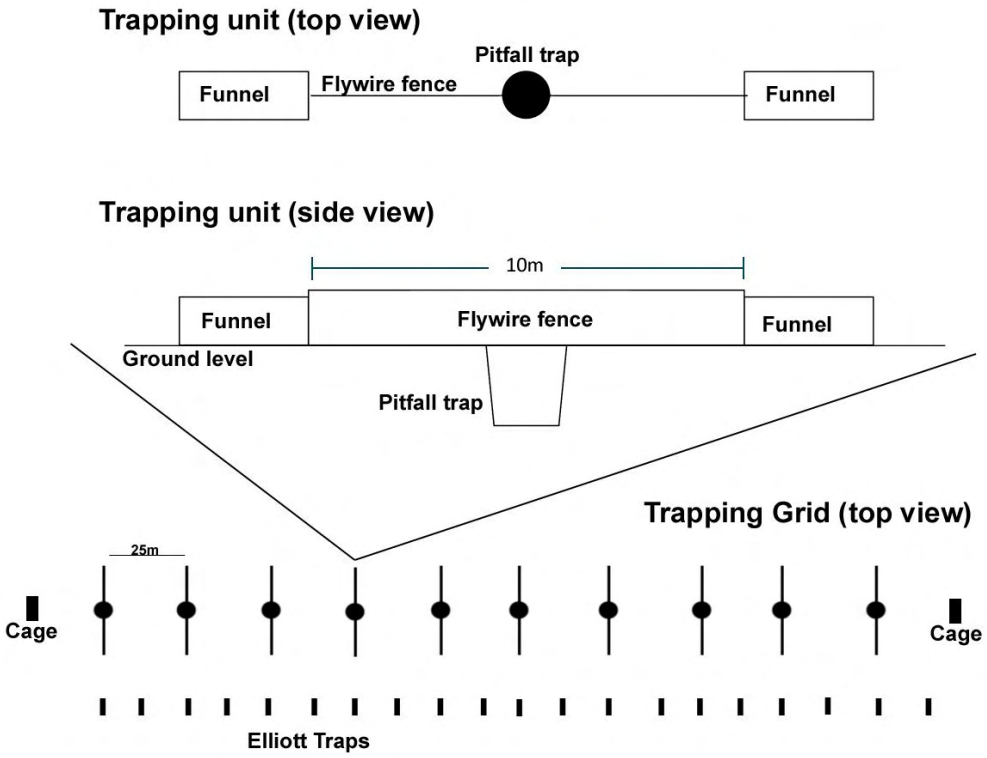

Figure 3.4 – Diagram of *ecologia* Environment's systematic sampling trap arrangement (Phase 2).

3.5.3.2 Avifauna

Twenty-minute set-time 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 2.0 ha area. This is the preferred survey method for the ongoing Birds Australia *Atlas of Australian Birds* project.

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

3.5.3.3 Bats

Bat echolocation calls were detected using two recording systems: Anabat II and SM2Bat 384 kHz recording devices. The Anabat Bat Detector is able to transform ultrasonic bat echolocation calls using zero crossing, and the resulting calls are saved on an Olympus digital recorder. The SM2Bat has a high sampling frequency, enabling calls to be recorded without being transformed. Both the transformed and untransformed calls were analysed by Mr Bob Bullen (Principal, Bat Call WA) and the acoustic calls identified to species Level.

3.5.4 Opportunistic Data

3.5.4.1 Nocturnal Searching

The Project area was searched at night using a combination of road transects and opportunistic ground searches using head torches and hand held spotlights to uncover nocturnal species, including geckos, snakes, frogs and birds.

3.5.4.2 Diurnal Searching

Both trapping and 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 and over-turning logs and stones. Sites were selected on the basis of fauna habitat (targeting uncommon habitats or habitats poorly represented by trapping sites) and the possibility of their supporting conservation significant fauna.

3.5.4.3 Opportunistic Sightings

Fauna were recorded while searching, travelling and during trap establishment within the Project area during the day and night. Tracks, diggings, scats, burrows and nests were recorded where possible.

3.5.4.4 Camera Trapping

Motion sensor cameras were used in areas with a high likelihood of animal activity, such as water sources, to detect fauna species. The Bushnell Trophy Cam, model number 119415 was used. The camera is triggered by movement by a highly sensitive Passive Infra-Red motion sensor and functions day and night taking either video footage or photos (Bushnell Outdoor Products 2009).

3.5.4.5 Targeted Conservation Significant Fauna Surveying

Prior to the commencement of survey activity, the preferred habitat of the conservation significant species that potentially occur in the Project area was determined. These habitats were identified and targeted during survey activities using both systematic survey sites and opportunistic surveys.

On the basis of the habitats observed during surveying, specific searches were also undertaken to determine the presence of conservation significant fauna using the following methods:

- 64 hours and 8 minutes was spent searching for Northern Quolls;
- 20 hours and 20 minutes was spent searching for Western Pebble-mound Mice;
- 62 hours and 8 minutes was spent searching for Ghost Bats;
- 62 hours and 8 minutes was spent searching for Pilbara Leaf-nosed Bats;
- 7 hours and 40 minutes was spent searching for Bush Stone-curlews;
- 61 hours and 8 minutes was spent searching for Pilbara Olive Pythons;
- 9 hours 20 minutes was spent searching for *Ramphotyphlops ganei*;

Table 3.6 – Survey effort.

Site	Pit Traps (trap nights)		Funnels (trap nights)		Elliotts (trap nights)		Cages (trap nights)		Bird Survey (min)		Diurnal Opp. Search (min)		Bat Recording (min)		Nocturnal Opp. Search (min)	
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
Coffey Environment																
BD1	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD2	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD3	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD4	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD5	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD6	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD7	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD8	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD9	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD10	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD11	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD12	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD13	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD14	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD15	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD16	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD17	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD18	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD19	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
BD20	144	-	108	-	72	-	-	-	-	-	-	-	-	-	-	-
OPP Sites	-	-	-	-	-	-	-	-	575	-	-	-	600	-	1080	-
***ecologia* Environment**																
CPP1	80	80	160	160	160	160	16	16	60	120	-	-	780	720	175	75
CPP2	80	80	160	160	160	160	16	16	60	120	-	-	220	720	150	60
CPP3	80	80	160	160	160	160	16	16	60	120	-	-	650	720	75	60
CPP4	80	80	160	160	160	160	16	16	45	120	-	90	120	720	75	-

Site	Pit Traps (trap nights)		Funnels (trap nights)		Elliotts (trap nights)		Cages (trap nights)		Bird Survey (min)		Diurnal Opp. Search (min)		Bat Recording (min)		Nocturnal Opp. Search (min)	
CPP5	80	80	160	160	160	160	16	16	20	120	-	80	720	720	-	120
CPP6	80	80	160	160	160	160	16	16	40	120	-	120	720	720	-	80
CPP7	80	80	160	160	160	160	16	16	40	120	-	30	-	720	-	80
CPP8	80	80	160	160	160	160	16	16	60	120	-	80	-	720	-	60
CPP9	80	80	160	160	160	160	16	16	100	120	-	60	-	720	-	60
CPP10	80	80	160	160	160	160	16	16	60	120	-	110	700	-	-	-
CPP11	80	80	160	160	160	160	16	16	60	120	-	80	1420	720	-	60
CPP12	80	80	160	160	160	160	16	16	60	120	-	60	570	-	-	30
CPP13	80	80	160	160	160	160	16	16	70	120	-	90	700	-	-	-
CPP14	80	80	160	160	160	160	16	16	120	120	-	90	700	-	-	-
CPP15	80	80	160	160	160	160	16	16	100	120	-	60	700	720	-	-
CPP16	80	80	160	160	160	160	16	16	80	120	-	60	700	-	-	60
CPP17	80	80	160	160	160	160	16	16	60	120	100	60	700	-	-	-
CPP18	80	80	160	160	160	160	16	16	120	120	-	50	-	720	-	90
CPP19	-	80	-	160	-	160	-	16	-	120	-	-	-	720	-	300
CPP20	-	80	-	160	-	160	-	16	-	120	-	-	-	720	-	-
CPP21	-	80	-	160	-	160	-	16	-	140	-	90	-	720	-	-
CPP22	-	80	-	160	-	160	-	16	-	120	-	-	-	720	-	-
CPP23	-	80	-	160	-	160	-	16	-	120	-	60	-	720	-	90
CPP24	-	80	-	160	-	160	-	16	-	120	-	60	-	720	-	60
Opp Sites	-	-	-	-	-	-	-	-	-	355	2540	3765	5775	-	1140	540
Total	4320	1920	5040	3840	4320	3840	288	384	1790	3255	2640	5095	15775	12960	2695	1825

3.6 ANIMAL ETHICS

Surveying was conducted using methods approved by the Edith Cowan University Animal Ethics Committee (Coffey Environments) and 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).

3.7 TAXONOMY AND NOMENCLATURE

Nomenclature for mammals, reptiles and amphibians within this report is as per *Western Australian Museum Checklist of the Vertebrates of Western Australia*, birds according to Christidis and Boles (2008). References used for fauna identification are listed in Table 3.7.

Table 3.7 – References used for identification.

Fauna Group	Reference
Mammals	Menkhorst and Knight (2009), Van Dyck and Strahan (2008)
Bats	Churchill (2008), Menkhorst and Knight (2009)
Birds	Simpson and Day (2004)
Reptiles	Cogger (2000), Wilson and Swan (2010)
Geckos	Storr *et al*. (1990), Wilson and Swan (2010)
Skinks	Storr *et al*. (1999), Wilson and Swan (2010)
Dragons	Storr *et al*. (1983), Wilson and Swan (2010)
Varanids	Storr *et al*. (1983), Wilson and Swan (2010)
Legless Lizards	Storr *et al*. (1990), Wilson and Swan (2010)
Snakes	Storr *et al*. (2002), Wilson and Swan (2010)
Amphibians	Tyler and Doughty (2009), Cogger (2000)

3.8 CONSERVATION SIGNIFICANT SPECIES

After the results of the literature review, database searches and survey results were compiled, vertebrate fauna species that are listed under current legislative frameworks were identified. Recorded conservation significant fauna and flora taxa of the area were categorised into their conservation status under:

- *Environment Protection and Biodiversity Conservation Act 1999* (National)

Flora and fauna species are protected at a National Level under the Commonwealth EPBC Act. The EPBC Act contains a list of species that are considered either 'Critically Endangered', 'Endangered', 'Vulnerable', 'Conservation Dependent', 'Extinct' or 'Extinct in the Wild' (Appendix A).

- *Wildlife Conservation Act 1950* (State)

Fauna and flora taxa protected under the *Western Australian Wildlife Conservation Notice 2010 (2)* of the WC Act are known as Threatened Taxa. This notice lists flora and fauna taxa that are extant and considered likely to become extinct or rare, defined as "taxa which have been adequately searched for and deemed to be either rare, in danger of extinction, or otherwise in need of special protection in the wild". These taxa are legally protected and their removal or impact to their surroundings cannot be conducted without Ministerial approval, obtained specifically on each occasion for each population (refer to Appendix A for category definitions).

- Department of Environment and Conservation Priority Flora and Fauna Lists (State)

The DEC maintains a list of Priority Flora and Fauna taxa, which are considered poorly known, uncommon or under threat, but for which there is insufficient justification, based on known distribution and population sizes, for inclusion on the Threatened Schedule. A Priority taxon is assigned to one of four Priority categories (Atkins 2008) as defined in Appendix A.

In addition, the likelihood of a conservation significant species being present within the Project area was determined by examining the following:

- potential fauna habitats and their condition known to exist within the Project area;
- distance of previously recorded conservation significant species from the Project area;
- frequency of occurrence of conservation significant species records in the region; and
- time elapsed since conservation significant species were recorded within, or surrounding, the Project area.

For each conservation significant species potentially occurring in the Project area, the examined factors were collated and assigned to their corresponding likelihood category (Table 3.8). The impact of disturbance to the species at a regional scale was also assessed. The regional impact to each species was categorised into three Levels (Table 3.9).

Note that all of these species are significant as they have been assigned a conservation status by the DEC and any disturbance to populations located within the Project area should be avoided where possible.

Table 3.8 – Likelihood of occurrence categories.

HIGH/RECORDED	Species recorded within, or in proximity to, the Project area within 50 years; suitable habitat occurs
MEDIUM	Species recorded outside, but within 100 km of, Project area; limited suitable habitat occurs
LOW	Species rarely, or not recorded, within 100 km of the Project area, and/or suitable habitat does not occur

If a conservation significant species was located within the Project area,

Table 3.9 – Regional impact to the conservation significant species.

HIGH	Disturbance to individuals will have a major regional impact as this is the only, or one of few, records within the region.
MEDIUM	There are some additional records for this species outside the Project area within the region, and the nature and scale of disturbance to these individuals would determine impact to the species at a regional scale.
LOW	The species has many records within the region and disturbance to individuals is unlikely to be regionally significant.

3.9 DATA ANALYSIS

3.9.1 Randomised Species Accumulation Curves

Aspects of the Level of survey adequacy and completeness can be 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 the Level at which no new species are present. *ecologia* compared several estimators 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.

SACs were randomised 9999 times using EstimateS (version 8, Colwell 2006). Only trapping data obtained using systematic sampling methods were included in SAC analysis, as this form of analysis assumes a standard type of effort was applied to recording species. Therefore, species recorded through opportunistic methods are not included in this analysis. Three separate SAC analyses were carried out on the trapping data, which included mammals (excluding bat data), birds and reptiles.

3.9.2 Habitat Analysis

Analysis of the fauna survey data was undertaken to determine the similarities in fauna communities and identify any unique fauna habitats. To analyse differences in species diversity between habitats, the data were subjected to log+1 transformation. To test whether the differences in species diversity between habitat types were significant, analyses of similarity (ANOSIM) (Clarke 1993) comparisons were made using the one-way ANOSIM function. ANOSIM was calculated using the Bray-Curtis Similarity Index with 9999 permutations. A resulting positive R-value that nears 1 indicates that the greatest similarities occur within groups (fauna habitats) rather than between groups, suggesting discrete habitat types. A p-value below 0.05 was considered to indicate statistical significance.

Non-metric multidimensional scaling (MDS) was also applied to the Bray-Curtis similarity matrix. Resulting stress values below 0.20 were considered to indicate a good fit of the scaling to the matrix. The dimensions that reduced the majority of the “raw stress” were chosen for the final scaling. Analysis was undertaken using the PAST software package (Hammer *et al.* 2001).

3.10 SURVEY TEAM

Field survey team members are listed in Table 3.10, and external consultants are listed in Table 3.11. The Coffey Environment survey was conducted under DEC Regulation 17 Licence SF006224. The *ecologia* Environment survey was conducted under DEC Regulation 17 Licence SF007849.

Table 3.10 – Field survey personnel.

Survey Member	Expertise	Qualification	Experience
Coffey Environments			
Scott Thompson	Senior Zoologist	PhD	20 years
Graeme Finlayson	Zoologist	BSc (Hons), PhD submitted	10 years
Graham Thompson	Senior Zoologist	Grad Dip Sc, Dip PE, MEd PhD	45 years
Jarrad Cousins	Ornithologist	PhD	10 years
Rodney Armistead	Mammalogy	PhD	9 years
Dean Edmunds	-	-	5 years
Tim McCabe	-	-	3 years
Clay Hickling	-	-	3 years
Nicholas Hill	-	-	1 years
***ecologia* Environment**			
Damien Cancilla	Mammalogy	BSc (Hon)	7 years
Astrid Heidrich	Herpetology	MSc	7 years
Bruce Greatwich	Ornithology	BSc	2 years
Bret Stewart	Herpetology	BSc (Hons)	7 years
Nigel Jackett	Ornithology	BSc (Hons)	7 years
George Swann	Ornithology	-	41 years
David Algaba	Herpetology	-	11 years
Jordan Vos	Herpetology	-	6 years
John Graff	Ornithology	-	5 years
Leigh Smith	Herpetology	Certificate for vet nursing	2 years
Catherine Hall	Zoology	BSc	3 years
Amy Griffiths	Field Assistant	BSc (Hons)	1 year
Tanya McKenna	Field Assistant	BA/BSc	1 year
Kaisan Critchell	Field Assistant	BSc	1 year
Adam Young	Herpetology	BSc	1 year

Table 3.11 – External consultants.

External Consultant	Institution	Relevant Experience
Bob Bullen	Bat Call WA	15 years – bat call IDs

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4 RESULTS

4.1 LITERATURE REVIEW

The potential fauna assemblage of the Project area was determined using the results of database searches and records of previous surveys within close proximity to the Project area. These records were interpreted and extinct and erroneous species excluded from the list. Based on these results, there is the potential for 45 mammal species (37 native and eight introduced), 157 bird species, 102 reptile species, and six amphibian species to occur within the Project area (Table 4.1, Appendix C).

Table 4.1 – Comparison of results of literature review and of current survey

Survey/Database	Mammals Native (introduced)	Birds	Reptiles	Amphibians
Brockman 2 Detritals (Mattiske and Ninox 1990)	4 (4)	64	15	0
Brockman Syncline (Biota 2005)	15 (5)	82	54	2
West Turner Section 10 (Biota 2009)	18 (2)	68	52	1
Marandoo to Great Northern Hwy Rd (Kendrick 1995)	15 (3)	67	49	3
Hamersley Range (Muir 1983)	23 (1)	135	86	6
Firetail Project area (Ecoscape 2010)	19 (3)	62	48	0
ecologia internal database	25 (5)	89	73	3
DEC NatureMap	23 (4)	116	74	1
DEC Threatened Fauna Database	6 (n/a)	4	3	0
DEWHA Protected Matters Database	2 (3)	4	1	0
Birds Australia Birdata	n/a	123	n/a	n/a
Total	**37 (8)**	**157**	**102**	**6**
Current Survey	23(5)	100	84	4

4.2 SURVEY RESULTS

A total of 216 species were recorded from the current survey. This included 28 mammal species (23 native and five introduced), 100 bird species, 84 reptile species and four amphibian species (Table 4.1, Appendix C). Three species not previously recorded from the region were recorded during this survey: Banded Lapwing (*Vanellus tricolor*), Varied Sittella (*Daphoenositta chrysoptera*) and Welcome Swallow (*Hirundo neoxena*). The Project area is located on the edge of the distribution of the Banded Lapwing. However, Welcome Swallow and Varied Sittella can be encountered in the area but due to their preferred habitat comprising open grasslands (Welcome Swallow) and Woodlands (Varied Sittella) which is limited in the area these two species were not observed during previous surveys in the area.

4.2.1 Mammals

In total, 23 native and five introduced mammal species were recorded during the current survey. This comprised 22 native (and five introduced) mammal species recorded during the phase 1 survey (autumn) and 18 native (four introduced) mammal species recorded during the phase 2 survey (spring). This represents a relativey large number of mammal species recorded during fauna surveys in the region (Table 4.1). The native mammal assemblage recorded comprised six dasyurids (small, carnivorous marsupials), two macropods (kangaroos), four murids (mice), and 11 bat species (one megadermatid, one hipposid, three emballonids, two molossids and four vespertilionids).

Noteworthy is the relatively large number of individuals of some dasyurid and murid species. The most frequently trapped species was the Sandy Inland Mouse (*Pseudomys hermannsburgensis*) with 118 records. Other abundant mammal species included Pilbara Ningaui (*Ningaui timealeyi*; 79 records), Desert Mouse (*Pseudomys desertor*; 77 records), Pilbara Planigale (*Planigale* sp.; 53 records), Kaluta (*Dasykaluta rosamondae*; 47 records) and Stripe-faced Dunnart (*Sminthopsis macroura*; 42 records). Murids and dasyurids were captured in pitfall and Elliott traps at systematic trapping sites. Macropods were observed during diurnal and nocturnal opportunistic searches and nocturnal road spotting. Bats were identified from calls recorded on SM2bat systems.

Five active, five recently active and three inactive Western Pebble-mound Mouse (*Pseudomys chapmani*; DEC Priority 4) mounds were recorded during opportunistic searches in the spinifex hills in the centre of the Project area during both survey phases. The activity Level of Western Pebble-mound Mouse mounds was assessed on the basis of their external features such as access hole and cones (Anstee 1996). Other conservation significant mammal species recorded included Long-tailed Dunnart (*Sminthopsis longicaudata*), Ghost Bat (*Macroderma gigas*) and Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*). The Long-tailed Dunnart was recorded from two trap sites in the east of the Project area. Ghost Bats and Pilbara Leaf-nosed Bats were recorded from several locations in the east and west of the Project area (Figure 4.1).

4.2.2 Birds

In total, 100 species of bird were recorded from the Project area which represents a large number of species recorded in the region (Table 4.1). This included 95 bird species recorded during the phase 1 survey (autumn) and 81 bird species recorded during the phase 2 survey (spring). Eighteen species were only recorded during phase 1, and eight species were only recorded during phase 2.

Several species were recorded in high numbers (number of records in parentheses) and from many of the sites, and can be considered to represent the common bird species of the Project area; Budgerigar (2053), Diamond Dove (804), Zebra Finch (607), Grey-headed Honeyeater (554), Rufous Songlark (519), Weebill (468), Little Corella (390), Singing Honeyeater (306), Yellow-throated Miner (299) and White-winged Triller (292).

Five species of conservation significance were observed; Fork-tailed Swift (EPBC Migratory, WC Act Schedule 3), Peregrine Falcon (WC Act Schedule 1), Australian Bustard (DEC Priority 4), Bush Stone-curlew (DEC Priority 4) and Rainbow Bee-eater (EPBC Migratory, WC Act Schedule 3). Fork-tailed Swifts are almost entirely aerial and are nomadic in response to broad-scale weather pattern changes. They are attracted to thunderstorms where they can be seen in flocks, occasionally of up to 2,000 birds. A total of 280 records of Fork-tailed Swift were made during phase 1 of the survey. No observations were made during phase 2, exemplifying the Fork-tailed Swift's nomadic nature.

4.2.3 Reptiles

In total, 84 species of reptiles were recorded during the current survey. This included 72 species recorded during the phase 1 survey (autumn) and 67 species recorded during the phase 2 survey (spring).

The reptile assemblage of the Project area comprised 27 skinks, 17 geckos (nine diplodactylid species, six gekkonid species and two carphodactylid species), 11 elapids (venomous snakes), seven pygopods (legless lizards), seven dragon species, seven varanid (monitor lizard) species, four blind snakes and four pythons.

The most common species recorded were *Ctenotus helenae* (429), *Ctenotus saxatilis* (303), *Ctenotus pantherinus* (235), *Carlia munda* (218), *Ctenophorus caudicinctus* (154) and *Heteronotia binoei* (144), all of which are common species throughout the Pilbara region.

Conservation significant species recorded during this survey include Pilbara Olive Python (*Liasis olivaceus barroni*; EPBC Vulnerable, WC Act Schedule 1) and *Notoscincus butleri* (DEC Priority 4). Noteworthy is also the record of the Pebble Dragon (*Tympanocryptis cephala*) which is closely associated with alluvial plains and cracking clays (recorded from CPP17), and Pilbara Bandy Bandy (*Vermicella snelli*) which, though not rare, is rarely encountered during surveys. The Narrow-banded Sand-swimmer (*Eremiascincus fasciolatus*) was recorded from a trapping site (CPP16) and during opportunistic searches focussing on searching rock crevices.

4.2.4 Amphibians

Four amphibian species were recorded in the phase 1 survey (autumn) and no amphibian species were recorded during the phase 2 survey (spring). The Sheep Frog (*Cyclorana maini*), is commonly recorded in the Pilbara region, and during periods after high rainfall, populations expand quickly resulting in high numbers recorded during some surveys. This was the case during phase 1 of the survey, where exceptionally high numbers of were evident (1398 records) all but one of which were trap captures. Other species recorded included Little Red Tree Frog (*Litoria rubella*), Gorge Toadlet (*Pseudophryne douglasi*) and Northwest Toadlet (*Uperoleia russelli*).

A paper published by Catullo *et al.* after the completion of the field work described the split of the Northwest Toadlet (*Uperoleia russelli*) in the Pilbara (Catullo *et al.* 2011). Based on the distribution map, all records of *Uperoleia russelli* that were made during this survey are expected be the new species, Pilbara Toadlet (*Uperoleia saxatilis*).

4.2.5 Introduced Species

Five introduced mammals, Horse (*Equus caballus*), Cow (*Bos taurus*), House Mouse (*Mus musculus*), Dog/dingo (*Canis lupus familiaris dingo*) and Cat (*Felis catus*), were also recorded in the Project area. Dingos recorded from the Project area appeared to be hybrid animals and are, therefore, considered introduced.

4.3 CONSERVATION SIGNIFICANT FAUNA

Based on database searches and the results of previous biological surveys in the surrounding region, seven mammal, 16 bird and three reptile species of conservation significance could potentially occur in the Project area. The location of these records are shown in Figure 4.2-Figure 4.4.

Thirteen species of conservation significance (four mammal, five bird and three reptile species) were recorded from within the Project area during the Level 2 survey and targeted conservation significant fauna survey (*ecologia* 2011), these records are summarised in Table 4.2 and displayed in Figure 4.1. Species recorded are the Northern Quoll (secondary evidence), Long-tailed Dunnart, Ghost Bat, Pilbara Leaf-nosed Bat, Western Pebble-mound Mouse, Fork-tailed Swift, Australian Bustard, Bush Stone-curlew, Rainbow Bee-eater, Peregrine Falcon, Pilbara Olive Python, *Notoscincus butleri* and *Ramphotyphlops ganei*. An additional two species (Short-tailed Mouse and Star Finch) are assessed as having a medium to high likelihood of occurrence, with the remaining eleven species assessed as having a low likelihood (Table 4.3). Species with medium to high likelihood of occurrence are described in greater detail in Section 5.5. Information on the distribution, ecology, likelihood of occurrence and potential impacts to the species are summarised in Table 4.3.

Table 4.2 – Conservation significant fauna recorded during the survey.

Species	Location			Comments[1]
	Easting	Northing	Site	
Mammals				
Northern Quoll	568937	7545504	Opp.	Old scats recorded (Figure 5.2)
Long-tailed Dunnart	570194	7541399	CPP23	1 individual
Long-tailed Dunnart	570991	7546895	CPP24	1 individual
Ghost Bat	556690	7550692	Opp.	1 call recorded, foraging
Ghost Bat	568624	7529729	Opp.	Calls recorded, foraging
Ghost Bat	556651	7550672	Opp.	30 calls recorded
Ghost Bat	571287	7538970	CPP14	1 call recorded
Ghost Bat	554251	7542845	CPP15	2 calls recorded
Ghost Bat[2]	546865	7537797	Targeted	Small number of calls on multiple nights
Ghost Bat[2]	556099	7550881	Targeted	Individual recorded flying from cave
Ghost Bat[2]	554656	7543213	Targeted	Remains recorded from cave
Pilbara Leaf-nosed Bat	563955	7531277	CPP17	3 calls recorded
Pilbara Leaf-nosed Bat[2]	546865	7537797	Targeted	Small number of calls on multiple nights
Pilbara Leaf-nosed Bat[2]	547069	7536815	Targeted	Small number of calls on multiple nights
Pilbara Leaf-nosed Bat[2]	559516	7540082	Targeted	Small number of calls on multiple nights
Western Pebble-mound Mouse	558399	7545453	CPP3	Active mound
Western Pebble-mound Mouse	567054	7537093	Opp.	Active mound
Western Pebble-mound Mouse	570253	7541389	CPP23	Active mound
Western Pebble-mound Mouse	575721	7542176	CPP12	Active mound
Western Pebble-mound Mouse	575670	7541986	CPP12	Active mound
Western Pebble-mound Mouse	557971	7545497	Opp.	Recently active mound
Western Pebble-mound Mouse	557522	7545355	Opp.	Recently active mound
Western Pebble-mound Mouse	575670	7541989	CPP12	Recently active mound
Western Pebble-mound Mouse	567845	7537471	CPP6	Recently active mound

Species	Location			Comments[1]
	Easting	Northing	Site	
Western Pebble-mound Mouse	555967	7550660	Opp.	Inactive mound
Western Pebble-mound Mouse	566973	7537495	Opp.	Inactive mound
Western Pebble-mound Mouse	567281	7537777	Opp.	Inactive mound
Western Pebble-mound Mouse	554170	7538876	Opp.	Inactive mound
Birds				
Fork-tailed Swift	572191	7544388	CPP10	205 individuals
Fork-tailed Swift	575780	7542089	CPP12	25 individuals
Fork-tailed Swift	557896	7549732	CPP2	50 individuals
Australian Bustard	568638	7529737	CPP15	3 individuals
Australian Bustard	567078	7529040	Opp.	3 individuals
Bush-stone Curlew	549731	7534489	Opp.	1 individual
Bush-stone Curlew	549670	7534476	Opp.	1 individual
Bush-stone Curlew	549555	7534460	Opp.	1 individual
Bush-stone Curlew	549990	7534531	Opp.	4 individuals
Bush-stone Curlew	563954	7531269	CPP17	1 individuals
Bush-stone Curlew	563909	7531259	CPP17	Tracks
Rainbow Bee-eater	571784	7544611	CPP10	2 records
Rainbow Bee-eater	571287	7538970	Opp.	3 records
Rainbow Bee-eater	571484	7538950	Opp.	5 records
Rainbow Bee-eater	574349	7541963	CPP11	1 records
Rainbow Bee-eater	571401	7539125	CPP14	3 records
Rainbow Bee-eater	547300	7543528	CPP19	1 record
Rainbow Bee-eater	569406	7539910	Opp.	3 record
Rainbow Bee-eater	565801	7544725	CPP18	1 record
Rainbow Bee-eater	570194	7541399	CPP23	1 record
Rainbow Bee-eater	570991	7546895	CPP24	1 record
Peregrine Falcon	571187	7538920	CPP14	1 individual
Reptiles				
Pilbara Olive Python	547391	7537190	Opp.	1 record of remains
Notoscincus butleri	571287	7538970	CPP14	3 records
Notoscincus butleri	552990	7540198	CPP22	2 records
Notoscincus butleri	553044	7541403	BD3	1 individual
Notoscincus butleri	553908	7541404	BD4	4 individuals
Notoscincus butleri	553123	7542207	BD5	3 individuals
Ramphotyphlops ganei	568254	7535860	CPP13	1 individual

Zone 50K; Datum WGS 84

*Individuals = animals seen at the same time and, therefore, numbers are confirmed. Records = may be separate bird surveys or different days at a trap site and, therefore, some individuals may have been observed multiple times.

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530000 540000 550000 560000 570000 580000

7550000

7540000

7530000

Legend

CPP Rail Spur

CPP Mine

Conservation Significant Fauna

- Northern Quoll- scats (targeted survey)
- Ghost Bat
- Pilbara Leaf-nosed Bat
- Long-tailed Dunnart
- Pebble Mound Mouse (Mound)
- Australian Bustard
- Bush Stone-curlew
- Fork-tailed Swift
- Peregrine Falcon
- Rainbow Bee-eater
- Pilbara Olive Python
- *Ramphotyphlops ganei*
- *Notoscincus butleri*
- Ghost bat (targeted survey)
- Pilbara Leaf-nosed Bat (targeted survey)

Fauna Habitat types

- Alluvial plain with cracking clays
- Major Creekline with fringing eucalypt
- Mulga/Acacia woodland
- Rocky ridge and breakaway
- Rocky spinifex plain and hills
- Snakewood shrubland

N

0 3 6

Kilometres

Absolute Scale - 1:150,000

ecologia ENVIRONMENT

FMG

Conservation Significant Fauna Recorded During Survey

Figure: 4.1
Project ID: 1304

Drawn: AH
Date: 09/11/11

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

Unique Map ID: AH407

A3

400000 450000 500000 550000 600000 650000 700000

7600000 7550000 7500000 7450000

Legend

Mammals of Conservation Significance

- Ghost Bat
- Long-tailed Dunnart
- Western Pebble Mound Mouse (Mound)
- Pilbara Leaf-nosed Bat
- Short-tailed Mouse
- Spectacle Hair Wallaby
- Northern Quoll
- Northern Quoll (scats)
- Major Roads
- Rivers
- Environmental Sensitive Area
- CPP Rail Spur
- CPP Mine

EMA POOL CREEK
PORTLAND RIVER
NARRINA CREEK
GEORGE RIVER
TANBERRY CREEK
PILBARA CREEK
SHERLOCK RIVER
POWDAR CREEK
PILBADDY CREEK
YULE RIVER
TURNER RIVER
EDGINA CREEK
COCKERAGA RIVER
COONARRIE CREEK
BEABEA CREEK
WEST YULE RIVER
KUMINA CREEK
CALIWINGINA CREEK
HOOLEY CREEK
MOUNT MARGARET
FORTESCUE RIVER
CANE RIVER
URANDY CREEK
SERPENTINE CREEK
DUCK CREEK
MOUNT BROCKMAN
CAVES CREEK
HAMERSLEY RANGE
BOOLGEEDA CREEK
ASHBURTON RIVER
BEASLEY RIVER
TOM PRICE
MARILLANA CREEK
TUREE CREEK
HARDEY RIVER
WANNERY CREEK
TABLELAND CREEK
BELLARY CREEK
WEELI WOLLI CREEK

N

0 20 40

Kilometres

Absolute Scale - 1:840,000

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FMG

Previous Records of Conservation Significant Mammals

Figure: 4.3 **Project ID: 1304**	**Drawn: AH** **Date: 09/11/11**

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

Unique Map ID: AH402

A3

450000 475000 500000 525000 550000 575000 600000 625000 650000 675000

7600000 7575000 7550000 7525000 7500000 7475000

Legend

Birds of Conservation Significance

- Australian Bustard
- Bush Stone-curlew
- Common Sandpiper
- Fork-tailed Swift
- Peregrine Falcon
- Rainbow Bee-eater
- Star Finch
- Wood Sandpiper
- Grey Falcon
- Glossy Ibis
- Snipe sp.
- Major Roads
- Rivers
- Environmental Sensitive Area
- CPP Rail Spur
- CPP Mine

SHERLOCK RIVER
POWDAR CREEK
PILBADDY CREEK
BEABEA CREEK
KUMINA CREEK
CALIWINGINA CREEK
HOOLEY CREEK
MOUNT MARGARET
WALL CREEK
WEST YULE RIVER
FORTESCUE RIVER
MOUNT BROCKMAN
CAVES CREEK
DUCK CREEK
MOUNT BROCKMAN
DUCK CREEK
BOOLGEEDA CREEK
BEASLEY RIVER
TOM PRICE
MARILLANA CREEK
HARDEY RIVER
HARDEY RIVER
BELLARY CREEK
TUREE CREEK

N

0 10 20
Kilometres

Absolute Scale - 1:600,000

ecologia ENVIRONMENT

FMG

Previous Records of Conservation Significant Birds

Figure: 4.4
Project ID: 1304

Drawn: AH
Date: 09/11/11

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

Unique Map ID: AH403

A3

475000 500000 525000 550000 575000 600000 625000 650000

7575000 7550000 7525000 7500000

Legend

Reptiles of Conservation Significance

- Pilbara Olive Python
- *Ramphotyphlops ganei*
- *Notoscincus butleri*
- Major Roads
- Rivers
- Environmental Sensitive Area
- CPP Mine
- CPP Rail Spur

CALIWINGINA CREEK
HOOLEY CREEK
FORTESCUE RIVER
PILBADDY CREEK
MOUNT MARGARET
CAVES CREEK
MOUNT BROCKMAN
HAMERSLEY RANGE
SERPENTINE CREEK
DUCK CREEK
MOUNT BROCKMAN
BOOLGEEDA CREEK
BEASLEY RIVER
HARDEY RIVER
TUREE CREEK

N

0 10 20
Kilometres

Absolute Scale - 1:460,000

ecologia ENVIRONMENT

FMG

Previous Records of Conservation Significant Reptiles

Figure: 4.5
Project ID: 1304

Drawn: AH
Date: 09/11/11

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

Unique Map ID: AH404

A3

Table 4.3 – Conservation significant fauna occurring or potentially occurring in the Project area.

Species	Conservation Significance			Habitat	Previous Records	Likelihood of Occurrence	Regional Impacts
	EPBC Act	WC Act	DEC				
Mammals							
Northern Quoll (*Dasyurus hallucatus*)	EN	S1	EN	Rocky areas, also eucalypt forest and woodland.	Records from two previous surveys (Ecoscape 2010, ecologia internal database). Four records from NatureMap within 50 km of the Project area.	**RECORDED (secondary evidence)** Several recent, nearby records. Secondary evidence (scats) recorded during targeted fauna survey. Suitable habitat present.	**LOW** Suitable habitat exists outside Project area. Northern Quolls are able to disperse from the impacted area.
Pilbara Leaf-nosed Bat *(Rhinonicteris aurantius)*	VU	S1	VU	Roost in caves with high humidity and temperature. Thought to utilise eucalypt trees as roost during wet season.	Two records from NatureMap within 50 km of the Project area.	**RECORDED** Recorded within Project area. Species was recorded from four locations within the Project area. Roost and or maternity caves have not been recorded to date but targeted surveys will be completed in November 2011.	**LOW** Impacts currently low but potentially could increase. Determined by presence or absence of roost or maternity caves within Project area. No roost or maternity caves recorded from current surveys.
Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*)			P3	Inhabits grasslands, open forests, open woodlands and tall shrublands and shelters during the day under tussocks of *Triodia* spp.	One NatureMap record from 1966 near Mt Sheila (20 km east of Project area); two further records from Chichester Range from 1979 (DEC Threatened Fauna database).	**LOW** No suitable habitat within Project area. Not recorded in the region in the last 30 years.	**LOW** Not likely to occur in the Project area
Long-tailed Dunnart (*Sminthopsis longicaudata*)			P4	Rocky range habitat with spinifex or open habitat with a rocky mantle.	Six records from NatureMap within 50 km of the Project area.	**RECORDED** Two individuals recorded within Project area during the current survey. Extensive suitable habitat present.	**MEDIUM** Cluster of records around Project area, species is typically restricted to rocky habitats such as that found in Project area.

Species	Conservation Significance			Habitat	Previous Records	Likelihood of Occurrence	Regional Impacts
Ghost Bat (*Macroderma gigas*)			P4	Caves, rockpiles and abandoned mines.	Four records from two locations along the Hamersley Range (Muir 1983, *ecologia* internal database). Five NatureMap records from within 50 km of the Project area.	**RECORDED** Recorded within Project area during the Level 2 survey and targeted survey. Suitable hunting habitat present. Potential roost habitat recorded. No maternity caves have been recorded from the Project area. Several individuals have been recorded using caves as roost and foraging habitat.	**LOW** Impacts currently low but potentially could increase. Determined by presence or absence of roost or maternity caves within Project area. No maternity caves recorded from current surveys.
Western Pebble-mound Mouse (*Pseudomys chapmani*)			P4	Spurs and rocky hills with many small pebbles vegetated by spinifex.	Active and inactive mounds recorded from the Project area and from all previous surveys in the region.	**RECORDED (secondary evidence)** Several active and inactive mounds recorded within the Project area. Extensive suitable habitat in surrounding area.	**LOW** Numerous records and extensive suitable habitat outside Project area.
Northern Short-tailed Mouse (*Leggadina lakedownensis*)			P4	Spinifex and tussock grassland on cracking clays. Also acacia shrubland, samphire, woodlands, stony ranges.	Twenty NatureMap records from within 50 km of the Project area (11 in 1998, 7 in 1999, 12 in 2009).	**HIGH** Area of suitable habitat (alluvial plain with cracking clay) located within Project, area is approximately 2652 ha. Numerous previous records nearby.	**LOW** Numerous records and suitable habitat outside Project area.
Birds							
Fork-tailed Swift (*Apus pacificus*)	M	S3		Almost entirely aerial, particularly associated with storm fronts.	Three records from NatureMap within 60 km of the Project area.	**RECORDED** Recorded within Project area and surroundings.	**LOW** Species rarely lands and will not be impacted by the project.

Species	Conservation Significance			Habitat	Previous Records	Likelihood of Occurrence	Regional Impacts
Rainbow Bee-eater (*Merops ornatus*)	M	S3		Open country, most vegetation types, dunes, banks.	Recorded from four previous surveys (Muir 1983; Biota 2005, 2009; Ecoscape 2010), with numerous records from NatureMap.	**RECORDED** Recorded within Project area. Suitable habitat for hunting and breeding.	**LOW** Species migratory and widespread, suitable habitat present in surrounding areas.
Eastern Great Egret (*Ardea modesta*)	M	S3		Floodwaters, rivers, shallow of wetlands, intertidal mud-flats.	Twelve records from NatureMap within 50 km of the Project area.	**LOW** No suitable wetland habitat and little area of significant drainage systems with the potential to create habitat within the Project area.	**NONE**
Cattle Egret (*Ardea ibis*)	M	S3		Grassy habitats and wetlands, particularly damp pastures,	Only recorded from DSEWPaC Protected Matters Search.	**LOW** No specific records within 100km radius, lack of typical habitat for this species in Project area.	**NONE**
Glossy Ibis (*Plegadis falcinellus*)	M	S3		Typically shallows and adjacent flats of freshwater lake and swamps, but it is also found in river pools, flooded samphire and sewage ponds	Recorded from Birdata and three records from NatureMap within 100 km.	**LOW** Scattered records throughout the Pilbara. No typical habitat for this species within Project area.	**NONE**
Oriental Plover (*Charadrius veredus*)	M	S3		Open plains, bare rolling country, bare claypans, open ground near inland swamps.	Recorded only from Birdata with no specific records within 100 km.	**LOW** Some suitable habitat but no local records.	**NONE**
Snipe species (*Gallinago* sp.)	M	S3		For all species typically boggy swampy and reedy areas on the edge of wetlands.	Single record from NatureMap approximately 25 km south of Project area.	**LOW** No typical habitat for this species within Project area.	**NONE**
Common Sandpiper (*Actitis hypoleucos*)	M	S3		Shallow, pebbly, muddy or sandy edges to rivers, dams, lakes, mangroves and waterways on the coast to far inland.	Recorded on previous survey (Muir 1983) and four records from NatureMap within 100 km.	**LOW** No typical habitat for this species within Project area.	**NONE**

Species	Conservation Significance			Habitat	Previous Records	Likelihood of Occurrence	Regional Impacts
Wood Sandpiper (*Tringa glareola*)	M	S3		Inland freshwater wetlands, rarely on intertidal mudflats	Single record from previous survey (Muir 1983).	**LOW** No suitable wetland habitat and little area of significant drainage systems with the potential to create habitat within the Project area.	**NONE**
White-bellied Sea-eagle (*Haliaeetus leucogaster*)	M	S3		Coastal and near coastal water bodies.	Recorded only from DSEWPaC Protected Matters Search. No records south of the Hamersley range.	**LOW** No suitable habitat and no specific records within 100km.	**NONE**
Eastern Osprey (*Pandion cristatus*)	M			Mangroves, rivers, estuaries, inland seas, coastal islands.	Single record from previous survey (Muir 1983).	**LOW** Very few records away from coast. No suitable habitat within Project area.	**NONE**
Peregrine Falcon (*Falco peregrinus*)		S4		Coastal cliffs, riverine gorges and wooded watercourses.	Recorded in two previous surveys (*ecologia* internal database, (Muir 1983). Four NatureMap records within 50 km of the Project area.	**RECORDED** Recorded within Project area on current survey. Suitable habitat for hunting and breeding.	**LOW** Wide ranging species which can avoid disturbance area and hunt and breed in similar habitat outside the Project area.
Australian Bustard *(Ardeotis australis)*			P4	Open grasslands, chenopod flats and low heathland.	Wide ranging species, 22 NatureMap records from within 50 km of the Project area and recorded from four previous surveys (Muir 1983; Mattiske and Ninox 1990; Biota 2009)	**RECORDED** Recorded on current survey. Two sightings, each consisting of three individuals.	**LOW** Species is widespread and can easily move if disturbed to similar adjacent habitat.
Bush Stone-curlew (*Burhinus grallarius*)			P4	Lightly wooded country next to daytime shelter of thickets or long grass.	Eleven NatureMap records from within 50 km of the Project area and recorded from three previous surveys (Muir 1983; Biota 2005; Ecoscape 2010).	**RECORDED** Eight individuals from six different locations recorded on current survey.	**LOW** Species is widespread and can easily move if disturbed to similar adjacent habitat.

Species	Conservation Significance			Habitat	Previous Records	Likelihood of Occurrence	Regional Impacts
Star Finch (western subspecies) (*Neochmia ruficauda subclarescens*)			P4	Vegetation around watercourses, particularly thick reed beds.	Six records from NatureMap within 30 km of the Project area and on three previous surveys (Muir 1983; Mattiske and Ninox 1990; Kendrick 1995).	**HIGH** Some suitable habitat within major creekline habitat type.	**LOW** Species can disperse outside Project area if disturbed.
Grey Falcon (*Falco hypoleucos*)			P4	Lightly wooded coastal and riverine plains.	Rarely seen across Australia. Single record within 100 km (Kendrick 1995)	**LOW** Wide-ranging species. Some suitable habitat for hunting within the Project area.	**LOW** Species can avoid disturbance area and hunt and breed in similar habitat outside the Project area.
Reptiles							
Pilbara Olive Python *(Liasis olivaceus barroni)*	VU	S1	VU	Typically inhabits watercourses and areas of permanent water in rocky gorges and gullies.	Recorded from four previous surveys (*ecologia* internal database, (Muir 1983; Biota 2009; Ecoscape 2010).	**RECORDED** The remains of one individual recorded from within the Project area.	**LOW** Species is found throughout region. No significant population within Project area.
Ramphotyphlops ganei			P1	Unknown. Possibly associated with moist gorges and gullies.	Single record of the same individual from two sources (*ecologia* internal database, NatureMap) within 20 km of the Project area.	**RECORDED** One individual recorded during survey.	**UNKNOWN/LOW** Total of 28 records from NatureMap, one single record within 110 km. Species appears to be widespread across the Pilbara; however, lack of species information results in uncertainty of impacts.
Notoscincus butleri			P4	Associated with spinifex dominated areas near creek and river margins	Recorded from three previous surveys in the surrounding area (Coffey 2009, Biota 2005, Biota 2009). Six NatureMap records within 50 km of the Project area.	**RECORDED** Recorded on current survey. Total of 13 records from five separate locations from Level 2 survey.	**LOW** Numerous records of this species outside the Project area in surrounding region.

Note: Description of conservation significant codes provided in Appendix A.

4.4 FAUNA HABITATS

Fauna habitat types were identified and classified based on on-site observation and mapped land systems and vegetation units. During the survey, trapping sites were located in discrete habitats that were representative of the main fauna habitat types occurring in the Project area to sample the highest number of fauna possible.

Based on vegetation structure and soil substrate, the Project area can be classified into six habitat types:

- Rocky spinifex plains and hillslopes;
- Rocky ridges and breakaways;
- Major creeklines with fringing eucalypt trees;
- Acacia shrubland;
- Alluvial plain with cracking clays; and
- Snakewood shrubland.

The extent and location of all fauna habitat types are listed in Table 4.4 and mapped in Figure 4.5. The greatest survey effort was concentrated on rocky spinifex plain and hills (ten survey sites) and areas adjacent to major creeklines with fringing eucalypt (nine survey sites), respectively. Both habitat types are the most widespread and variable habitat within the Project area and, therefore, the survey effort was concentrated here to capture the entire range and variation of fauna species present. The smaller areas of Acacia woodland, snakewood shrubland and alluvial plain with cracking clays were sampled with a total of four sites. Rocky ridges and breakaways are a less accessible habitat type with difficulties involved with digging pitfall traps. Two sites were set up in this habitat type and a number of opportunistic searches were conducted along ridges and gullies.

Table 4.4 – Fauna habitat types within Project area.

Fauna Habitat type	Area within Project area [ha]	Percent of Project area
Rocky spinifex plain and hills	50840.72	86.1
Major creekline with fringing eucalypt	1799.32	3.1
Alluvial plain with cracking clays	2652.60	4.5
Snakewood shrubland	758.44	1.3
Rocky ridge and breakaway	2378.69	4.0
Acacia woodland	630.73	1.1

4.4.1 Rocky spinifex plains and hills

The majority of the Project area consists of rocky spinifex plains and hills (86.1%). This habitat type includes Calcrete, Paraburdoo, Newman, Boolgeeda and Platform land system. It supports scattered mixed acacia shrubs and occasionally eucalypt trees over small to large clumps of spinifex on rocky loamy soils. Spinifex provides a necessary cover and/or food source for small to medium sized

mammal and reptile species. The substrate is usually not suitable for burrowing, which limits the terrestrial fauna assemblage to species that can find shelter amongst dense vegetation, spoil heaps, leaf litter, loose rocks, or within larger hummocks of spinifex.

The majority of the Project area consisted of spinifex grassland with no trees and only an open layer of shrubs such as *Acacia inaequilatera* and *Hakea lorea*. Denser and more diverse shrub communities could be found in the vicinity of drainage channels and smaller gullies between hills.

Many common and widespread Pilbara mammal species are found in this habitat type. The small marsupial carnivores, Pilbara Ningaui, Stripe-faced Dunnart and Planigale, forage at night within and between clumps of spinifex, as do Murids such as the Desert Mouse and the Sandy Inland Mouse. Mounded shelters built out of small pebbles by the Western Pebble-mound Mouse (DEC Priority 4) can be found on low hillslopes.

The avifauna assemblage associated with this habitat includes many widespread arid zone species. Although most of the birds of stony spinifex hummock grassland live and feed in scattered patches of low shrubs and trees, some species such as the Brown Quail, Little Button Quail, Peaceful Dove, Spinifex Pigeon and Spinifexbird can be found foraging on the ground in between the spinifex hummocks. Birds of prey such as Wedge-tailed Eagle, Whistling Kite, Grey Falcon (DEC Priority 4) and Peregrine Falcon (WC Act Schedule 4) are also attracted to hunt in this open habitat type. Although no conservation significant bird species on this survey was recorded from this habitat type, the Australian Bustard (DEC Priority 4) can be found in areas of open spinifex grassland. During this survey the Rainbow Bee-eater was recorded from this habitat type (Figure 4.1) it does not represent its preferred habitat. However, the Rainbow Bee-eater can occasionally be encountered on spinifex plains with patches of dense vegetation.

The majority of the herpetofauna assemblage recorded during this survey is associated with this habitat type. The small diurnal *Ctenophorus caudicinctus* and a variety of diurnal skinks of the genus *Ctenotus* are particularly common and highly abundant in this habitat type. At night, the gecko *Diplodactylus conspicillatus*, *D. savagei* and *Heteronotia binoei* can be seen foraging between the spinifex. Legless lizard species of the genus *Delma* and *Pygopus,* and the goanna *Varanus brevicauda* are fast movers and climbers amongst the spinifex. The small skink *Notoscincus butleri* (DEC Priority 4) can be found in this habitat type usually in association with drainage lines and creek beds.

4.4.2 Rocky ridges and breakaways

Small patches of rocky ridges and breakaways usually surrounded by large areas of rocky spinifex plains and hills were recorded throughout the north of the Project area (CPP Mine). It comprises approximately 2651.6 ha which represents 4.5 % of the Project area. Two survey sites were installed in this habitat type to capture the unique vertebrate fauna that inhabits the rocks, crevices and rock shelters. Additional opportunistic searches targeting this habitat type was also conducted.

The vegetation around the rocky ridges typically consists of spinifex hummocks with occasional very sparse low shrubs. Native fig trees (*Ficus* sp.) can be found along larger ridges and within moist gorges. Fig trees provide shade and, therefore, keep the humidity higher than in the surrounding areas which attracts a large number of birds, reptiles and larger mammals such as the Euro and the Rothschild's Rock-wallaby. Gullies and rocky ridges also provide suitable habitat for a number of conservation significant species such as the Northern Quoll (EPBC Act Endangered, WC Act Schedule 1), the Long-tailed Dunnart (DEC Priority 4) and Pilbara Olive Python (EPBC Vulnerable, WC Act Schedule 1).

The majority of mammals associated with rocky ridges and breakaways include the Common Rock-rat, Fat-tailed Dunnart, Northern Quoll and Long-tailed Dunnart. During the night these species forage between rocks and crevices which provide excellent shelter and hiding spots for both their insect prey species and themselves.

The avian fauna species occurring along breakaways is relatively similar to the species inhabiting the surrounding spinifex hills. Birds of prey such as the Peregrine Falcon (WC Act Schedule 4) are likely to utilise the top of high ridges and cliff faces as nesting ground. Caves and larger crevices are sometimes utilised by Owlet Nightjars and other nocturnal bird species for shelter during day time.

The reptile assemblage associated with this habitat type is distinct with many species occurring only in rocky gullies and ridges. Examples of this include the goanna *Varanus pilbarensis* and the geckos *Underwoodisaurus seorsus, Oedura marmorata* and *Heteronotia spelea*.

4.4.3 Major creeklines with fringing eucalypt trees

Major creeklines with fringing eucalypt trees were recorded along the rail spur and along the middle of Serenity Valley. This habitat type comprises 3.05 % of the Project area and is associated with the River land system. It consists of creeklines with and without semi permanent water pools. The major creeklines in the north of the Project area comprise bloodwood (*Corymbia hamersleyana*) whereas the majority of eucalypt trees recorded from creeklines in the centre of the rail spur consisted of coolibah trees (*Eucalyptus victrix).* Major creeklines in the Project area were usually surrounded by rocky spinifex plains and hillslopes or acacia woodland and snakewood shrubland. At the time of the first phase Level 2 survey in 2011, water pools were present in a number of creeklines which attracted a large number of vertebrate fauna species.

The mammal fauna assemblage recorded from the creeklines with fringing eucalypt habitat appeared to be relatively rich. This is indicated by the ten bat species (Site CPP14), four species of marsupial and two species of rodent that were recorded from the trapping sites in this habitat type. During the wet season tall eucalypt trees along creeklines can maintain a high Level of humidity and provide suitable roost habitat for the Pilbara Leaf-nosed Bat.

This habitat type provides suitable conditions for a large number of bird species in particular species such as the Australian Wood Duck, Grey Teal Pacific Black Duck, White-faced Heron, White-necked Heron and Australian Spotted Crake which are restricted to habitats that have pools of surface water. The majority of these water birds are attracted to ephemeral water bodies when sufficient food source (consisting of aquatic invertebrates and water plants) are available. The fringing tall trees are inhabited by Sacred Kingfisher, Red-backed Kingfisher and Blue-winged Kookaburra using this habitat as foraging and potential roost habitat. The Bush Stone-curlew (DEC Priority 4) is typically found in this habitat due to the lightly wooded character of this habitat type. The majority of EPBC listed Migratory species that could potentially occur within the Project area would only occur in this habitat type when surface water is present.

The diversity of herpetofauna in the riparian zone is is usually high. The Long-nosed Dragon (*Amphibolurus longirostris*) is a typical inhabitant of the major creeklines although a large variety of reptiles and amphibians can be found along this habitat type: *Ctenotus saxatilis, Ctenotus helenae, Ctenotus robustus*, *Carlia munda* and the Black-headed Monitor *Varanus tristis*. During this survey 31 reptile species (119 records) were recorded from site CPP10, 23 reptile species (159 records) were trapped at Site CPP4 and 29 reptile species (114 records) were captured at Site CPP14. Common reptile species in this habaitat type comprise Binoe's Gecko (*Heternotia binoei*- 41 records), the skink *Carlia munda* (62 records), *Ctenotus helenae* (78 records), *Ctenotus saxatilis* (40 records)

and the Yellow-faced Whipsnake (*Demansia psammophis cupreiceps* – 6 records). Amphibians were far more abundant in the creeklines than in any other habitat type. Large numbers of the Main's frog were caught at Sites CPP1, CPP13, CPP14 and CPP15 (total of 847 records).

4.4.4 Acacia woodland

Acacia woodland recorded in the Project area comprise a dense layer of mulga (*Acacia aneura*) or mixed acacia high shrubs and trees over mixed shrubs and moderate clumps of spinifex on clay soils. This habitat type comprises 630.73 ha which represents 1.1 % of the Project area and is associated with the Boolgeeda land system.

The mammal fauna recorded from this habitat type includes fourteen mammal species at moderate densities. No mammal species are considered specialists of this habitat type and the low understorey at Site CPP12 did not support any mammal species (apart from the record of a Cat at this site).

Acacia woodland when in flower attract a large number of birds, in particular Honeyeaters and Thornbills. During the survey the mulga and other acacia shrubs found in this habitat type were not flowering and, therefore, the avian fauna assemblage was quite poor considering the difference in vegetation structure and plant species and their value as food source.

Trapping Site CPP16 was the systematic site with the largest number of amphibians (237 individuals) but the smallest amphibian diversity with all individuals recorded from the same species (Sheep Frog). The skink *Eremiascincus richardsonii* was only recorded from this habitat type. This species is known to occur in sandy and stony spinifex country, sheltering in leaf litter, in soil cracks and disused burrows and, therefore, is not considered a specialist for this habitat type.

A noteworthy record is the capture of a *Ramphotyphlops ganei* (DEC Priority P1) from the mulga woodland trapping site (CPP13). There is little known about the biology of this species but the literature review suggest that rocky gullies are their preferred habitat which differs greatly from the mulga woodland in which it was recorded in during this survey. The substrate of the trapping Site CPP13 comprises compact clay which is quite different to the rocky loam soils found in the preferred gully habitats. However, the trapping site was located adjacent to a rocky spinifex plain with minor drainage channels and, therefore, the species may have been moved into the mulga woodland from surrounding areas.

4.4.5 Alluvial plain with cracking clay

Alluvial plain with cracking clay was recorded from one patch of a total of 2652.6 ha in the centre of the rail spur. This represents 4.5% of the Project area. This habitat type is associated with the Brockman land system (Figure 4.5). Alluvial plains with cracking clays typically comprise an open vegetation structure of low shrubs and soft grasses but buffel grass has dominated this habitat type, in particular where this habitat meets major creeklines. The substrate of these plains comprises mainly compacted clay which can open up to cracking clay in sections and provide habitat for ground dwelling fauna species.

The mammal fauna recorded from this habitat type is similar to the species recorded from other habitat types, in particular from acacia woodlands. However, cracking clays provide suitable habitat for the Northern Short-tailed Mouse (DEC Priority 4) which was not recorded during this survey but has been previously recorded in the surrounding region (*ecologia* internal database).

The avian fauna diversity was moderate in relation to other habitat types. Generally bird species that prefer open vegetation structure are dominant. Australian Bustards (DEC Priority 4) were found in this habitat but this species prefers patches with a moderate ground cover such as buffel grass or spinifex. Site CPP 15 was installed along a creekline leading through an alluvial plain. The majority of birds recorded from this site were mainly water birds such as the Plumed Whistling Duck, Black-fronted Dotterel and Banded Lapwing or bird species adapted to tall eucalypt trees such as the Blue-winged Kookaburra.

The herpetofauna of the alluvial plain displays a lack of arboreal species such as climbing geckos and dragon lizards. The dominant reptile species in this habitat type was the skink *Ctenotus robustus* (species currently under revision) which inhabits the buffel grass and was captured 25 times during this survey. However, due to the surface water present along the creekline during the first phase survey, a large number (216 individuals) of the Sheep Frog was caught which indicates the habitats suitability for amphibians when conditions are right.

4.4.6 Snakewood shrubland

A small area of snakewood shrubland (758.44 ha) which represents 1.3% of the Project area was recorded from the centre of the rail spur. The snakewood shrubland is characterised by a very dense layer of snakewood (*Acacia xiphophylla)* and a very sparse understorey on rocky substrate. This habitat type is associated with the Hooley land system which is defined as alluvial clay plain supporting a mosaic of snakewood shrubland and spinifex grassland. Trapping Site CPP17 was installed in this habitat and is located in the vicinity of a creekline which may have influenced the fauna assemblage.

The diversity of the mammal fauna of this habitat type was relatively low, included only four terrestrial marsupial species and no rodent species. The large number of bat species recorded can be attributed to the adjacent creekline which contained large pools of water. These pools attract large amounts of insects and, therefore, represent an ideal food source for most bat species such as the protected Pilbara Leaf-nosed Bat (EPBC Vulnerable, WC Act Schedule 1).

The avifauna utilises this habitat type within the dense shrubs to forage and nest. Due to the adjacent creekline a number of waterbirds and birds of prey were encountered: Grey Teal, Pacific Black Duck, Collared Sparrowhawk, Nankeen Kestrel, Brown Falcon and Tawny Frogmouth. The open ground cover may attract birds of prey for hunting whereas the eucalypt trees along the creekline provide excellent roost and nest habitat.

The Pebble Dragon *Tympanocryptis cephala* was the most noteworthy record of reptile from this trapping site. The Pebble Dragon is a cryptic species inhabiting open rocky habitats and cracking clays and was not recorded from any other habitat within the Project area which is most likely due to the substrate consisting of small scattered pebbles on clay representing a major feature in its known preferred habitat.

530000 540000 550000 560000 570000 580000

7550000

7540000

7530000

Legend

CPP Rail Spur

CPP Mine

Fauna Habitat types

Alluvial plain with cracking clays

Major Creekline with fringing eucalypt

Mulga/Acacia woodland

Rocky ridge and breakaway

Rocky spinifex plain and hills

Snakewood shrubland

N

0 3 6

Kilometres

Absolute Scale - 1:150,000

ecologia ENVIRONMENT

FMG

Fauna Habitat Types

Figure: 4.1
Project ID: 1304

Drawn: AH
Date: 09/11/11

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

Unique Map ID: AH405

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4.5 FAUNA HABITAT ANALYSIS

Six fauna habitats (rocky spinifex plains and hills; rocky ridges and breakaways; major creeklines with fringing eucalypt trees; acacia shrubland; alluvial plain with cracking clays; and snakewood shrubland) were identified during the current survey. However, Trap Site CPP 15 combined two habitat types: major creekline and alluvial plain with cracking clays due to the inaccessibility of the remaining sections of this habitat type. This trap site was therefore excluded from this habitat analysis.

Analysis of similarity using a one-way ANOSIM indicated there were mixed degrees of similarity between and within groups (habitat types), meaning the five habitat types are statistically similar ($R = 0.1527$, $p = 0.0001$). A pair-wise comparison (Table 4.5) indicates that the statistical significance (represented as p-values) is lowest for rocky spinifex plain and hills and acacia woodland, suggesting these were the most distinct habitat types.

Analysis of the habitat types using non-metric MDS indicates that the habitat types are closely related. The greatest degree of dissimilarity is evident in the major creeklines with fringing eucalypts. However, a large proportion of common species occurred in all habitat types, suggesting that there are no habitat types within the Project area that support a distinct and restricted fauna assemblage.

Caution must be exercised in interpreting the MDS plot (Figure 4.6) as it has a high stress value of 0.3971 meaning that some or all of the distances in the plot are, to some degree, distortions of the input data. However, larger general patterns are still visible even when stress is high.

Table 4.5 – One-way ANOSIM results from terrestrial trapping data

	Major Creekline with Fringing Eucalypt	Rocky Ridge and Breakaway	Acacia Woodland	Rocky Spinifex Plain and Hills	Snakewood Shrubland
Major Creekline with Fringing Eucalypt	-	0.0212	0.3899	0.0001	0.9431
Rocky Ridge and Breakaway	0.5826	-	0.0001	0.012	0.0265
Acacia Woodland	0.3848	0.0001	-	0.0355	0.8369
Rocky Spinifex Plain and Hills	0.0001	0.012	0.0355	-	0.8088
Snakewood Shrubland	0.9431	0.0265	0.8369	0.8088	-

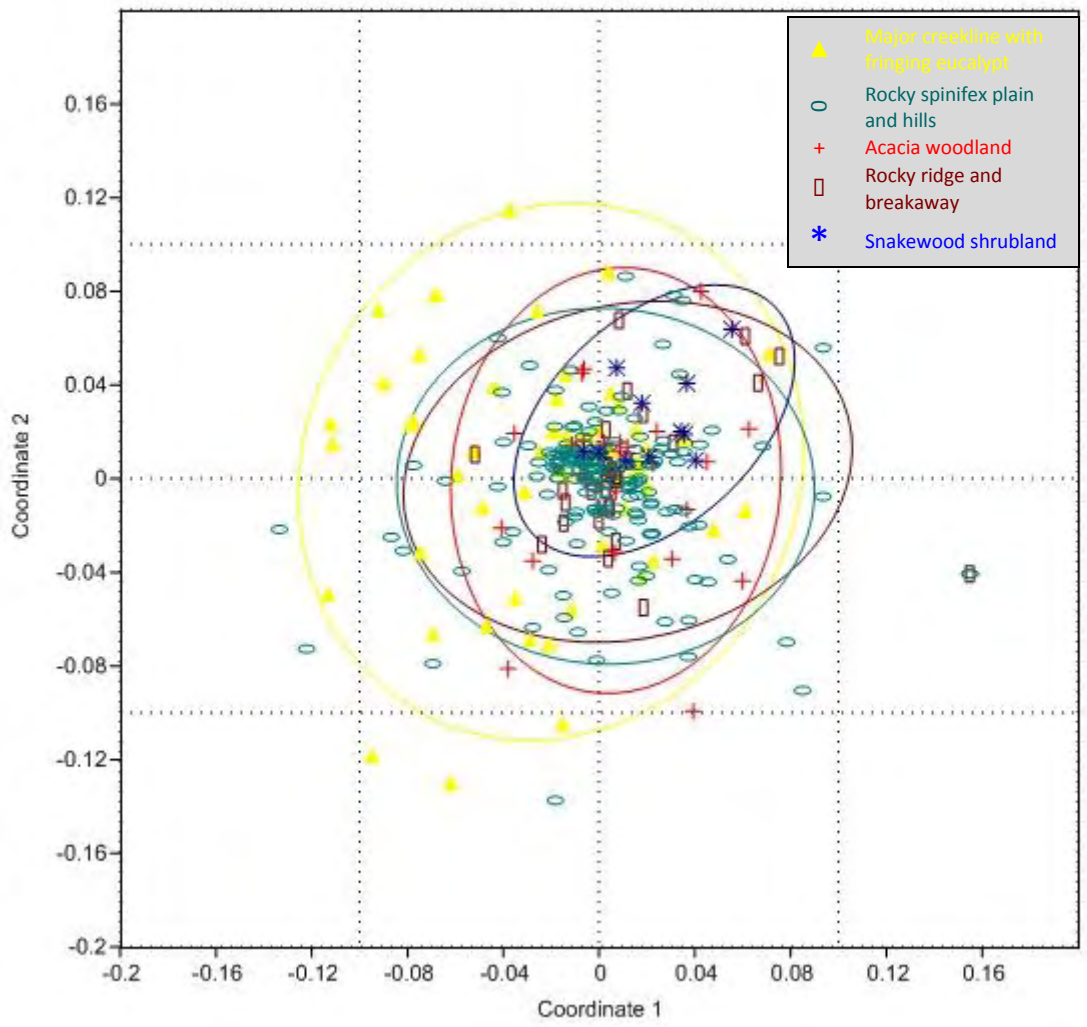

Figure 4.6 – MDS analysis of fauna habitats.

4.6 SURVEY ADEQUACY

Parametric (SAC) analysis of systematically obtained survey data for mammal, bird and reptile faunal groups revealed that survey effort was adequate. Table 4.6 provides a summary of the theoretical maximum number of species, as estimated using seven different methods, based on the rate of accumulation of species as more individuals are collected, i.e. by using species accumulation curves to estimate the total number of species.

Table 4.6 – Mean estimates of total species richness of the vertebrate fauna groups.

Richness Estimators	Total Richness Estimate		
	Mammals	Birds	Reptiles
ACE	10	94.31	87.01
ICE	10	97.19	87.09
Chao-1	10	91.63	99.5
Jack-1	10	100.95	92.97
Jack-2	8.01	105.94	100.94
Bootstrap	10.27	94.54	85.82
Michaelis-Menten	10.27	86.66	82.07
Species observed	10	89	80

4.7 MAMMALS

A SAC analysis, through 10,000 randomisations of the sample sequence of the mammal fauna trapping data set, produce a Michaelis-Menten (MM) curve which spikes early in the sampling period before dropping and then slowly beginning to increase at a low gradient (Figure 4.7). This type of curve is the result of the nature of the mammal data, which contained high numbers of individuals of some species, but few individuals of other species, resulting in a large number of samples contributing little to the accumulation of species.

For the most part, analysis of the mammal trapping data resulted in richness estimators of approximately 10 species (Table 4.6). This suggests that the trapping effort was adequate, as 10 mammal species were recorded from the use of systematic trapping methods. However, this result should be interpreted with caution, as SAC analysis excludes species not amendable to standard trapping, such as macropods and bats. The results of the literature review and database search (Appendix A) suggest that an additional seven species amendable to standard trapping techniques potentially occur in the Project area, and the possibility of their occurrence can not be discounted.

4.8 BIRDS

A SAC analysis, through 10,000 randomisations of the sample sequence of the complete avifauna dataset provided a smooth curve that reaches an asymptote (Figure 4.8). The Michaelis-Menten (MM) estimator, used as stopping rule, indicated that the survey was sufficient at the break point of approximately 136 minutes of survey effort. The MM estimator generated a theoretical maximum of 87 species. This was exceeded with 89 bird species recorded during systematic bird surveys. However, application of the Jackknife estimator (Table 4.6) resulted in a maximum of 106 bird species present in the Project area, suggesting further survey effort may have identified seven additional species. Given that an additional 11 bird species were observed opportunistically, it may be deemed that total survey effort was sufficient.

4.9 REPTILES

Analysis of the reptile trapping data produced a smooth SAC, tending towards, but not yet reaching, asymptote (Figure 4.9). The Michaelis-Menten (MM) estimator used as a stopping rule suggests that the total survey effort expended in resulted in 92.3% of the total reptile assemblage having been captured (Table 4.6). This indicates that an additional six species could occur in the Project area. Given that an additional four species of reptiles were recorded through opportunistic searches, the overall survey effort was adequate.

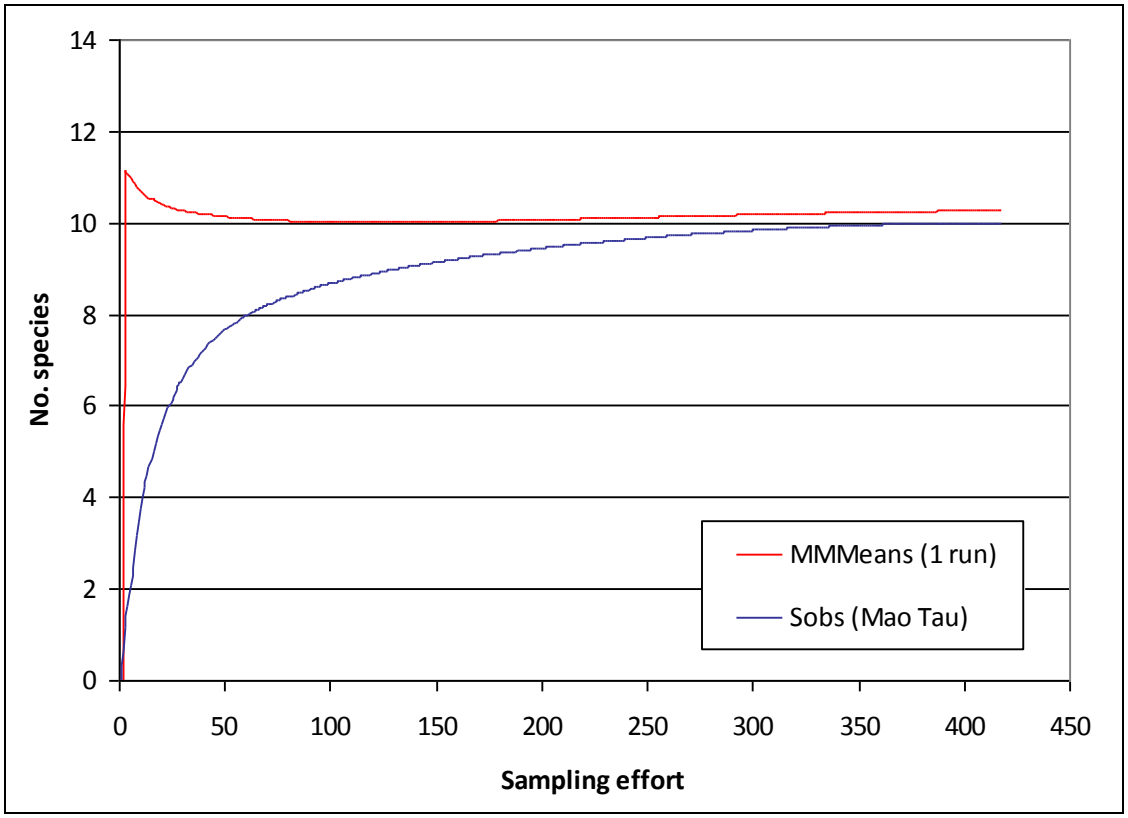

Figure 4.7 – Species accumulation curve: mammals.

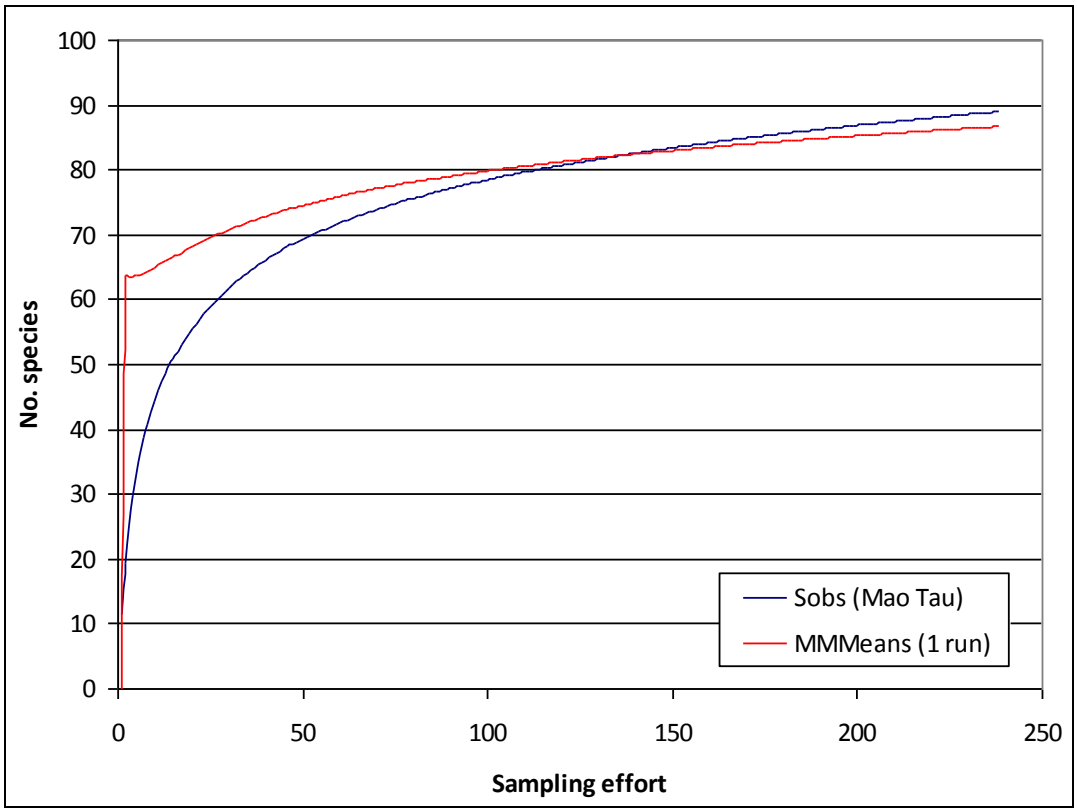

Figure 4.8 – Species accumulation curve: birds.

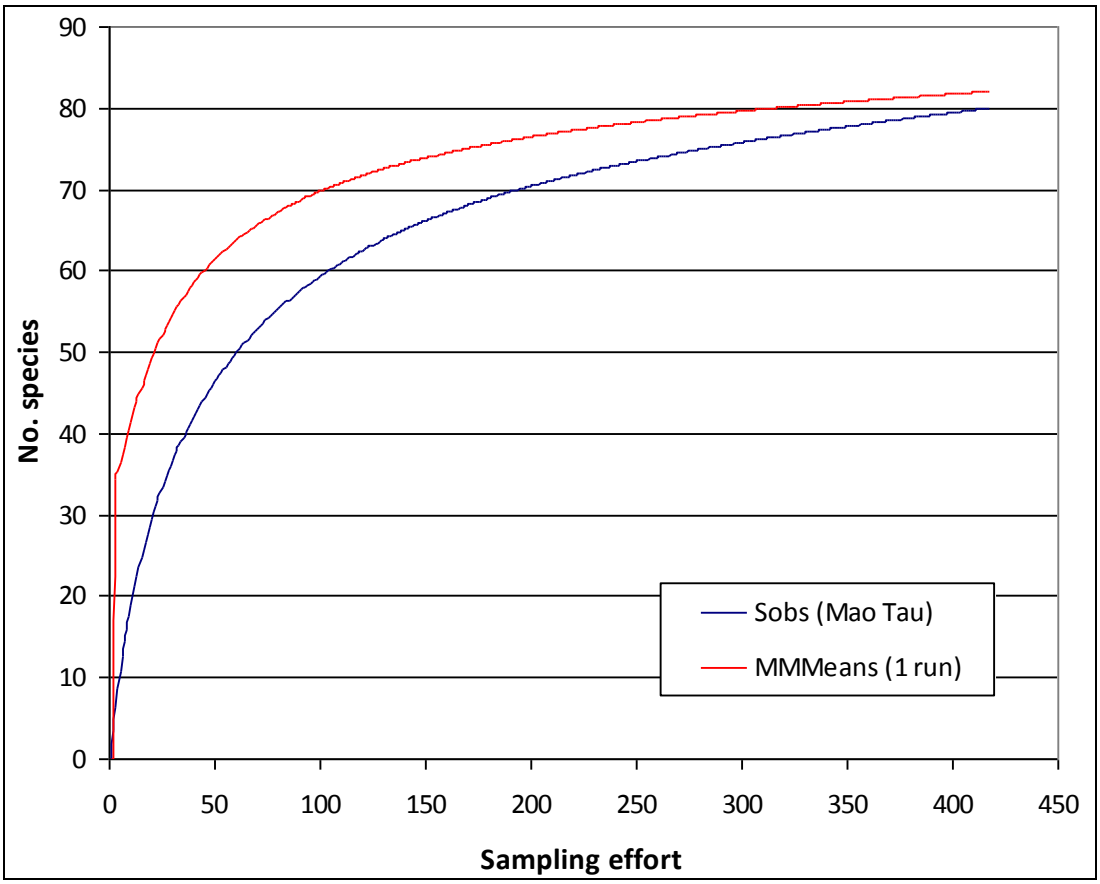

Figure 4.9 – Species accumulation curve: reptiles.

4.10 SURVEY LIMITATIONS

Limitations of the current survey are summarised in Table 4.7 below. Given the few limitations encountered, it can be confirmed that an adequate Level of survey has been undertaken.

Table 4.7 – Summary of survey limitations.

Constraint	Relevant (yes/no)	Comment
Competency/ experience of the consultant carrying out the survey.	No	All members of the survey team were experienced in Pilbara fauna identification and fauna 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	All habitat types were surveyed and their suitability as habitat for conservation significant species was assessed. All faunal groups were able to be adequately sampled.
Proportion of fauna identified, recorded and/ or collected.	No	The survey was conducted as a two-phase Level 2 survey with an additional Targeted Fauna survey, which is considered adequate for the fauna present as the majority of species are thought to have been recorded and identified.
Sources of information (previously available information as distinct from new data).	No	Eleven biological surveys have been conducted in the vicinity of the Project area. Data from three databases have also been included to provide a regional context.
The proportion of the task achieved and further work which might be needed.	No	Both a two-phase Level 2 survey and a Targeted Fauna survey were conducted, providing comprehensive information on the conservation significant species present.
Timing/ weather/ season/ cycle.	No	The two phases of the Level 2 survey were conducted in Spring and Autumn, covering a range of weather and seasonal conditions suitable for a variety of species.
Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention).	No	There were no disturbances.
Intensity (in retrospect was the intensity adequate).	No	The survey intensity was adequate, all habitat types were surveyed and most of the species thought to occur in the Project area were recorded.
Completeness (e.g. was relevant area fully surveyed).	No	The Project area was comprehensively surveyed.
Resources (e.g. degree of expertise available in animal identification to taxon Level).	No	All zoologists were suitably qualified and experienced in identification of Pilbara fauna. There were no other resource issues.
Remoteness and/ or access problems.	No	All areas of interest were accessible and trapping sites were spread throughout the Project area.
Availability of contextual (e.g. biogeographic) information on the region).	No	Sufficient contextual information was available on the Pilbara region and the Project area.
Efficacy of sampling methods (i.e. any groups not sampled by survey methods).	No	Survey methods were suitable to record all terrestrial vertebrate fauna groups.

5 DISCUSSION

5.1 MAMMALS

Some species of murids and dasyurids were trapped relatively lare numbers (see section 4.2.1) which indicates that they are widely distributed throughout the Project area. The high number of captures for these species is attributed to the fairly dense spinifex or buffelgrass understorey at all of the survey sites combined with higher than average rainfall in summer 2010/11 (Figure 2.1, BOM 2011). This triggered seeding of spinifex and other grasses which provides a food source for murids and insects and therefore may have increased the number of dasyurids captured and preent in the Project area.

5.2 BIRDS

The number of bird species recorded during this survey was relatively high compared to other surveys conducted in the region (Table 4.1, Appendix C). This may be a result of higher than averge rainfall prior to the first phase of surveying in 2011 which resulted in flowering and seeding of most vegetation at the time of surveying. In addition, surface water was present when the first phase of the 2011 survey was conducted and attracted waterbirds such as the Plumed Whistling Duck, Pacific Black Duck, Grey Teal, Australian Wood Duck and White-faced Heron. Bush Stone-curlews and Spotted Nightjars were observed hunting for insects along ephemeral water on roads and tracks. During the intial phase of the *ecologia* survey in 2011 a total of 10 Wedge-tailed Eagle records was noted. It is highly likely that this comprises several sightings of the same individual as this number of observations is relatively large for this species.

5.3 REPTILES

The record of the Narrow-banded Sand-swimmer (*Eremiascincus fasciolatus*) from a rocky gorge and a trap site on rocky spinifex hill is unusual, given that the species typically inhabits sandy areas with spinifex and shelters under thick leaf litter (Wilson and Swan 2010). Another noteworthy record is that of the Barking gecko *Underwoodisaurus seorsus*, a newly described species of gecko in the Pilbara (Doughty and Oliver 2011). This species has been split from *U. milii*, and is thus far, known from only a few specimens from mid elevations in the Hamersley Ranges. Given its rarity and small (possibly relictual) distribution, although not yet officially recognized as conservation significance, this species may be of conservation concern.

5.4 AMPHIBIANS

Given the heavy rain events prior to the autumn survey in 2011 the number of species of amphibian was relatively low. Many additional species may also be present in the Project area: Centralian Burrowing Frog (*Platyplectrum spenceri*) and Water-Holding Frog (*Cyclorana platycephala*) have been recorded from the region during previous surveys (Appendix C) and have the potential to occur within the Project area.

The record of the Gorge Toadlet was unusual, as the species' typical habitat comprises of permanent seeps and pools in deep gorges and canyons (Tyler and Doughty 2009). This species was recorded from CPP7, a site dominated by spinifex plains and hills which increases the known preferred habitat.

5.4.1 Introduced Species

The dingo is regarded as being a native animal although records from this survey were identified as dingo/dog hybrids and therefore the records are regarded to be of an introduced species.

Twelve of the 14 individuals of House Mouse found on this survey were recorded from major creeklines which provide moist habitats and represent a water source. This reflects the tendency of this species to effectively invade wetter habitat within arid regions.

5.5 CONSERVATION SIGNIFICANT FAUNA

A total of 13 species of conservation significance (five species of mammal, five species of bird and three species of reptile) were recorded during the survey. In addition, two species of conservation significance (one mammal, one bird species) are thought to have a high likelihood to occur within the Project area. Further information regarding the distribution, ecology, likelihood of occurrence and potential impacts to these conservation significant fauna are discussed below.

5.5.1 Mammals

5.5.1.1 Northern Quoll (*Dasyurus hallucatus*)

Conservation Status: EPBC Act Endangered, WC Act Schedule 1 (Endangered).

Distribution and Habitat: The Northern Quoll formerly occurred across northern Australia, from the Pilbara region in Western Australia to south-eastern Queensland. A 75% reduction of available habitat occurred during the 20th century, so that the species is now restricted to the Pilbara and north Kimberley in Western Australia, and a few discrete populations across the Northern Territory and eastern Queensland (Braithwaite and Griffiths 1994). Northern Quolls are most common on dissected rocky escarpments, but are also found in eucalypt forest and woodland (Oakwood 2008). They are both arboreal and terrestrial and use a variety of den sites, including rock crevices, tree hollows, logs, termite mounds, house roofs and goanna burrows (Oakwood 2008).

Ecology: Northern Quolls are the smallest of the Australian quolls (Oakwood 2008). Northern Quolls are nocturnal and opportunistic omnivores feeding primarily on small vertebrates, large insects and soft fruits. Breeding tends to occur near creeklines, where individuals go to drink when water is available (Oakwood 2008).

The most common cause of adult mortality is predation by dingoes, feral cats, snakes, owls and kites (Maxwell *et al.* 1996; Oakwood 2008). Other causes of mortality include predation by domestic dogs, motor vehicle strikes and pesticide poisoning. The Level of predation is increased through the removal of groundcover by fire.

Likelihood of Occurrence: **Recorded from secondary evidence**. Northern Quolls have been recorded near the Project area during two previous surveys (Ecoscape 2010, *ecologia* internal database). There are also four records from NatureMap within 50 km of the Project area, and records from the DEC Threatened Fauna and DSEWPaC Protected Matters databases. Suitable habitat exists within the Project area, which may support Northern Quolls, particularly the Rocky Ridges and Breakaways, and Creekline habitat types. Suitable habitat exists in the form of a number of large rocky boulder piles and scree slopes, flanking the sides and slopes of the rocky ridges present in the Project area (Figure 5.1). This habitat provides suitable foraging and denning habitat for the Northern Quoll.

During the targeted conservation significant fauna survey (*ecologia* 2011), a scat was recorded in habitat typical for this species (Table 4.2, Figure 5.2). The scat was too old and deteriorated to be positively confirmed; however, based on information from scat identification guides (Triggs 2004) the size and shape is indicative of Northern Quoll, with no other species likely to produce similar scats. No further evidence for this species was recorded.

Due to nearby records of this species, and the presence of suitable habitat within the Project area, there is a high likelihood of Northern Quolls occurring in the Project area. Throughout the local area of the Hamersley Ranges, Northern Quolls have been recorded, but the records usually consist of single captures or observations, indicating there is not a large population or high density of this species present. The reasons for this are unknown, as habitat appears to be sufficient to support a high density population in this area of the Hamersley Ranges; however, a lack of permanent surface water in the Project area could be the reasons for low population densities.

Potential Impacts: Potential destruction of habitat and potential den sites, and disturbance from humans is likely to have a small impact on the local population of Northern Quolls, potentially causing mortality and/or forced relocation away from disturbed areas. Individuals may be able to

move away from impact areas to areas of similar habitat that surrounds the Project area. It is anticipated the major impact areas within the Project area will be within the valley floors, which should largely avoid impact on habitat for the Northern Quoll. No regional impacts to the species are anticipated.

Figure 5.1 – Rocky scree and boulder piles providing suitable Northern Quoll habitat.

Figure 5.2 – Northern Quoll scat recorded from targeted survey.

5.5.1.2 Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*)

Conservation Status: EPBC Act Vulnerable, WC Act Schedule 1 (Vulnerable).

Distribution and Habitat: The Pilbara Leaf-nosed Bat is the Pilbara form of the Orange Leaf-nosed Bat (*Rhinonicteris aurantia*). While it is considered a separate form, formal reclassification has been hampered by the small sample size of the Pilbara population (Armstrong 2008).

Recent evidence suggests two main stronghold areas for the Pilbara Leaf-nosed Bat; in the western Pilbara and north of Marble Bar (Armstrong 2008). In the western Pilbara, they roost in caves formed in gorges that dissect siliceous sedimentary geology. They are most often observed in flight over waterholes in gorges, although they are rare even in the Hamersley Ranges where this habitat is common (Armstrong 2008). The Pilbara Leaf-nosed Bat roosts in disused mines and areas of high relief with gorges and watercourses (Armstrong 2001). They are unlikely to occur in the shallow 'breakaway' caves that occur along mesas and strike ridges.

Ecology: At dusk, Pilbara Leaf-nosed Bats emerge from their roosting sites to forage in gorges, small gullies and large watercourses for insects (van Dyck and Strahan 2008). They are susceptible to disturbance and will abandon roost caves if disturbed. Colonies in mines in the eastern Pilbara are subject to several pressures, including human visitation, and the collapse and flooding of disused mines (Armstrong 2008; DEWHA 2008b).

Likelihood of Occurrence: Recorded. This species was recorded on phase 1 of the Level 2 survey and again during the targeted conservation significant fauna survey. The record from phase 1 consisted of a single recording with three calls (Table 4.2), typical of an individual out foraging. The location of this record, which was from site CPP17 is within the snakewood shrubland habitat type, but in close proximity to the major creekline with fringing eucalypt habitat type (Figure 4.1). The Pilbara Leaf-nosed Bat is known to occupy riverine habitat during the wet season, and typically retreat back to their roost caves during the dry season. This record appears to reflect this.

A further three records of the Pilbara Leaf-nosed bat was made during the targeted survey which was conducted in the following Dry season (*ecologia* 2011). These locations were from more typical habitat, within the rocky ridge and breakaway habitat type (Figure 4.1). All records were again characteristic of individuals foraging. The locations of individuls within the Project area suggest the potential for two roost caves to be present in the vicinity of the Project area; however, no caves have been recorded.

Potential Impacts: Potential impacts to this species will vary, depending on whether there is a roost cave present within the Project area. No roost caves have been recorded; however, the presence of individuals and suitable habitat that may contain roost caves have been identified, suggesting roost caves may be present in or near the Project area. Due to the sensitive nature of Pilbara Leaf-nosed Bats (as stated by to disturbance, any construction activities in the vicinity of roost caves may impact on this species.

If there is no roost caves present, there will be no significant impact to any Pilbara Leaf-nosed Bat populations. Some individuals may be impacted through loss of hunting territory but it is anticipated those impacted upon will be able to find new hunting ranges. If roost caves are present, and these caves are impacted upon, there is the potential for a loss in the local population of this species. However, the proposed impact areas are currently focussed within the valley floors of the Project area. These areas are not typical of roost cave habitat and, therefore, this species is less likely to be

impacted upon. If roost caves are found within the Project area then these areas should be protected from any impacts. It is anticipated there will be no regional impacts to the species.

5.5.1.3 Long-tailed Dunnart (*Sminthopsis longicaudata*)

Conservation Status: DEC Priority 4.

Distribution and Habitat: Long-tailed Dunnarts are mostly found in rocky country in the western arid zone, although occasionally in open country with a gravel/stony mantle. Although rarely encountered, in Western Australia they occur in the Pilbara, Murchison, north-eastern Goldfields, Ashburton and Gibson Desert regions (Burbidge *et al.* 2008).

Ecology: The Long-tailed Dunnart is a small, carnivorous marsupial, distinguished from other *Sminthopsis* species by the length of its brush-tipped tail; more than twice the head-body length (Burbidge *et al.* 2008). The species feeds on arthropods such as beetles, ants, spiders, cockroaches, centipedes, grasshoppers and larvae. Its long tail is muscular at the base, allowing it to be held in a variety of positions, probably acting as a balancer; this, along with striated foot pads, suggest it is adapted to climbing (Burbidge *et al.* 2008).

Due to the limited knowledge about this species threatening processes are likely but are not limited to: inappropriate fire regimes and habitat modification as a result of the activities of introduced herbivores such as horses and cattle, invasion by buffel grass and predation by feral cats and foxes (Pavey 2006).

Likelihood of Occurrence: Recorded. Two individuals from two different sites were trapped during the current survey (Figure 4.1). In addition there are six records of Long-tailed Dunnarts from NatureMap from within 50 km of the Project area (Figure 4.2). DEC's Threatened Fauna database returned four recent, nearby records of the species (two from Mt Sheila, 1998; and four from Hamersley Range form 1995 and 1998). Large areas of suitable habitat for Long-tailed Dunnarts exist within the Project area.

Potential Impacts: Although this species is relatively widespread throughout Western Australia, it is typically restricted to areas of habitat with rocky hills and ranges. Although only two individuals were recorded during the survey, there is a high consentration of records in the surrounding region (to the south west of the Project area) suggesting that a potentially significant population of this species occurs in the area. Due to the rarity of records for this species across Western Australia and isolated nature of the populations, impacts to the population in the local area could be of medium regional significance.

5.5.1.4 Ghost Bat (*Macroderma gigas*)

Conservation Status: DEC Priority 4.

Distribution and Habitat: The Ghost Bat has a patchy but widespread distribution across northern Australia. Preferred roosting habitats in the Pilbara include caves beneath bluffs of low, rounded hills composed of Marra Mamba geology, and granite rock piles. They have also been known to roost in large colonies within sandstone caves, under boulder piles and in abandoned mines (Churchill 2008). Ghost Bats disperse widely during the non-breeding season but require warm caves with high relative humidity (80%) for rearing their young (maternity caves) (Toop 1985). These maternity caves are uncommon with only eleven recorded in the Pilbara region (three natural caves and eight mines) (Armstrong and Anstee 2000), one of which was found in the Hamersley Range, near the Project area (Muir 1983).

Ecology: The Ghost Bat is carnivorous and takes prey to an established feeding site to be eaten. These feeding sites are usually a rock overhang or small cave, and are easily recognised by the accumulation of discarded prey parts littering the floor (Richards *et al.* 2008). Foraging occurs in an area of approximately 60 ha, in a radius of approximately 2 km from the bat's roost (Tidemann *et al.* 1985).

Likelihood of Occurrence: Recorded. Recorded during Level 2 survey and targeted conservation significant survey (*ecologia* 2011). Ghost Bats have also been recorded from two previous surveys (Muir 1983, ecologia internal database). Database records of Ghost Bats include five NatureMap records from within 50 km of the Project area, and four DEC Threatened Fauna Database records (two from Mt Sheila from 1979 and 1998; one from Rocklea from 2003, and one from Hamersley Range from 2009). A Ghost Bat maternity cave was recorded 60 – 70 km to the east of the Project area within the Hamersley Range near Wittenoom (Muir 1983).

The Ghost Bat was recorded from five separate locations during phase 1. The additional three records of the Ghost Bat during the targeted survey were all in close proximity to the records from phase 1 (Figure 4.1). This indicates Ghost Bats are regularly present in the immediate area of these locations and roost caves are likely to be close by. One of the records from phase 1 consisted of the recording of up to 30 calls, from an opportunistic site in the north of Serenity Valley. This indicates a roost site for at least one individual Ghost Bat in this lcoation. In addition during the targeted survey, one of the records consisted of observing a Ghost Bat exiting a cave at dusk, indicating another roost cave for at least one individual. Three potential roost caves were observed in the west of the Project area (Table 4.2, Figure 5.3); however, no caves have been identified as having the potential to act as a maternity cave.

Potential Impacts: As with the Pilbara Leaf-nosed bat, the Ghost bat is sensitive towards human disturbance. Any disturbance to roost caves will result on an impact to individuals. Known roost caves within the Project area should be buffered by a suitable distance to reduce any disturbance impacts. Individuals may suffer a loss in hunting territory; however, it is anticipated individuals impacted will be able to move away from disturbances, in to similar habitat outside the Project area.

Figure 5.3 – Potential Ghost Bat roost cave from the Project area.

5.5.1.5 Western Pebble-mound Mouse (*Pseudomys chapmani*)

Conservation Status: DEC Priority 4.

Distribution and Habitat: The Western Pebble-mound Mouse occurs across central and southern Pilbara and extends into the smaller ranges of the Little Sandy Desert (Start 2008). Abandoned mounds have been found in the Gascoyne and Murchison, indicating a recent decline in distribution. This decline is most likely attributable to foxes and exotic herbivores. However, the species appears relatively secure in its remaining range (Start 2008). The Western Pebble-mound Mouse inhabits gently sloping hills of rocky ranges where the ground is stony and vegetated by spinifex with a sparse overstorey of eucalypts and scattered shrubs of senna, acacia and ptilotus.

Ecology: In suitable habitats, pebble mounds of this species can be found in large numbers, although not all of these mounds are active and occupied by mice at the same time. The demographic structure of the groups that inhabit the mounds and their patterns of movement around the mounds is still unknown (Anstee 1996; Anstee *et al.* 1997). Mounds can cover an area of 0.5-9.0 m^2, and a single mound can house up to 25 mice (Start 2008). Breeding occurs throughout the year with females producing several litters of four young per year (Start 2008).

Likelihood of Occurrence: Recorded from secondary evidence. Thirteen records were made of the Western Pebble-mound Mouse during the current survey (Table 4.2). These included five active mounds (Figure 5.4), four recently active mounds and four inactive mounds. Motion sensitive cameras set up around these mounds during the second phase survey recorded footage of mice utilising and maintaining the mounds. Literature and database searches revealed 29 records of the Western Pebble-mound Mouse from previous surveys, which included 12 active, eight 'either active or inactive' and four inactive mounds, and 14 records from NatureMap (Figure 4.7).

Potential Impacts: The Western Pebble-mound Mouse has been recorded across the Pilbara, and development of this project is not expected to cause regional impacts to this species. Suitable habitat exists outside the Project area, where several records of the Western Pebble-mound Mouse have been made.

Figure 5.4 – Active Western Pebble-Mouse mound recorded from the Project area.

5.5.1.6 Short-tailed Mouse (*Leggadina lakedownensis*)

Conservation Status: DEC Priority 4.

Distribution and Habitat: Populations of this small, secretive rodent are distributed across northern Australia but records have been sporadic (Moro and Kutt 2008). They occupy a diverse range of habitats from the monsoon tropical coast to semiarid climates, including spinifex and tussock grasslands, samphire and sedgelands, acacia shrublands, tropical eucalypt and melaleuca woodlands and stony ranges. Most habitats, however, are seasonally inundated on red or white sandy-clay soils (Moro and Kutt 2008).

Ecology: Their diet consists primarily of invertebrates, with plants supplementing their water requirements (Moro and Kutt 2008). Populations fluctuate greatly in response to rainfall, sometimes reaching plague proportions. The species is nocturnal and solitary, spending the day in simple, single-chambered burrows (Moro and Kutt 2008).

Likelihood of Occurrence:High. This species was not recorded during the Level 2 survey; however, there are numerous close by records from previous surveys and NatureMap (Figure 4.3). Although not trapped at Site CPP15 which was set up within suitable habitat the species has a high likelihood to be present within the Project area based on closeby records and suitable habitat being present, primarily in the form of alluvial plain with cracking clay (Figure 4.5).

Potential Impacts: Individuals may be directly impacted upon during vegetation clearing and construction activities. They may either suffer mortality or be forced to disperse out of impact areas into habitat found outside the Project area. Although local impacts are anticipated, no regional impacts to this species are anticipated.

5.5.2 Birds

5.5.2.1 Fork-tailed Swift (*Apus pacificus*)

Conservation Status: EPBC Act Migratory, WC Act Schedule 3.

Distribution and Habitat: The Fork-tailed Swift is a small insectivorous species with a white throat and rump and a deeply forked tail (Morcombe 2000). It 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 (Johnstone and Storr 1998). 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).

Ecology: 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 (Simpson and Day 2004).

Likelihood of Occurrence: Recorded.The Fork-tailed Swift was recorded on three occasions during phase 1 of the Level 2 survey. One of these sightings consisted of a large flock of 205 individuals. During the wet season, it is not unusual for flocks of this size to be recorded, particularly when thunderstorm activity is occurring, such as that experienced during the first phase of surveying.

Potential Impacts: This species is entirely aerial whilst in Australia and will not be directly impacted upon by any planned disturbance in the Project area.

5.5.2.2 Rainbow Bee-eater (*Merops ornatus*)

Conservation Status: EPBC Act Migratory, WC Act Schedule 3.

Distribution and Habitat: The Rainbow Bee-eater is 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).

Ecology: In Western Australia the Rainbow Bee-eater can occur as a resident, breeding visitor, post-nuptial nomad, passage migrant or winter visitor. It nests in burrows usually dug at a slight angle on flat ground, sandy banks or cuttings, and often at the margins of roads or tracks (Simpson and Day 2004). Eggs are laid at the end of the metre-long tunnel from August to January (Boland 2004). Rainbow Bee-eaters are most susceptible to predation during breeding.

Likelihood of Occurrence: Recorded. Rainbow Bee-eaters are commonly recorded across the Pilbara, with this species recorded from ten different locations within the Project area (Table 4.2, Figure 4.1). Suitable nesting and foraging habitat is present within the Project area.

Potential Impacts: Suitable nesting habitat exists for the Rainbow Bee-eater within the Project area, within the major creekline with fringing eucalypt habitat type. The Rainbow Bee-eater burrows in to sandy embankments, of which there are numerous areas within this habitat where they could nest. If these areas are impacted upon during the breeding season of this species, then some individuals could be impacted on. There will be no regional impacts anticipated for this species.

5.5.2.3 Peregrine Falcon (*Falco peregrinus*)

Conservation Status: WC Act Schedule 4.

Distribution and Habitat: 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. 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). The Peregrine Falcon occurs most commonly near cliffs along coasts, rivers and ranges, and around wooded watercourses and lakes.

Ecology: Peregrines feed almost entirely on birds, especially parrots and pigeons. Peregrine Falcons primarily nest on ledges on 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; Olsen *et al.* 2006).

Likelihood of Occurrence: Recorded. A single individual was recorded form site CPP14 during phase two of the survey (Figure 4.1), with a number of surrounding records within 50 km (Figure 4.7).

Potential Impacts: No impacts to Peregrine Falcons at either a local or regional scale are anticipated. Suitable nesting habitat exists within the Project area along the cliff faces of the rocky ridge and break away habitat type as shown in Figure 4.5, with suitable hunting territory throughout the Project area in all habitat types. If this species is disturbed within the Project area, it can easily disperse to similar nesting and hunting habitat outside the Project area.

5.5.2.4 Australian Bustard *(Ardeotis australis)*

Conservation Status: DEC Priority 4.

Distribution and Habitat: The Australian Bustard occurs Australia-wide and utilises a number of open habitats, including open or lightly wooded grasslands, chenopod flats, plains and heathlands (Johnstone and Storr 1998).

Ecology: It is a nomadic species, ranging over very large areas, and its abundance varies locally and seasonally from scarce to common, largely dependent on rainfall and food availability. The Australian Bustard has an omnivorous diet, feeding on grasses, seeds, fruit, insects and small vertebrates.

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 (Garnett and Crowley 2000). This is a result of hunting, degradation of its grassland habitat by sheep and rabbits and predation by foxes and cats (Frith 1976; Garnett and Crowley 2000). Australian Bustards readily desert nests in response to disturbance by humans, sheep or cattle (Garnett and Crowley 2000).

Likelihood of Occurrence: Recorded. A total of six individuals were recorded from two separate locations during the Level 2 survey (Figure 4.1). Numerous records were made in the surrounding region from NatureMap and previous surveys (Figure 4.3).

Potential Impacts: This species is highly mobile and nomadic and will easily move away from any areas in the Project area if disturbed. No significant impacts to this species are anticipated.

5.5.2.5 Bush Stone-curlew (*Burhinus grallarius*)

Conservation Status: DEC Priority 4.

Distribution and Habitat: The Bush Stone-curlew occurs across much of Australia, except the arid interior and central south coast, preferring lightly wooded country near thickets or long grass that acts as daytime shelter (Johnstone and Storr 1998). The Bush Stone-curlew inhabits woodlands, riparian vegetation, dry and open grasslands and croplands with cover nearby (NSW National Parks and Wildlife Service 1999).

Ecology: The species is primarily insectivorous, preying upon beetles, etc. although they will also eat seeds and shoots, frogs, lizards and snakes (Marchant and Higgins 1993; NSW National Parks and Wildlife Service 1999). They are usually seen in pairs, although may occasionally flock together during the breeding season (August to January) and are generally nocturnal, especially on moonlit nights (NSW National Parks and Wildlife Service 1999). Historically, this species was widely distributed throughout much of Western Australia, but it is now considered rare, with an estimated Australian population of 15,000 individuals (Garnett and Crowley 2000). Since Bush Stone-curlews are a ground-dwelling and non-migratory species, they are quite susceptible to local disturbances by humans and to predation by cats and foxes (Frith 1976; Johnstone and Storr 1998). They are most common where land disturbance is minimal, and generally become rare or extinct around human settlements (Johnstone and Storr 1998).

Likelihood of Occurrence: Recorded. The Bush-stone Curlew was recorded during the survey on six occasions (Figure 4.1, Figure 5.5). It has also been recorded regularly on previous surveys and from NatureMap.

Potential Impacts: This species is highly mobile and will easily move away from any areas in the Project area if disturbed. No significant impacts to this species are anticipated.

Figure 5.5 – Group of Bush-stone Curlews recorded from the Project area.

5.5.2.6 Star Finch (Western subspecies) (*Neochmia ruficauda subclarescens*)

Conservation Status: DEC Priority 4.

Distribution and Habitat: The western subspecies of the Star Finch is found across northern Australia, including the Pilbara region where it is patchily distributed, with occasional concentrations at Exmouth and Millstream. Typical Star Finch habitat is long grass or rushes around swamps and lagoons or permanent pools. It is also found in irrigated crops and pastures (Johnstone and Storr 2004).

Ecology: It feeds mainly on small grass seeds, but also flying ants, termites and other small insects and spiders. It usually occurs in pairs or small flocks. Breeding occurs between February and October. Both parents incubate the eggs and care for the young (Johnstone and Storr 2004).

Likelihood of Occurrenc: High. This species was not recorded during the survey; however, there are a number of surrounding records (Figure 4.1). Star Finch habitat within the Project area is restricted to areas within the major creekline and fringing eucalypt habitat type. There is no permanent surface water within the Project area, resulting in the Star Finch being unlikely to be a permanent resident within the Project area. However, Star Finches are likely to occur or move through the Project area on occasions, particularly after rainfall when surface water is persisting within the creeklines providing good habitat.

Potential Impacts: If Star Finches are present at times within the Project area, they can easily relocate to similar habitat outside the Project area if disturbed.

5.5.3 Reptiles

5.5.3.1 Pilbara Olive Python (*Liasis olivaceus barroni*)

Conservation Status: EPBC Act Vulnerable, WC Act Schedule 1 (Vulnerable).

Distribution and Habitat: The Pilbara subspecies of the Olive Python only occurs in the ranges of the Pilbara region of Western Australia. It inhabits watercourses and areas of permanent water in rocky gorges and gullies (Pearson 2006).

Ecology: This subspecies is an adept swimmer, often hunting in water, feeding on a variety of vertebrates, including rock wallabies, fruit bats, ducks and pigeons. Individuals spend the cooler winter months sheltering in caves and rock crevices. In the warmer months this species can move widely, usually in close proximity to water and rock outcrops (DEWHA 2008a). In late winter or early spring males will travel large distances to find and mate with females.

Population size estimates are difficult due to the species cryptic nature and lack of a reliable trapping and census data (DEWHA 2008a). The main threats to this subspecies come from predation from feral cats and foxes, particularly of juveniles, competition with foxes for food, and destruction of habitat (Pearson 2006).

Likelihood of Occurrence: Recorded. This species was recorded from the Project area during phase 1, in the form of remains of a dead individual (Figure 5.6, Figure 4.1). This specimen was recorded within a creekline adjacent to the rocky ridge and breakaway habitat type, in suitable habitat for this species. Throughout the Project area there are a number of large rocky gullies which contain suitable habitat for this species to shelter in during the day and over the cooler winter months (Figure 5.7). The Pilbara Olive Python has the potential to occur anywhere throughout the Project area while they are dispersing over the summer months.

The only limitation to the suitable habitat for the Pilbara Olive Python within the Project area is an absence of permanent surface water. Areas where surface water collects such as deep bowls and depressions were observed within rocky gorges, which typically would contain surface water for a period of time following rainfall events. It is anticipated that due to permanent water not being present, it is unlikely there is a significant population or high density of Pilbara Olive Pythons within the Project area. There is likely to be a low number of long term residents occupying suitable gorges within the rocky ridge and breakaway habitat type, particularly over the cooler winter months where this species aestivates within deep rocky crevices. During the warm summer months there is likely to be a higher number of transient individuals regularly moving through the Project area, temporarily occupying the suitable habitat.

Potential Impacts: Due to the anticipated low density of Pilbara Olive Pythons within the Project area, there are no impacts anticipated for this species on a regional Level. Individuals may be impacted upon through mortality if they are present within rocky gullies during construction activities of these areas. However, it is currently anticipated that most of the rocky ridge and breakaway habitat will not be impacted upon by mining activities, as the majority of impact areas are located within the valley areas, this results in a lower impact to the local Pilbara Olive Python population.

Figure 5.6 – Remains of a Pilbara Olive Python recorded from the Project area.

Figure 5.7 – Suitable Pilbara Olive Python habitat within the Project area

5.5.3.2 *Ramphotyphlops ganei*

Conservation Status: DEC Priority 1.

Distribution and Habitat: Very little is known about this elusive blind snake due to its fossorial lifestyle. Blind snakes are exclusively insectivorous, and like other members of their genus, *R. ganei* probably burrow into social insect colonies to feed on termites and ants, as well as their eggs and pupae (Wilson and Swan 2010). *R. ganei* has been found within the Pilbara region between Newman and Pannawonica (Wilson and Swan 2010).

Ecology: It has been suggested that *R. ganei* prefer to live in subterranean habitats near moist gullies and gorges (Wilson and Swan 2010) but little is know about the ecology of this species. Although no information about threatening processing is available at this stage, this species is likely to be threatened by removal of suitable habitat, and by drilling and/or any other mining activities impacting the subterranean environment.

Likelihood of Occurrence: Recorded. A single individual of this species was recorded during phase 2 of the Level 2 survey (Figure 4.1, Figure 5.8), from site CPP13. Interestingly this site is located in the acacia woodland habitat type, which is not the known typical habitat for this species. However the location of the record is in close proximity to more typical habitat of rocky spinifex hills and plains and rocky ridge and breakaway. There is a further single record of this species within 20 km of the Project area. Although there are two sources for this record, it represents only a single individual, as the record is from an *ecologia* survey which has been submitted to DEC via the regulation 17 fauna licensing returns procedure, and consequently uploaded to NatureMap. No other records of this species are present within 110 km of the Project area (Figure 4.4).

Potential Impacts: Due to the lack of knowledge regarding this species, assessing the impacts are difficult. It is a rarely encountered species, with just 28 records on NatureMap. Despite this, these records show this species occupies a large area of the Pilbara, and it does not appear to be restricted to any local region. The two records within 20 km of each other indicate suitable habitat is present within the local area; however, no assessment on population densities can be made. Due to the apparent relatively wide ranging distribution of this species within the Pilbara, it is anticipated there will be no significant impacts to this species, at a local or regional Level.

Figure 5.8 – The *Ramphotyphlops ganei* individual recorded during the Survey.

5.5.3.3 Notoscincus butleri

Conservation Status: DEC Priority 4.

Distribution and Habitat: This small skink has a limited distribution, restricted to the arid north-west near-coastal Pilbara (Wilson and Swan 2010) of the Dampier district to Harding River dam (Storr *et al.* 1999). Its habitat is typically spinifex dominated areas near creek and river margins (Wilson and Swan 2010).

Ecology: Very little is known about this species of skink. There are only two species belonging to the *Notoscincus* genus. Theses species are secretive, but readily bask in sunshine (Wilson and Swan 2010). *Notoscincus butleri* is an egg layer and feeds on invertebrates (Wilson and Swan 2010).

Likelihood of Occurrence: Recorded. This species was recorded from five separate locations with a total of 13 records (Figure 4.1,Figure 5.9, Table 4.2). *Notoscincus butleri* is typically found in areas near drainage lines, creeks and riverine areas. All records for this species from the Level 2 survey were in relatively close proximity to the major creekline with fringing eucalypt habitat type, confirming the habitat preference for this species. In addition there are a number of surrounding records within 50 km. Based on NatureMap records, the Project area falls within the southern extremity of this species distribution (Figure 4.4).

Potential Impacts: No regional impacts to this species are anticipated. Some individuals within the local population may be impacted upon within the Project area; however, suitable habitat exists outside the Project area where this species is also likely to occur.

Figure 5.9 – One of the *Notoscincus butleri* individuals recorded during the Survey.

5.6 THREATENING PROCESSES

Greater human activity in the area, processes/activities associated with the development of the Project and processes/activities associated with the continued operation of the Project all create threatening processes that could potentially impact vertebrate fauna. These processes/activities are discussed in this section.

5.6.1 Vegetation Clearing

Impacts to native fauna arising from vegetation clearing activities will include a reduction in the amount of available fauna habitat, and mortality of small and sedentary fauna that are unable to move out of the area prior to clearing (Western Pebble-mound Mouse, Northern Short-tailed Mouse, *Notoscincus butleri* and *Ramphotyphlops ganei*). Clearing activities which result in the fragmentation of habitats may result in the inability of individuals to move between areas of habitat and may increase the risk of predation as individuals move across cleared areas. Examples of this that relate to the Project include the clearing of the valley bottoms which will separate the rocky ridge habitats. In general, vegetation clearing will cause a local loss of biodiversity and ecological function.

5.6.2 Vegetation Degradation

Vegetation degradation is caused through the effects of dust pollution or increased weed invasion. Development of the Project will involve the clearing of native vegetation and the construction and operation of mine site and associated infrastructure. The activities involved in clearing vegetation and construction and operation of a mine can increase the Level of dust pollution and can facilitate the spread of weed species already present in the area, and the increase in vehicle and equipment movement may introduce species from other areas.

Dust pollution has many potential impacts to vegetation including physical damage to plant tissue, introduction of disease causing chemicals, reductions in physiological processes and changes to species compositions of vegetation communities (Farmer 1993). The resulting changes to the vegetation communities alter the associated fauna habitats, typically resulting in reduced suitability of the vegetation as a habitat, food source or other ecological aspect.

The impacts of the introduction of weed species are similar to the effects of dust, in that it alters the associated fauna habitats. In a worst case scenario, this may result in weed species dominating the understorey to the exclusion of annuals and eventually larger perennial flora. Of 20 studies of environmental weed impact in Australia, 19 demonstrated that weed species contribute to a decline in flora species richness, canopy cover or frequency of native flora species. Although no studies have been undertaken in sub-tropical Australia, studies on vertebrates in tropical Australia (Braithwaite *et al.* 1989; Griffin *et al.* 1989), South Africa (Winterbottom 1970) and the United States (Brock *et al.* 1986) indicate a substantial decline in fauna species richness and abundance following the introduction of exotic weed species.

5.6.3 Noise and Light Pollution

Noise pollution is expected to occur due to the use of heavy machinery and transportation. Noise pollution may cause fauna species to move away, alter their behaviour, or change community structure due to the negative response of wildlife to new stimuli (Larkin 1996; Radle 1998).

Bat species are sensitive to both light and noise pollution, particularly approaching and during the maternity season (Mann *et al.* 2002). The presence of light and noise may be advantageous to some species, for example those that feed on insects around lights, and disadvantageous to others, for example species in which the noise pollution interferes with their echolocation calls (Zagorodniuk 2003). This has the potential to alter the species composition within the Project area. Mercury vapour lights in particular have been found to affect the predator-prey relationship between bats and moths (Longcore and Rich 2004).

Noise and light can attract feral predators to areas as they associate human activity with food resources. An increase in feral predator numbers will result in a corresponding increase in predation rates on native animals. High predation rates (from both feral and native fauna) have also been found to occur in areas of high illumination, and small mammals tend to forage less in these areas (Longcore and Rich 2004).

Light pollution can disrupt bird migrations, particularly nocturnally migrating species when environmental conditions force them to fly lower to the ground at night (Longcore and Rich 2004). Birds can become trapped in artificially lit areas as they will not move out into dark areas where they have difficulty navigating. Trapped individuals may become exhausted, collide with other individuals or suffer from increased predation (Longcore and Rich 2004).

The potential impacts of noise and/or light pollution is difficult to estimate due to the lack of specific studies related to mine sites in the Pilbara. Due to the wide spacing of mine sites in the Pilbara it is expected that impacts will be minimal and the most species will either habituate to the light and noise associated with development of the Project, or move to a suitable distance away from the noise source so that it is no longer disturbing (Larkin 1996; Radle 1998). Due to the large areas of relatively undisturbed habitat surrounding the Project area and the mobility of most species, individuals should be able to move away from light and noise sources and thus reduce the potential impact.

5.6.4 Fire

Increased human activity is often associated with an increased risk of fire or altered fire regimes, which may lead to temporary destruction of fauna habitats or more lasting degradation of natural vegetation if, for example, fire frequency is increased (Williams 2002). Frequent fires will reduce the ability of fauna species to recolonise burnt areas as unburnt areas tend to become scarcer with increased fire occurrence.

Movement of vehicles, machinery and human influences have the potential to increase the frequency of spot fires, particularly in the highly flammable spinifex that occurs across the Project area.

5.6.5 Vehicle Strike

The construction of roads and access tracks within the Project area will increase the likelihood of vehicle strikes on native fauna. Reptiles may be killed on roads while basking during the day and mammals (particularly macropods) are commonly killed on roads following dusk. This attracts scavenging species such as the Wedge-tailed Eagle, which are then more likely to be killed themselves. Species such as Pilbara Leaf-nosed Bats, Ghost Bats and nocturnal birds such as the Spooted Nightjar and the Australian Owlet-nightjar also forage close to ground (Johnstone and Storr 1998; Churchill 2008) and, therefore, are susceptible to vehicle strikes at night.

5.6.6 Barbed Wire Fences

Barbed wire fences have been reported as a potential hazard to native fauna across Australia. Sixty-two species have been recorded entangled in barb wire fences (van der Ree 1999). Animals typically entangled are flying species such as gliding marsupials, bats and birds and the most common sites are areas where barbed wire fences are located between cleared and well-vegetated areas. Any use of barbed wire fences within the Project area may impact species such as Pilbara Leaf-nosed Bats and Ghost Bats.

5.6.7 Food Waste and Open Water

The presence of open water sources and accessible food wastes can cause an increase of feral fauna densities and allow these species to occur in areas that would not otherwise be possible in the arid zones of Australia. An increase in feral fauna densities will have an increased negative impact on the abundance and diversity of native fauna due to increased predation pressure and resource competition. Water resources include water sumps and any areas where excess water accumulates, and water sources not often associated as such (e.g. water tanks) can attract feral European Honey Bees, which may also affect the health and safety of people employed on the Project. Food wastes are typically concentrated around accommodation camps (such as poorly disposed kitchen scraps), though poorly disposed lunch scraps from staff members working away from the camp can also provide a food resource for feral fauna species.

5.7 IMPACTS ON FAUNA HABITATS

Six fauna habitat types were recognised within the Project area: rocky spinifex plains and hillslopes; rocky ridges and breakaways, Major creeklines with fringing eucalypt trees, acacia shrubland, alluvial plain with cracking clays and snakewood shrubland. Based on the extent of the Land systems associated with these fauna habitat types (as described in section 4.4) the majority of these habitat types are widespread throughout the Pilbara region and well represented in the surrounding area (Table 2.2).

Two vegetation associations, 82 (Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*) of which 32.1% lie within Project area and 565 (Hummock grasslands, low tree steppe; bloodwood over soft spinifex) of which 10.72% are located within the Project area could potentially be impacted on a regional scale due to the relatively high percentage that occurs within the Project area. Both vegetation association are located in the north of the Project area and are associated with the rocky ridges and breakaways and the major creeklines with frinding bloodwood as described in section 4.4. Any clearance and disturbance of this vegetation type should be minimised where possible.

Few impacts are expected as a result of vegetation clearing in the described fauna habitat types as several vegetation associations can form the same fauna habitat. This also means that extensive areas of similar habitat occur in the surrounding region in the form of a variety of vegetation associations.

5.8 IMPACTS ON FAUNAL ASSEMBLAGES

5.8.1 Biodiversity

The diversity of fauna assemblages within the surrounding region is unlikely to be significantly affected by the proposed Project. Most terrestrial fauna are expected to be able to move to adjacent areas of suitable habitat. However, individuals of sedentary fauna, e.g. ground-dwelling species with poor dispersal capabilities, may be impacted. Vegetation surrounding the Project area may also be degraded from impacts, such as fire, dust and weeds, which may reduce the quality of local fauna habitats thereby reducing local fauna diversity; however, impacts to regional biodiversity are not expected.

5.8.2 Ecological Function

Localised reduction in ecological function can be expected as a result of habitat clearing, fragmentation, traffic, noise, and light pollution. However, ecological function at a regional scale is not expected to be impacted.

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. Adequate weed management, including regular monitoring for exotic weeds, is important for rehabilitation of disturbed areas to succeed in re-creating some of the original fauna habitats present prior to the Project. It should be noted that it is unlikely that full restoration of the original habitat and ecosystems can be achieved, and therefore, vegetation clearing should be minimised where possible.

6 CONCLUSION

The main conclusions of the terrestrial vertebrate fauna assessment of the Central Pilbara Project: Mine are:

- The survey methods were consistent with the EPA's Guidance Statement No. 56, Position Statement No. 3 and *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* to sample for terrestrial fauna. Species accumulation curves showed that survey adequacy from the current survey was moderate, but when previous surveys in the area are taken into account, adequacy overall is sufficient.
- The vertebrate fauna survey conducted at the Central Pilbara Project: Mine area found that the land systems, vegetation communities and habitats supported a diverse group of fauna, including conservation significant fauna, but they were not restricted to the Project area.
- Thirteen conservation significant vertebrate fauna species were recorded within, or in close proximity to the Project area, an additional two species of conservation significance have a medium or high likelihood and 11 conservation significant species have a low likelihood to occur within the Project area
- No limitations on survey techniques were experienced
- Six fauna habitat types were recorded within the Project area. The majority of these (rocky spinifex plains and hills, major creeklines and rocky ridges and breakaways) occur extensively surrounding the Project area and are continuous with it. The major creeklines with fringing eucalypt is considered the most sensitive fauna habitat type to disturbance.
- The DEC listed Long-tailed Dunnart (Priority 4) is the only species known to occur within the Project area with the potential for impact at a regional Level as the knowledge about the species' distribution and ecology is very limited. For this reason it is the impact on this species has a potential to be moderate on a regional Level.
- Targeted surveys for species of conservation significance were conducted in September 2011 and November 2011. No significant roost colonies of Pilbara Leaf-nosed Bat, Ghost Bat and no Northern Quoll individuals were encountered during these surveys.

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Special Thanks:

Mr Bob Bullen for the identification of Bat calls recorded during this survey.

8 REFERENCES

Anstee, S. D. 1996. Use of external mound structures as indicators of the presence of the Pebble-mound Mouse, *Pseudomys chapmani*, in mound systems. Wildlife Research. 23:429-434.

Anstee, S. D., Roberts, J. D., and O'Shea, J. E. 1997. Social structure and patterns of movement of the Western Pebble-mouse, *Pseudomys chapmani*, at Marandoo, Western Australia. . Wildlife Research. 24:295-305.

Armstrong, K. N. 2001. The distribution and roost habitat of the orange leaf-nosed bat, *Rhinonicteris aurantius*, in the Pilbara region of Western Australia. Wildlife Research. 28:95-104.

Armstrong, K. N. 2008. Pilbara Leaf-nosed Bat, *Rhinonicteris aurantia*. pp. 470-471 *in* Van Dyck, S., and Strahan, R., eds. The Mammals of Australia. Reed New Holland, Sydney.

Armstrong, K. N. and Anstee, S. D. 2000. The ghost bat in the pilbara: 100 years on. Australian Mammalogy. 22:93-101.

Atkins, K. J. 2008. Declared Rare and Priority Flora List for Western Australia. Department of Environment and Conservation.

Beard, J. S. 1975. The vegetation of the Pilbara region. Explanatory notes to map sheet 5 of vegetation survey of Western Australia: Pilbara. University of Western Australia Press, Nedlands.

Beard, J. S. 1979. Kimberley: The vegetation of the Kimberley area. Vegetation Survey of Western Australia 1:1,000,000 series, explanatory notes and map. University of Western Australia Press, Nedlands, WA.

Biota Environmental Sciences. 2005. Fauna habitats and fauna assemblage of the Brockman Syncline 4 project, near Tom Price. Unpublished report for Hamersley Iron Pty Ltd.

Biota Environmental Sciences. 2009. West Turner Syncline Section 10 Development Two-Phase Fauna Survey. Unpublished report for Pilbara Iron Company.

Boland, C. R. J. 2004. Breeding biology of Rainbow Bee-eaters (*Merops ornatus*): a migratory, colonial, cooperative bird. The Auk. 121:811-823.

BOM. 2011. Bureau of Meteorology. Accessed 01 December 2010. http://www.bom.gov.au.

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

Braithwaite, R. W., Lonsdale, W. M., and Esthbergs, J. A. 1989. Alien vegetation and native biota in tropical Australia: impact of *Mimosa pigra*. Biological Conservation. 48:189-210.

Brock, C. E., Brock, C. H., Jepson, K. L., and Ortega, J. C. 1986. Ecological effects of planting African lovegrasses in Arizona. National Geographic Research. 2:456-463.

Burbidge, A. A., McKenzie, N. L., and Fuller, P. J. 2008. Long-tailed Dunnart, *Sminthopsis longicaudata*. pp. 148-150 *in* Van Dyck, S., and Strahan, R., eds. The Mammals of Australia. Reed New Holland, Sydney.

Bushnell Outdoor Products. 2009. Trophy Cam Instruction Manual.

Catullo, R. A., Doughty, P., Roberts, J. D., and Keogh, J. S. 2011. Multi-locus phylogeny and taxonomic revision of *Uperoleia* toadlets (Anura: Myobatrachidae) from the western arid zone of Australia, with a description of a new species. Zootaxa. 2902:1-43.

Christidis, L. and Boles, W. E. 2008. Systematics and Taxonomy of Australian Birds. CSIRO Publishing, Collingwood.

Churchill, S. 2008. Australian Bats. Jacana Books, Crows Nest NSW.

Clarke, K. R. 1993. Non-parametric multivariate analyses of changes in community structure. Australian Journal of Ecology. 18:117-143.

Coffey Environments. 2008. Level 2 Terrestrial Vertebrate Fauna Assessment for the Solomon Project.

Coffey Environments. 2008. Level 2 Terrestrial Vertebrate Fauna Assessment for the Solomon Project. Prepared for Fortescue Metals Group Ltd.

Cogger, H. G. 2000. Reptiles and Amphibians of Australia. Reed New Holland, Sydney.

Colwell, R. K. 2006. EstimateS: Statistical estimation of species richness and shared species from samples. Version 8.

Department of Environment, Water, Heritage and the Arts. 2008a. Approved Conservation Advice for *Liasis olivaceus barroni* (Olive Python-Pilbara subspecies).

Department of Environment, Water, Heritage and the Arts. 2008b. Approved Conservation Advice for *Rhinonicteris aurantius* (Pilbara form) (Pilbara Leaf-nosed Bat).

Doughty, P. and Oliver, P. M. 2011. A new species of *Underwoodisaurus* (Squamata: Gekkota: Carphodactylidae) from the Pilbara region of Western Australia. Zootaxa. 3010:20-30.

Department of Sustainability, Environment, Water, Population and Communities. 2010. Maps: Australia's bioregions (IBRA).

ecologia Environment. 2010. Vertebrate fauna assessment: Solomon project: Kings area. Unpublished report for Fortescue Metals Group.

ecologia Environment. 2011. Central Pilbara Project: Mine, Targeted Conservation Significant Fauna Survey.

Ecoscape Australia. 2010. Vertebrate Fauna and Fauna Habitat Assessment for the Firetail Project.

EPA. 2002. Terrestrial Biological Surveys as an Element of Biodiversity Protection *in* Environmental Protection Authority, ed, Perth.

EPA. 2004. Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia *in* Environmental Protection Authority, ed, Perth.

Environmental Protection Authority and Department of Environment and Conservation. 2010. Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment.

Farmer, A. M. 1993. The Effects of Dust on Vegetation. Environmental Pollution. 79:63-75.

Frith, A. J. 1976. Reader's Digest Complete Birds of Australia. Reader's Digest, Sydney.

Garnett, S. T. and Crowley, G. M. 2000. The Action Plan for Australian Birds. Environment Australia, Canberra.

Griffin, G. F., Stafford-Smith, D. M., Morton, S. R., Allan, G. E., and Masters, K. A. 1989. Status and implications of the invasion of Tamarisk (*T. aphylla*) on the Finke River, Northern Territory, Australia. Journal of Environmental Management. 29:297-315.

Hammer, Ø., Harper, D. A. T., and Ryan, P. D. 2001. PAST: Paleontological Statistics Software Package for Education and Data Analysis. Palaeontologia Electronica. 4.

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

Johnstone, R. E. and Storr, G. M. 2004. Handbook of Western Australian Birds, Volume II - Passerines (Blue-winged Pitta to Goldfinch). Western Australian Museum, Perth.

Jolly, S. 1997. Analysis of bat echolocation call recorded by Anabat bat detectors. M.S. Thesis. Department of Computer and Mathematical Sciences, Victoria University of Technology, Melbourne, Australia.

Kendrick, P. 1995. Vertebrate Fauna of the Marandoo to Great Northern Highway Road.

Kendrick, P. 2001. Pilbara 3 (PIL3 - Hamersley subregion). A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions in 2002. DEC.

Larkin, R. P. 1996. Effects of military noise on wildlife: a literature review. USACERL Technical report 96/21.

Longcore, T. and Rich, C. 2004. Ecological Light Pollution. Frontiers in Ecology and the Environment. 2:191-198.

Mann, S. L., Steidl, R. J., and Dalton, V. M. 2002. Effects of cave tours on breeding *Myotis velifer*. Journal of Wildlife Management. 66:618-624.

Marchant, S. and Higgins, P. J. 1993. Handbook of Australian, New Zealand and Antarctic Birds. Oxford University Press, Melbourne.

Mattiske and Associates and Ninox Wildlife Consulting. 1990. Brockman 2 Detritals Survey Area and Proposed Transport Corridor.

Maxwell, S., Burbidge, A. A., and Morris, K. D., eds. 1996. The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia, Canberra.

McKenzie, N. L. and Muir, W. P. 2000. Bats of the southern carnarvon basin, Western Australia. Records of the Western Australian Museum. Supplement No. 61:465-477.

Menkhorst, P. and Knight, F. 2009. A Field Guide to the Mammals of Australia. Oxford University Press, Melbourne.

Milne, D. J. 2002. Key to the bat calls of the Top End of the Northern Territory. Technical Report No. 71.

Morcombe, M. 2000. Field Guide to Australian Birds. Steve Parish Publishing Pty Ltd, Archerfield, Australia.

Moro, D. and Kutt, A. S. 2008. Northern Short-tailed Mouse, *Leggadina lakedownensis*. pp. 583-584 *in* van Dyck, S., and Strahan, R., eds. The Mammals of Australia. Reed New Holland, Sydney.

Muir, B. G., ed. 1983. A Fauna Survey of the Hamersley Range National Park Western Australia. Bulletin No. 1. National Parks Authority of Western Australia.

National Health and Medical Research Council. 2004. Australian code of practice for the care and use of animals for scientific purposes.

NSW National Parks and Wildlife Service. 1999. Bush Stone-curlew *Burhinus grallarius* (Latham, 1801). NSW National Parks and Wildlife Service, Hurstville, NSW www.npws.nsw.gov.au,.

Oakwood, M. 2008. Northern Quoll, *Dasyurus hallucatus.* . pp. 57-59 *in* van Dyck, S., and Strahan, R., eds. The Mammals of Australia. Reed New Holland, Sydney.

Olsen, J., Fuentes, E., Dykstra, R., and Rose, A. B. 2006. Male Peregrine Falcon *Falco peregrinus* fledged from a cliff-nest found breeding in a stick-nest. Australian Field Ornithology. 23:8-14.

Pavey, C. 2006. Threatened Species of the Northern Territory: Long-tailed Dunnart (*Sminthopsis longicaudata*).

Pearson, D. J. 2006. Giant pythons of the pilbara. Landscope. 19:32-39.

Radle, A. L. 1998. The Effect of Noise on Wildlife: A Literature Review. Accessed http://interact.uoregon.edu/MediaLit/FC/WFAEResaearch/radle.html.

Richards, G. C., Hand, S., and Armstrong, K. N. 2008. Ghost Bat, *Macroderma gigas*. pp. 449-450 *in* van Dyck, S., and Strahan, R., eds. The Mammals of Australia. Reed New Holland, Sydney.

Shepherd, D. P., Beeston, G. R., and Hopkins, A. J. M. 2001. Native vegetation in Western Australia: Extent, type and status. Technical Report 249. Department of Agriculture, South Perth.

Shepherd, *et al.* 2002. Native Vegetation in Western Australia. Technical Report 249.

Simpson, K. and Day, N. 2004. Field Guide to the Birds of Australia. Penguin Group, Camberwell.

Start, A. N. 2008. Western Pebble-mouse, *Pseudomys chapmani*. pp. 621-622 *in* van Dyck, S., and Strahan, R., eds. The Mammals of Australia. Reed New Holland, Sydney.

Storr, G. M., Smith, L. A., and Johnstone, R. E. 1983. Lizards of Western Australia II: Dragons and Monitors. Western Australian Museum, Perth.

Storr, G. M., Smith, L. A., and Johnstone, R. E. 1990. Lizards of Western Australia III: Geckos and Pygopods. Western Australian Museum, Perth.

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

Storr, G. M., Smith, L. A., and Johnstone, R. E. 2002. Snakes of Western Australia. Western Australian Museum, Perth.

Thackway, R. and Cresswell, I. D. 1995. An Interim Biogeographic Regionalisation for Australia. Australian Nature Conservation Agency, Canberra.

Tidemann, C. R., Priddel, D. M., Nelson, J. E., and Pettigrew, J. D. 1985. Foraging behaviour of the Australian Ghost Bat, *Macroderma gigas* (Microchiroptera: Megadermatidae). Australian Journal of Zoology. 33:705-713.

Toop, J. 1985. Habitat requirements, survival strategies and ecology of the ghost bat, *Macroderma gigas* Dobson (Microchiroptera, Megadermatidae) in central coastal Queensland. Macroderma. 1:37-41.

Triggs, B. 2004. Tracks, scats and other traces: a field guide to Australian mammals. Oxford University Press, Melbourne.

Tyler, M. J. and Doughty, P. 2009. Field Guide to Frogs of Western Australia. Western Australian Museum, Perth.

van der Ree, R. 1999. Barbed Wire Fencing as a Hazard for Wildlife. Victorian Naturalist. 116:210-217.

van Dyck, S. and Strahan, R. 2008. *The Mammals of Australia*. Reed New Holland, Sydney.

van Vreeswyk, A. M. E., Payne, A. L., Leighton, K. A., and Hennig, P. 2004. An inventory and condition survey of the Pilbara region, Western Australia. Department of Agriculture Technical Bulletin No. 92.

Vreeswyk, A. M. E. V., Payne, A. L., Leighton, K. A., and Hennig, P. 2004. An inventory and condition survey of the Pilbara region,Western Australia. Department of Agriculture, W.A.

Williams, J. 2002. Fire regimes and their impacts in the Mulga (*Acacia aneura*) Landscapes of Central Australia *in* Russel-Smith, J., Craig, R., Gill, A. M., Smith, R., and Williams, J., eds. Australian Fire Regimes: Contemporary Patterns (April 1998 - March 2000) and Changes Since European Settlement. Department of Environment and Heritage, Canberra.

Wilson, S. and Swan, G. 2010. *A Complete Guide to Reptiles of Australia*. New Holland Publishers, Sydney.

Winterbottom, J. M. 1970. The birds of alien *Acacia* thickets of the South African Western Cape. Zoologica Africana. 5:49-57.

Zagorodniuk, I. V. 2003. Bat communities in urban areas: species selection by the frequency of their ultrasonic signals. Proceedings of the National Academy of Sciences of the Ukraine. 8:184-189.

APPENDIX A EXPLANATION OF 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 Animal) for which Australia is a range state; • the agreement between the Government of Australian 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 species 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 species protection.
Schedule 4 (S4)	Declared to be fauna that is in need of species protection, otherwise than for the reasons mentioned above.

Appendix A3 Definition of Department of Environment and Conservation Priority Codes.

Threatened	Definition
Critically Endangered (CR)	Considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Considered to be facing a high risk of extinction in the wild.
Priority	**Definition**
Priority 1 (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 2 (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 3 (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 4 (P4)	*Taxa in need of monitoring.* Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands.
Priority 5 (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.

APPENDIX B WEATHER OBSERVATIONS RECORDED DURING THE SURVEY

Appendix B Weather observations recorded at Paraburdoo Weather Station (BOM 2011).

Date	Maximum Temperature (°C)	Minimum Temperature (°C)	Rainfall (mm)
Coffey Environments			
Phase 1			
29/02/11	40.3	22.8	0.0
01/03/11	40.6	23.0	0.0
02/03/11	41.5	22.6	0.0
03/03/11	41.0	26.9	0.0
04/03/11	39.2	24.2	0.0
05/03/11	39.8	26.6	0.2
06/03/11	40.0	25.7	0.0
***ecologia* Environment**			
Phase 1			
03/03/11	31.4	20.4	0.0
04/03/11	32.1	20.4	0.0
05/03/11	34.5	21.5	0.0
06/03/11	37.2	24.1	0.0
07/03/11	36.6	26.4	0.0
08/03/11	35.6	24.5	19.2
09/03/11	36.2	25.3	0.0
10/03/11	36.3	21.9	0.0
11/03/11	37.5	22.6	0.0
12/03/11	38.5	21.1	0.0
13/03/11	37.9	22.6	0.0
14/03/11	37.2	26.4	0.0
15/03/11	36.3	25.4	0.0
Phase 2 survey 1			
25/08/11	32.1	12.7	0.0
26/08/11	31.5	13.4	0.0
27/08/11	32.0	11.9	0.0
28/08/11	32.9	10.2	0.0
29/08/11	34.1	11.1	0.0
30/08/11	30.9	13.0	0.0
31/08/11	33.1	12.5	0.0
01/09/11	30.2	16.9	0.0
02/09/11	28.4	11.7	0.0
03/09/11	25.5	14.8	0.0
04/09/11	31.1	12.6	0.0
05/09/11	32.4	12.0	0.0
Phase 2 survey 2			
23/09/11	33.0	13.8	0.0
24/09/11	35.9	17.3	0.0
25/09/11	32.9	12.8	0.0
26/09/11	31.2	10.1	0.0
27/09/11	28.7	16.0	0.0
28/09/11	30.9	15.1	0.0
29/09/11	33.7	11.5	0.0
30/09/11	34.7	14.7	0.0

Date	Maximum Temperature (°C)	Minimum Temperature (°C)	Rainfall (mm)
01/10/11	30.3	16.0	0.0
02/10/11	30.0	16.6	0.0
03/10/11	25.4	14.6	0.0
04/10/11	28.0	14.3	0.0
05/10/11	33.7	18.1	0.0

APPENDIX C REGIONAL FAUNA DATA

Appendix C1 – Mammals

Family and Species	Common name	Conservation Status			*ecologia* Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (*ecologia* 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Current Survey
		EPBC Act	WC Act	DEC													
TACHYGLOSSIDAE																	
Tachyglossus aculeatus	Short-beaked Echidna				●	●	●	●				●		●			
DASYURIDAE																	
Dasykaluta rosamondae	Kaluta				●	●		●		●	●	●	●	●			●
Dasyurus hallucatus	Northern Quoll	EN	S1	EN	●	●	●	●							●	●	
Ningaui timealeyi	Pilbara Ningaui				●	●	●	●		●	●	●	●	●			●
Planigale sp. (prev. maculata)	Common Planigale				●	●	●	●			●	●	●				●
Planigale sp.2													●	●			
Pseudantechinus roryi	Rory's Pseudantechinus												●				
Pseudantechinus woolleyae	Woolley's False Antechinus				●	●	●				●			●			●
Sminthopsis longicaudata	Long-tailed Dunnart			P4										●	●		●
Sminthopsis macroura	Stripe-faced Dunnart				●	●	●	●			●	●	●	●			●
Sminthopsis ooldea	Ooldea Dunnart											●	●				
PHALANGERIDAE																	
Trichosurus vulpecula arnhemensis	Northern Brushtail Possum							●									
MACROPODIDAE																	
Lagorchestes conspicillatus leichardti	Spectacled Hare-wallaby			P3										●	●		
Macropus robustus	Euro				●	●	●	●	●	●	●	●		●			●
Macropus rufus	Red Kangaroo				●	●	●		S	●	●	●		●			●
Petrogale sp.	Unidentified Rock Wallaby							S									
MEGADERMATIDAE																	
Macroderma gigas	Ghost Bat			P4	●	●	●						●	●	●		●
HIPPOSIDERIDAE																	
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	S1	VU										●		●	●

Family and Species	Common name	Conservation Status			*ecologia* Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (*ecologia* 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Current Survey
		EPBC Act	WC Act	DEC													
EMBALLONURIDAE																	
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat				●	●	●	●			●		●				●
Taphozous georgianus	Common Sheathtail Bat				●	●	●	●		●	●		●	●			●
Taphozous hilli	Hill's Sheattail Bat				●		●						●	●			●
MOLOSSIDAE																	
Chaerophon jobensis	Northern Freetail Bat				●	●	●					●	●				●
Mormopterus beccarii	Beccari's Freetail Bat				●	●	●	●					●	●			●
Mormopterus loriae	Little Northern Freetail Bat									●							
Tadarida australis	White-striped Freetail Bat									●			●				
VESPERTILIONIDAE																	
Chalinolobus gouldii	Gould's Wattled Bat				●	●	●	●		●	●	●	●	●			●
Chalinolobus morio	Chocolate Wattled Bat										●						
Nyctophilus arnhemensis	Northern Long-eared Bat									●							
Nyctophilus bifax daedalus	Eastern Long-eared Bat				●								●				
Nyctophilus geoffroyi	Lesser Long-eared Bat				●								●				●
Scotorepens greyii	Little Broad-nosed Bat				●	●	●	●		●	●		●	●			●
Vespadelus finlaysoni	Finlayson's Cave Bat				●	●	●	●		●	●	●	●	●			●
MURIDAE																	
Notomys alexis	Spinifex Hopping-mouse												●				
Leggadina lakedownensis	Northern Short-tailed Mouse			P4	●									●	●		
Pseudomys chapmani	Western Pebble-mound Mouse			P4	●	S	S	S	S	●	●	●	●	●	●		S
Pseudomys desertor	Desert Mouse				●	●	●	●		●	●			●			●
Pseudomys hermannsburgensis	Sandy Inland Mouse				●			●		●	●	●	●	●			●
Zyzomys argurus	Common Rock-rat				●	●	●	●	●	●	●	●	●	●			●

Family and Species	Common name	Conservation Status			*ecologia* Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (*ecologia* 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Current Survey
		EPBC Act	WC Act	DEC													
INTRODUCED MAMMALS																	
Mus musculus	House Mouse				●	●	●			●	●	●	●	●			●
Canis lupus familiaris/dingo	Dog/Dingo				●	●	●	●		●							●
Vulpes vulpes	Red Fox															●	
Felis catus	Cat				●	●	●	●	●	●	●	●		●		●	●
Oryctolagus cuniculus	European Rabbit															●	
Equus asinus	Donkey				●				●	●				●			
Equus caballus	Horse								●	●							●
Bos taurus	Cow				●	●	●	●	●			●		●			●

S Secondary evidence

Appendix C2 – Birds

Family and Species	Common name	Conservation Status			ecologia Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (ecologia 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Birdata	Current Survey
		EPBC Act	WC Act	DEC														
CASUARIIDAE																		
Dromaius novaehollandiae	Emu				●		●		●	●		●	●	●			●	●
PHASIANIDAE																		
Coturnix pectoralis	Stubble Quail							●						●				●
Coturnix ypsilophora	Brown Quail				●	●	●	●						●			●	●
ANATIDAE																		
Dendrocygna eytoni	Plumed Whistling-duck																●	●
Cygnus atratus	Black Swan												●				●	
Chenonetta jubata	Australian Wood Duck								●				●	●			●	●
Malacorhynchus membranaceus	Pink-eared Duck												●	●			●	
Anas gracilis	Grey Teal									●			●	●			●	●
Anas superciliosa	Pacific Black Duck									●			●	●			●	●
Aythya australis	Hardhead												●	●			●	
PODICIPEDIDAE																		
Tachybaptus novaehollandiae	Australasian Grebe												●	●			●	
Poliocephalus poliocephalus	Hoary-headed Grebe												●	●			●	
COLUMBIDAE																		
Phaps chalcoptera	Common Bronzewing				●	●	●	●	●	●	●	●	●	●			●	●
Phaps histrionica	Flock Bronzewing					●	●						●					
Ocyphaps lophotes	Crested Pigeon				●	●	●	●	●	●	●	●	●	●			●	●
Geophaps plumifera	Spinifex Pigeon				●	●	●	●	●	●	●	●	●	●			●	●
Geopelia cuneata	Diamond Dove				●	●	●	●	●	●	●	●	●	●			●	●
Geopelia striata	Peaceful Dove				●	●	●	●			●		●	●			●	●

Family and Species	Common name	Conservation Status			ecologia Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (ecologia 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Birdata	Current Survey
		EPBC Act	WC Act	DEC														
PODARGIDAE																		
Podargus strigoides	Tawny Frogmouth				●	●	●	●				●	●	●			●	●
EUROSTOPODIDAE																		
Eurostopodus argus	Spotted Nightjar				●	●	●	●	●	●		●	●				●	●
AEGOTHELIDAE																		
Aegotheles cristatus	Australian Owlet-nightjar				●		●	●	●			●	●	●			●	●
APODIDAE																		
Apus pacificus	Fork-tailed Swift	M	S3		●		●						●	●				●
ANHINGIDAE																		
Anhinga novaehollandiae	Australasian Darter												●				●	
PHALACROCORACIDAE																		
Microcarbo melanoleucos	Little Pied Cormorant							●					●	●			●	
Phalacrocorax sulcirostris	Little Black Cormorant																●	
Phalacrocorax carbo	Great Cormorant												●					
PELECANIDAE																		
Pelecanus conspicillatus	Australian Pelican												●	●			●	
ARDEIDAE																		
Ardea pacifica	White-necked Heron				●		●			●			●	●			●	●
Ardea modesta	Eastern Great Egret	M	S3										●	●			●	
Ardea ibis	Cattle Egret	M	S3													●		
Ardea intermedia	Intermediate Egret																●	
Egretta novaehollandiae	White-faced Heron									●			●	●			●	●
Nycticorax caledonicus	Nankeen Night Heron												●				●	

Family and Species	Common name	Conservation Status			ecologia Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (ecologia 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Birdata	Current Survey
		EPBC Act	WC Act	DEC														
THRESKIORNITHIDAE																		
Plegadis falcinellus	Glossy Ibis	M	S3														●	
Threskiornis spinicollis	Straw-necked Ibis												●	●				
ACCIPITRIDAE																		
Pandion cristatus	Eastern Osprey	M											●					
Elanus axillaris	Black-shouldered Kite					●					●	●	●	●			●	●
Lophoictinia isura	Square-tailed Kite				●		●							●				
Hamirostra melanosternon	Black-breasted Buzzard												●					
Haliaeetus leucogaster	White-bellied Sea-Eagle	M	S3													●		
Haliastur sphenurus	Whistling Kite				●	●	●		●	●	●		●	●			●	●
Milvus migrans	Black Kite												●	●			●	
Accipiter fasciatus	Brown Goshawk				●	●	●	●		●			●	●			●	●
Accipiter cirrocephalus	Collared Sparrowhawk				●	●	●	●	●				●	●			●	●
Circus assimilis	Spotted Harrier				●					●	●	●	●	●			●	●
Aquila audax	Wedge-tailed Eagle				●	●	●			●	●	●	●	●			●	●
Hieraaetus morphnoides	Little Eagle				●					●	●		●				●	
FALCONIDAE																		
Falco cenchroides	Nankeen Kestrel				●		●	●	●	●	●	●	●	●			●	●
Falco berigora	Brown Falcon				●	●	●	●	●	●	●	●	●	●			●	●
Falco longipennis	Australian Hobby				●		●			●	●	●	●	●			●	
Falco hypoleucos	Grey Falcon			P4								●						
Falco peregrinus	Peregrine Falcon		S4		●								●		●		●	●
RALLIDAE																		
Gallirallus philippensis	Buff-banded Rail												●				●	
Porzana fluminea	Australian Spotted Crake												●					●

Family and Species	Common name	Conservation Status			ecologia Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (ecologia 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Birdata	Current Survey
		EPBC Act	WC Act	DEC														
Porzana pusilla	Baillon's Crake																●	
Porzana tabuensis	Spotless Crake												●					
Tribonyx ventralis	Black-tailed Native-hen												●				●	
Fulica atra	Eurasian Coot												●	●			●	
OTIDIDAE																		
Ardeotis australis	Australian Bustard			P4	●	●	●		●	●	●		●	●	●		●	●
BURHINIDAE																		
Burhinus grallarius	Bush Stone-curlew			P4				●		●			●		●		●	●
RECURVIROSTRIDAE																		
Himantopus himantopus	Black-winged Stilt												●	●			●	
CHARADRIIDAE																		
Charadrius veredus	Oriental Plover	M	S3													●		
Elseyornis melanops	Black-fronted Dotterel						●			●			●	●			●	●
Erythrogonys cinctus	Red-kneed Dotterel												●					
Vanellus tricolor	Banded Lapwing																	●
SCOLOPACIDAE																		
Gallinago sp.	Snipe		S3											●				
Actitis hypoleucos	Common Sandpiper	M	S3										●	●			●	
Tringa glareola	Wood Sandpiper	M	S3										●					
TURNICIDAE																		
Turnix velox	Little Button-quail				●	●	●	●	●	●		●	●	●			●	●
LARIDAE																		
Chlidonias hybrida	Whiskered Tern												●					

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		EPBC Act	WC Act	DEC														
CACATUIDAE (PSITTACIDAE)																		
Calyptorhynchus banksii	Red-tailed Black-Cockatoo												●					
Eolophus roseicapillus	Galah				●	●	●	●	●	●	●	●	●	●			●	●
Cacatua sanguinea	Little Corella				●	●	●	●		●	●	●	●	●			●	●
Nymphicus hollandicus	Cockatiel				●		●	●	●	●	●		●	●			●	●
PSITTACIDAE																		
Barnardius zonarius	Australian Ringneck				●	●	●	●	●	●	●	●	●	●			●	●
Psephotus varius	Mulga Parrot					●	●						●					
Melopsittacus undulatus	Budgerigar				●			●	●	●	●	●	●	●			●	●
Neopsephotus bourkii	Bourke's Parrot												●	●				●
NEOSITTIDAE																		
Daphoenositta chrysoptera	Varied Sitella																	●
CUCULIDAE																		
(Centropodidae) *Centropus phasianinus*	Pheasant Coucal				●	●	●	●									●	●
Chalcites basalis	Horsfield's Bronze-Cuckoo				●	●	●	●	●	●	●	●	●	●			●	●
Chalcites osculans	Black-eared Cuckoo										●		●				●	
Cacomantis pallidus	Pallid Cuckoo				●	●	●	●		●	●	●	●	●			●	●
STRIGIDAE																		
Ninox connivens	Barking Owl												●					
Ninox novaeseelandiae	Southern Boobook				●	●	●	●					●	●			●	●
TYTONIDAE																		
Tyto javanica	Eastern Barn Owl				●					●		●	●				●	
HALCYONIDAE																		
Dacelo leachii	Blue-winged Kookaburra				●	●	●	●		●			●	●			●	●

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		EPBC Act	WC Act	DEC														
Todiramphus pyrrhopygius	Red-backed Kingfisher				●	●	●	●	●	●	●	●	●	●			●	●
Todiramphus sanctus	Sacred Kingfisher				●	●	●	●	●			●	●	●			●	●
MEROPIDAE																		
Merops ornatus	Rainbow Bee-eater	M	S3		●	●	●	●		●	●		●	●		●	●	●
CLIMACTERIDAE																		
Climacteris melanura	Black-tailed Treecreeper									●		●	●	●				●
PTILINORHYNCHIDAE																		
Ptilonorhynchus guttatus	Western Bowerbird				●			●	●	●	●		●	●			●	●
MALURIDAE																		
Malurus lamberti	Variegated Fairy-wren				●	●	●	●	●	●	●	●	●	●			●	
Malurus leucopterus	White-winged Fairy-wren				●	●	●		●	●	●	●	●	●			●	●
Stipiturus ruficeps	Rufous-crowned Emu-wren				●					●	●	●	●	●			●	●
Amytornis striatus	Striated Grasswren				●	●	●	●		●	●		●	●	●		●	●
ACANTHIZIDAE																		
Pyrrholaemus brunneus	Redthroat												●	●			●	
Smicrornis brevirostris	Weebill				●	●	●	●	●	●	●	●	●	●			●	●
Gerygone fusca	Western Gerygone				●		●	●	●	●	●	●	●	●			●	●
Acanthiza robustirostris	Slaty-backed Thornbill				●								●	●			●	●
Acanthiza chrysorrhoa	Yellow-rumped Thornbill				●			●				●	●	●			●	
Acanthiza uropygialis	Chestnut-rumped Thornbill				●				●	●	●	●	●	●			●	●
Acanthiza apicalis	Inland Thornbill				●				●	●	●	●	●	●				●
Aphelocephala leucopsis	Southern Whiteface							●									●	
PARDALOTIDAE																		
Pardalotus rubricatus	Red-browed Pardalote				●	●	●	●		●	●		●	●			●	●

Family and Species	Common name	Conservation Status			ecologia Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (ecologia 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Birdata	Current Survey
		EPBC Act	WC Act	DEC														
Pardalotus striatus	Striated Pardalote				●	●	●	●	●	●	●	●	●	●			●	●
MELIPHAGIDAE																		
Certhionyx variegatus	Pied Honeyeater				●		●		●		●	●	●	●				●
Lichenostomus virescens	Singing Honeyeater				●	●	●	●	●	●	●	●	●	●			●	●
Lichenostomus keartlandi	Grey-headed Honeyeater				●	●	●	●	●	●	●	●	●	●			●	●
Lichenostomus plumulus	Grey-fronted Honeyeater													●				
Lichenostomus penicillatus	White-plumed Honeyeater				●	●	●	●	●	●	●	●	●	●			●	●
Purnella albifrons	White-fronted Honeyeater								●	●			●					
Manorina flavigula	Yellow-throated Miner				●		●	●	●	●	●	●	●	●			●	●
Acanthagenys rufogularis	Spiny-cheeked Honeyeater				●	●	●	●	●	●	●	●	●	●			●	●
Conopophila whitei	Grey Honeyeater										●	●	●	●			●	
Epthianura tricolor	Crimson Chat				●				●	●		●	●	●			●	●
Epthianura aurifrons	Orange Chat												●					
Sugomel niger	Black Honeyeater				●		●						●	●				●
Lichmera indistincta	Brown Honeyeater				●	●	●	●		●	●	●	●	●			●	●
Melithreptus gularis	Black-chinned Honeyeater				●	●	●	●		●		●	●	●			●	●
POMATOSTOMIDAE																		
Pomatostomus temporalis	Grey-crowned Babbler				●	●		●		●	●	●	●	●			●	●
Pomatostomus superciliosus	White-browed Babbler								S	●				●			●	
PSOPHODIDAE (CINCLOSOMATIDAE)																		
Cinclosoma castaneothorax	Chestnut-breasted Quail-thrush									●				●			●	
Psophodes occidentalis	Chiming Wedgebill													●				
NEOSITTIDAE																		
Daphoenositta chrysoptera	Varied Sittella												●	●			●	

Family and Species	Common name	Conservation Status			ecologia Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (ecologia 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Birdata	Current Survey
		EPBC Act	WC Act	DEC														
CAMPEPHAGIDAE																		
Coracina maxima	Ground Cuckoo-shrike				●		●			●	●		●	●				●
Coracina novaehollandiae	Black-faced Cuckoo-shrike				●	●	●	●	●	●	●	●	●	●			●	●
Lalage sueurii	White-winged Triller				●	●	●	●	●	●	●	●	●	●			●	●
PACHYCEPHALIDAE																		
Pachycephala rufiventris	Rufous Whistler				●	●	●	●	●	●	●	●	●	●			●	●
Colluricincla harmonica	Grey Shrike-thrush				●	●	●	●	●	●	●	●	●	●			●	●
Oreoica gutturalis	Crested Bellbird				●	●	●	●	●	●	●	●	●	●			●	●
ARTAMIDAE																		
Artamus personatus	Masked Woodswallow				●		●		●		●	●	●	●			●	●
Artamus cinereus	Black-faced Woodswallow				●	●	●	●	●	●	●	●	●	●			●	●
Artamus minor	Little Woodswallow				●	●	●	●	●	●	●	●	●	●			●	●
Cracticus torquatus	Grey Butcherbird				●	●	●	●	●	●	●	●	●				●	●
Cracticus nigrogularis	Pied Butcherbird				●	●	●	●	●	●	●	●	●				●	●
Cracticus tibicen	Australian Magpie				●	●	●		●	●	●	●	●				●	●
RHIPIDURIDAE (DICRURIDAE)																		
Rhipidura albiscapa	Grey Fantail										●		●	●			●	
Rhipidura leucophrys	Willie Wagtail				●	●	●	●	●	●	●	●	●	●			●	●
CORVIDAE																		
Corvus bennetti	Little Crow				●				●		●	●	●	●			●	●
Corvus orru	Torresian Crow				●	●	●			●	●		●	●			●	●
MONARCHIDAE (DICRURIDAE)																		
Grallina cyanoleuca	Magpie-lark				●	●	●	●	●	●	●	●	●	●			●	●
PETROICIDAE																		

Family and Species	Common name	Conservation Status			ecologia Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (ecologia 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Birdata	Current Survey
		EPBC Act	WC Act	DEC														
Petroica goodenovii	Red-capped Robin				●				●	●	●	●	●	●			●	●
Melanodryas cucullata	Hooded Robin				●	●	●	●	●	●	●	●	●	●			●	●
ALAUDIDAE																		
Mirafra javanica	Horsfield's Bushlark								●				●	●			●	●
ACROCEPHALIDAE (SYLVIIDAE)																		
Acrocephalus australis	Australian Reed-Warbler												●	●			●	
MEGALURIDAE (SYLVIIDAE)																		
Cincloramphus mathewsi	Rufous Songlark				●	●				●		●	●	●			●	●
Cincloramphus cruralis	Brown Songlark				●	●			●	●	●		●	●			●	●
Eremiornis carteri	Spinifex-bird				●	●	●	●	●	●	●	●	●	●			●	●
HIRUNDINIDAE																		
Cheramoeca leucosterna	White-backed Swallow								●									
Hirundo neoxena	Welcome Swallow																	●
Petrochelidon ariel	Fairy Martin						●		S	●			●	●			●	●
Petrochelidon nigricans	Tree Martin				●	●	●		●	●			●	●			●	●
NECTARINIIDAE (DICAEIDAE)																		
Dicaeum hirundinaceum	Mistletoebird				●	●	●	●		●	●		●	●			●	●
ESTRILDIDAE																		
Taeniopygia guttata	Zebra Finch				●	●	●	●	●	●	●	●	●	●			●	●
Neochmia ruficauda subclarescens	Star Finch (western)			P4					●			●	●	●			●	
Emblema pictum	Painted Finch				●	●	●	●	●	●	●	●	●	●			●	●
MOTACILLIDAE																		
Anthus novaeseelandiae	Australasian Pipit								●	●			●	●			●	

† Species recorded just outside Project area

Appendix C3 - Reptiles

Family and Species	Common name	Conservation Status			*ecologia* Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (*ecologia* 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Current Survey
		EPBC Act	WC Act	DEC													
CHELUIDAE																	
Chelodina steindachneri	Steindachner's Turtle												●				
AGAMIDAE																	
Amphibolurus longirostris	Long-nosed Dragon				●	●	●	●	●	●	●	●	●	●			●
Caimanops amphiboluroides	Mulga Dragon				●								†				●
Ctenophorus caudicinctus	Ring-tailed Dragon				●	●	●	●	●	●	●	●	●	●			●
Ctenophorus isolepis	Central Military Dragon				●	●	●			●	●	●	●	●			●
Ctenophorus reticulatus	Western Netted Dragon				●								●	●			
Diporiphora valens					●		●			●	●	●	●	●			●
Pogona minor	Dwarf Bearded Dragon				●	●	●	●	●	●	●	●	●	●			●
Tympanocryptis cephalus	Pebble Dragon													●			●
DIPLODACTYLIDAE																	
Crenadactylus ocellatus	Clawless Gecko				●		●										●
Diplodactylus conspicillatus	Fat-tailed Gecko				●	●	●			●	●		†	●			●
Diplodactylus pulcher													†				
Diplodactylus savagei					●	●		●		●	●		†	●			●
Lucasium squarrosum													●				
Lucasium stenodactylum	Sand-plain Gecko				●	●				●		●	●	●			●
Lucasium wombeyi					●	●	●	●		●			†	●			●
Oedura marmorata	Marbled Velvet Gecko				●	●	●	●	●		●		●	●			●
Rhynchoedura ornata	Beaked Gecko									●	●	●	†	●			●
Strophurus elderi	Jewelled Gecko				●		●			●	●	●	●	●			●
Strophurus strophurus	Western Spiny-tailed Gecko					●											●
Strophurus wellingtonae					●	●	●	●		●	●			●			●
CARPHODACTYLIDAE																	

Family and Species	Common name	Conservation Status			*ecologia* Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (*ecologia* 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Current Survey
		EPBC Act	WC Act	DEC													
Nephrurus wheeleri	Banded Knob-tailed Gecko				●	●	●	●		●		●	●	●			●
Underwoodisaurus seorsus	Barking Gecko							●									●
GEKKONIDAE																	
Gehyra pilbara					●	●						●	●	●			●
Gehyra punctata					●	●	●	●	●	●	●	●	●	●			●
Gehyra purpurascens					●												
Gehyra variegata					●	●	●	●		●	●	●	●	●			●
Heteronotia binoei	Bynoe's Gecko				●	●	●	●	●	●	●	●	●	●			●
Heteronotia spelea	Desert Cave Gecko				●	●	●						●	●			●
PYGOPODIDAE																	
Delma butleri												●					●
Delma elegans					●	●	●						●	●			●
Delma nasuta					●	●	●	●	●	●	●	●	●	●			●
Delma pax					●	●	●	●		●	●	●	†	●			●
Delma tincta					●	●				●	●	●	●	●			●
Lialis burtonis	Burton's Snake-lizard				●	●	●	●		●	●		●	●			●
Pygopus nigriceps	Western Hooded Scaly-foot				●	●		●		●			●	●			●
SCINCIDAE																	
Carlia munda					●	●		●		●	●	●		●			●
Carlia triacantha					●	●	●	●				●	●	●			●
Cryptoblepharus buchananii						◊			◊	◊	◊		◊	●			●
Cryptoblepharus ustulatus					●	◊		●	◊	◊	◊		◊	●			●
Ctenotus atlas													†				
Ctenotus duricola					●	●	●	●	●	●	●	●	●	●			●
Ctenotus grandis					●	●	●			●	●	●		●			●
Ctenotus helenae					●	●	●	●	●	●	●		●	●			●

Family and Species	Common name	Conservation Status			*ecologia* Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (*ecologia* 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Current Survey
		EPBC Act	WC Act	DEC													
Ctenotus leonhardii					●	●							†				●
Ctenotus pantherinus	Leopard Ctenotus				●	●	●	●	●	●	●	●	●	●			●
Ctenotus robustus	Eastern Striped Skink					●								●			●
Ctenotus rubicundus						●		●			●	●	●	●			●
Ctenotus rutilans					●	●				●		●	●	●			●
Ctenotus saxatilis	Rock Ctenotus				●	●	●	●		●	●	●	●	●			●
Ctenotus schomburgkii					●	●				●	●	●	●	●			●
Ctenotus serventyi													†				●
Cyclodomorphus melanops	Spinifex Slender Blue-tongue				●	●	●	●	●	●	●	●	●	●			●
Egernia depressa	Pygmy Spiny-tailed Skink												†				
Egernia formosa					●		●			●			●	●			●
Egernia pilbarensis						●											
Eremiascincus fasciolatus	Narrow-banded Sand-swimmer				●		●										●
Eremiascincus richardsonii	Broad-banded Sand-swimmer												●	●			●
Lerista flammicauda					●						●			●			
Lerista jacksoni	(L.muelleri group)							●			●						●
Lerista muelleri					●	●	●			●		●	●	●			●
Lerista neander													†				
Lerista verhmens						●								●			
Lerista zietzi						●		●									●
Menetia greyii					●	●		●	●	●	●	●	†	●			●
Menetia surda					●	●				●	●		●	●			●
Morethia ruficauda					●	●		●		●	●	●	●	●			●
Notoscincus butleri				P4		●				●	●			●	●		●
Proablepharus reginae						●						●	●	●			
Tiliqua multifasciata	Centralian Blue-tongue				●	●		●		●	●	●	●	●			●

Family and Species	Common name	Conservation Status			*ecologia* Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (*ecologia* 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Current Survey
		EPBC Act	WC Act	DEC													
VARANIDAE																	
Varanus acanthurus	Spiny-tailed Monitor				●	●	●	●		●	●	●	●	●			●
Varanus brevicauda	Short-tailed Pygmy Monitor				●	●	●			●	●	●	●	●			●
Varanus bushi	Pilbara Monitor				●	●	●	●			●			●			●
Varanus caudolineatus	Stripe-tailed Monitor											●	●				
Varanus eremius	Pygmy Desert Monitor				●	●	●	●		●				●			●
Varanus giganteus	Perentie				●	●	●	●		●		●	●				
Varanus gouldii	Gould's Monitor												●				
Varanus panoptes	Yellow-spotted Monitor				●	●	●	●		●		●	●	●			●
Varanus pilbarensis	Pilbara Rock Monitor				●	●	●			●			●	●			●
Varanus tristis	Black-headed Monitor				●	●	●	●		●	●	●	●	●			●
TYPHLOPIDAE																	
Ramphotyphlops ammodytes					●	●					●			●			●
Ramphotyphlops ganei				P1	●		●								●		●
Ramphotyphlops grypus	Beaked Blind Snake				●	●		●		●	●	●	●	●			●
Ramphotyphlops hamatus													●	●			
Ramphotyphlops pilbarensis	Pilbara Blind Snake				●	●		●		●				●			●
Ramphotyphlops waitii													●				
PYTHONIDAE																	
Antaresia perthensis	Pygmy Python				●	●		●					●	●			●
Antaresia stimsoni	Stimson's Python				●	●	●	●				●	●	●			●
Aspidites melanocephalus	Black-headed Python				●	●	●					●	†				●
Liasis olivaceus barroni	Pilbara Olive Python	VU	S1	VU	●		●	●			●		●		●	●	●
ELAPIDAE																	
Acanthophis pyrrhus	Desert Death Adder										●		●				
Acanthophis wellsi	Pilbara Death Adder				●		●	●						●			●

Family and Species	Common name	Conservation Status			*ecologia* Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (*ecologia* 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Current Survey
		EPBC Act	WC Act	DEC													
Brachyurophis approximans	NW 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 mengdeni	Gwardar				●	●	●	●	●	●	●	●	●	●			●
Pseudonaja modesta	Ringed Brown Snake				●	●	●				●	●	●				●
Suta fasciata	Rosen's Snake					●					●	●	●				●
Suta punctata	Little Spotted Snake												†	●			
Vermicella snelli	Pilbara Bandy Bandy					●					●		●				●

† Species recorded just outside project area

◊ Due to new taxonomic updates, records of Cryptoblepharus plagiocephalus and C. carnabyi can be either C. buchanani or C ustulatus

Appendix C4 - Amphibians

Family and Species	Common name	Conservation Status			*ecologia* Internal Database	Solomon Project Area (Coffey 2008)	Solomon Project (*ecologia* 2010)	Firetail mining area (Ecoscape 2010)	Brockman 2 Detritals (Mattiske & Ninox 1990)	Brockman Syncline (Biota 2005)	West Turner Section 10 (Biota 2009)	Maradoo to Great Northern Hwy Rd (Kendrick 1995)	Hamersley Range (Muir 1983)	NatureMap	DEC Rare Fauna	DSEWPaC Protected Matters Search	Current Survey
		EPBC Act	WC Act	DEC													
HYLIDAE																	
Cyclorana maini	Sheep Frog				●	●	●			●	●	●	●	●			●
Cyclorana platycephala	Water-Holding Frog												†				
Litoria rubella	Little Red Tree Frog				●	●	●			●		●	●				●
LIMNODYNASTIDAE																	
Platyplectrum spenceri	Centralian Burrowing Frog											●	●				
MYOBATRACHIDAE																	
Pseudophryne douglasi	Gorge Toadlet												●				●
Uperoleia russelli	Northwest Toadlet				●	●											●
Uperoleia sp.						●	●						●				

† Species recorded just outside project area

APPENDIX D SITE DESCRIPTIONS

CPP 1 **Site location**: 554339 E, 7551675 S Moderately dense eucalypt woodland (Bloodwood) over mixed shrubs and dense spinifex on sandy loam. Sparse wood litter and moderate leaf litter. **Habitat type**: Major creekline with fringing eucalypt.	
CPP 2 **Site location**: 557904 E, 7549716 S Moderately open eucalypt woodland over mixed acacia shrubland over moderate spinifex on rocky loam. Sparse wood litter and sparse leaf litter. **Habitat type**: Rocky spinifex plain and hills.	
CPP 3 **Site location**: 558322 E, 7545325 S Very open eucalypt woodland over patches of dense acacia shrubland over moderate small clumps of spinifex on rocky loam. Sparse leaf litter and sparse wood litter **Habitat type:** Rocky spinifex plain and hills.	

CPP 4 **Site location**: 550539 E, 7538370 S Open eucalypt woodland over moderately open mixed acacia shrubland over dense large clumps of spinifex on hard clay with rocky mantle. Moderate wood litter and sparse leaf litter. **Habitat type**: Major creekline with fringing eucalypt.	
CPP 5 **Site location**: 565268 E, 7534258 S Very open *Acacia pruinocarpa* over early regeneration of mixed acacia shrubland over open soft spinifex on firm clay with rocky mantle. Moderate wood litter and sparse leaf litter. **Habitat type:** Acacia woodland.	
CPP 6 **Site location**: 567855 E, 7537466 S Hillslope with very open *A. pruinocarpa* over open layer of mixed acacia shrubland over dense spinifex. Loose loam with pebbles. Sparse wood litter and no leaf litter present. **Habitat type**: Rocky spinifex plain and hills.	

CPP 7 **Site location**: 563146 E, 7540259 S Rocky gully with open eucalypt woodland over dense patches of *A. tumida* and occasional *A. inaequilatera* over dense spinifex on rocky loam with pebbles. No leaf litter or wood litter present. **Habitat type**: Rocky spinifex plain and hills.	
CPP 8 **Site location**: 562101 E, 7542532 S Ridge top with very open acacia shrubland over moderate small clumps of spinifex on rocky loam. Sparse wood litter and sparse leaf litter. **Habitat type**: Rocky ridge and breakaway.	
CPP 9 **Site location**: 570642 E, 7545130 S Gully with scattered *Eucalyptus aspera* over very dense *Acacia tumida* and mixed acacia over moderately dense spinifex on rocky loam. Sparse wood litter and moderate leaf litter. **Habitat type:** Rocky spinifex plain and hills.	

CPP 10 **Site location**: 572177 E, 7544393 S Moderately open eucalypt woodland over open mixed shrubland over moderate spinifex on rocky loam. No wood litter and sparse leaf litter. **Habitat type:** Rocky spinifex plain and hills.	
CPP 11 **Site location**: 574349 E, 7541963 S Rocky ridge with sparse eucalypt trees and open mixed shrubland over dense large clumps of spinifex on very rocky loam with dense rocks. Sparse wood litter and sparse leaf litter. **Habitat type:** Rocky ridge and breakaway.	
CPP 12 **Site location**: 575682 E, 7542109 S Scattered eucalypt trees over scattered mixed shrubland over moderately dense large clumps of spinifex on rocky loam. No wood litter and sparse leaf litter. **Habitat type**: Rocky spinifex plain and hills.	

CPP 13 **Site location**: 568254 E, 7535860 S Moderately open mulga woodland (*Acacia aneura*) over open layer of mixed shrubland over scattered spinifex and low weeds on soft clay with moderate wood litter and sparse leaf litter. **Habitat type**: Acacia woodland.	
CPP 14 **Site location**: 571401 E, 7539125 S Scattered eucalypt trees over mixed shrubland (*Acacia* sp., *Hakea* sp.) over large clumps of dense spinifex on calcrete and hard loam. Adjacent creekline with very dense mixed shrubland. Sparse wood litter and sparse leaf litter. **Habitat type**: Rocky spinifex plain and hills.	
CPP 15 **Site location**: 568614 E, 7529787 S Creek bed with large pools. Open eucalypt woodland over scattered mixed shrubs over grazed moderately dense buffel grass and weeds on soft clay. Sparse wood litter and sparse leaf litter. **Habitat type:** Major creekline with fringing eucalypt/alluvial plain with cracking clays.	

CPP 16 **Site location**: 565787 E, 7528574 S Rocky spinifex hill with open *A. inaequilatera* and *A. aneura* over moderately dense spinifex on rocky loam. Sparse wood litter and sparse leaf litter. **Habitat type**: Rocky spinifex plain and hills.	
CPP 17 **Site location**: 563909 E, 7531259 S Snakewood shrubland withadjacent patch of *Eucalypt victrix* over moderately dense buffel grass and patches of dense snakewood over open spinifex on loamy clay with pebbles. Sparse wood litter and sparse leaf litter. **Habitat type:** Snakewood shrubland.	
CPP 18 **Site location**: 565801 E, 7544725 S Rocky dry creek bed with open *Eucalyptus victrix* over mixed shrubs over fringing spinifex on rocks. Sparse wood litter and sparse leaf litter. **Habitat type:** Major creekline with fringing eucalypt.	

CPP 19 **Site location**: 547300 E, 7543528 S Sparse *Eucalyptus hamersleyana* over open low mixed shrubland over low moderately dense spinifex on rocky loam. No wood litter and sparse leaf litter. **Habitat type:** Rocky spinifex plain and hills.	
CPP 20 **Site location**: 556368 E, 7538748 S Open eucalypt woodland over sparse mixed shrubland over moderate spinifex on rocky loam. Continous rocky mantle. No wood litter and sparse leaf litter. **Habitat type**: Rocky spinifex plain and hills.	
CPP 21 **Site location**: 552990 E, 7540198 S Open eucalypt woodland (*Eucalyptus hamersleyana*) over moderate mixed shrubland over moderately dense spinifex on rocky loam. Sparse wood litter and sparse leaf litter. **Habitat type**: Rocky spinifex plain and hills.	

CPP 22 **Site location**: 553304 E, 7543395 S Scattered eucalypt (*Eucalyptus hamersleyana*) trees over mixed shrubs over moderately dense large clumps of spinifex on rocky loam with sparse wood litter and sparse leaf litter. **Habitat type**: Rocky spinifex plain and hills.	
CPP 23 **Site location**: 570194 E, 7541399 S Mixed open acacia shrubland over dense spinifex with sparse leaf litter and wood litter on rocky loam. **Habitat type:** Rocky spinifex plain and hills.	No Picture Available
CPP 24 **Site location**: 570991 E, 7546895 S Mixed open acacia shrubland over dense spinifex with sparse leaf litter and wood litter on reddish brown sandy clay. **Fauna habitat: R**ocky spinifex plain and hills.	No Picture Available

APPENDIX E FAUNA SPECIES RECORDED DURING TRAPPING

Appendix E1a – Mammals (Coffey Environment Survey 2008)

Family and Species	Common Name	Conservation Status			BD1	BD2	BD3	BD4	BD5	BD6	BD7	BD8	BD9	BD10	BD11	BD12	BD13	BD14	BD15	BD16	BD17	BD18	BD19	BD20
		EPBC	WCA	DEC	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1
DASYURIDAE																								
Dasykaluta rosamondae	Kaluta																			3				
Ningaui timealeyi	Pilbara Ningaui					1		1		3	1				1		2			3	1			1
Planigale sp.					1	1	4	1	3	3	3	1	1	1		1	1	1				1		1
Pseudantechinus woolleyae	Woolley's False Antechinus																							
Sminthopsis longicaudata	Long-tailed Dunnart			P4																				
Sminthopsis macroura	Stripe-faced Dunnart				2				1					2					3		1		1	
MACROPODIDAE																								
Macropus robustus	Euro																							
Macropus rufus	Red Kangaroo																							
MEGADERMATIDAE																								
Macroderma gigas	Ghost Bat			P4																				
HIPPOSIDERIDAE																								
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	S1	VU																				
EMBALLONURIDAE																								
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat																							
Taphozous georgianus	Common Sheathtail Bat																							
Taphozous hilli	Hill's Sheathtail Bat																							
MOLOSSIDAE																								
Chaerephon jobensis	Northern Freetail Bat																							
Mormopterus beccarii	Beccari's Freetail Bat																							
VESPERTILIONIDAE																								
Chalinolobus gouldii	Gould's Wattled Bat																							
Nyctophilus geoffroyi	Lesser Long-eared Bat																							
Scotorepens greyii	Little Broad-nosed Bat																							
Vespadelus finlaysoni	Finlayson's Cave Bat																							
MURIDAE																								
Pseudomys chapmani	Western-pebble Mouse			P4																				
Pseudomys desertor	Desert Mouse				4	4	3	4	3	7	2	1		7			4	4		3		1		4
Pseudomys hermannsburgensis	Sandy Inland Mouse				2	2	5	11	3	6	1	4	6	2	3	3	5	4	8	4	1	6	9	2
Zyzomys argurus	Common Rock Rat						1					1												
INTRODUCED MAMMALS																								
**Mus musculus*	House mouse								1															
**Canis lupus*	Dog/dingo																							
**Felis catus*	Cat																							
**Equus caballus*	Horse																							
**Bos taurus*	Cow																							

A Recorded via bat echolocation call analysis, M Active/inactive pebble mounds recorded

Appendix E1b – Mammals (ecologia Environment Survey 2011)

Family and Species	Conservation Status			CPP 1		CPP 2		CPP 3		CPP 4		CPP 5		CPP 6		CPP 7		CPP 8		CPP 9		CPP 10		CPP 11		CPP 12		CPP 13		CPP 14		CPP 15		CPP 16		CPP 17		CPP 18		19	20	21	22	23	24	Opp	
	EPBC Act	WC Act	DEC	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 1	Ph 2
DASYURIDAE																																													
Dasykaluta rosamondae					5				3	1	6	1			1		1												1	1				1		1				1				2
Ningaui timealeyi				2	1					7								3	8	1		1	3			1	2	1	6	1	4	1		1	2		2		2	1			1		1		
Planigale sp.					2						1							1			1	1								2	1	3				3		3	2	4	1	1		1		
Pseudantechinus woolleyae																																												1	
Sminthopsis longicaudata			P4																																			1					1		
Sminthopsis macroura					1						1		1						4						1				2		1	5		1		1		3		2	2	3		3		
MACROPODIDAE																																												
Macropus robustus															2		1		3																								5	
Macropus rufus														1	2													1															4	
MEGADERMATIDAE																																												
Macroderma gigas			P4																										A		A												A	
HIPPOSIDERIDAE																																			A										
Rhinonicteris aurantia	VU	S1	VU																																										
EMBALLONURIDAE																																												
Saccolaimus flaviventris					A		A		A		A	A			A		A						A		A				A				A					A	A		A	A		A	
Taphozous georgianus					A		A				A	A								A			A						A				A								A		A	A	
Taphozous hilli																							A						A				A										A	
MOLOSSIDAE																																												
Chaerephon jobensis						A	A	A	A		A	A	A		A						A	A		A		A				A		A	A	A		A			A	A		A		A	
Mormopterus beccarii						A								A										A						A		A		A		A						A	
VESPERTILIONIDAE																																												
Chalinolobus gouldii				A	A	A	A	A			A	A	A	A	A				A		A	A		A		A		A		A		A	A	A		A			A	A	A	A	
Nyctophilus geoffroyi				A				A	A			A					A									A		A		A		A										A	
Scotorepens greyii					A		A		A	A	A	A		A					A		A		A			A		A		A		A		A			A		A	A	A	A	A	
Vespadelus finlaysoni				A	A		A	A	A	A	A	A	A	A	A		A				A	A		A		A		A		A		A		A			A	A	A	A	A	A	A	
MURIDAE																																												
Pseudomys chapmani			P4					S																																S		S	
Pseudomys desertor				1	1															1	2												2			2	1		2	4	5	2	3		
Pseudomys hermannsburgensis					5		3	1	1		1		1				1		1			1		1									1		1		1		1	1		2		7		
Zyzomys argurus																			5		1																								
INTRODUCED MAMMALS																																												
**Mus musculus*					1														1			1	1						1		1	1					5		1						
**Canis lupus*															1																												4	
**Felis catus*																									1																		1	
**Equus caballus*																																											2	3
**Bos taurus*																																											4	6

A Recorded via bat echolocation call analysis, M Active/inactive pebble mounds recorded.
S Secondary evidence

Appendix E2a – Birds (Coffey Environment Survey 2008)

Family and Species	Common Name	Conservation Status			EucAcaSpinGrav	EucMxShbSpinGrav	EucMxdShbSand	EucAcaGrasSand	EucWoodSpinSand	EucWoodGrasSand	EucCreekSpinGra
		EPBC Act	WC Act	DEC	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1
CASUARIIDAE											
Dromaius novaehollandiae	Emu							1			
PHASIANIDAE											
Coturnix pectoralis	Stubble Quail										
Coturnix ypsilophora	Brown Quail				2						
ANATIDAE											
Dendrocygna eytoni	Plumed Whistling-Duck										
Chenonetta jubata	Australian Wood Duck										
Anas gracilis	Grey Teal										
Anas superciliosa	Pacific Black Duck					2					
COLUMBIDAE											
Phaps chalcoptera	Common Bronzewing										
Ocyphaps lophotes	Crested Pigeon				2						
Geophaps plumifera	Spinifex Pigeon				6						
Geopelia cuneata	Diamond Dove				2	2				2	
Geopelia striata	Peaceful Dove										
PODARGIDAE											
Podargus strigoides	Tawny Frogmouth										
EUROSTOPODIDAE											
Eurostopodus argus	Spotted Nightjar										
AEGOTHELIDAE											
Aegotheles cristatus	Australian Owlet Nightjar										
APODIDAE											
Apus pacificus	Fork-tailed Swift	M	S3								
ARDEIDAE											
Ardea pacifica	White-necked Heron										
Egretta novaehollandiae	White-faced Heron										
ACCIPITRIDAE											
Elanus axillaris	Black-shouldered Kite							1			1
Haliastur sphenurus	Whistling Kite										
Accipiter fasciatus	Brown Goshawk										
Accipiter cirrocephalus	Collared Sparrowhawk										
Circus assimilis	Spotted Harrier										
Aquila audax	Wedge-tailed Eagle										
FALCONIDAE											
Falco cenchroides	Nankeen Kestrel				1						
Falco berigora	Brown Falcon										
Falcon peregrinus	Peregrine Falcon		S1								
RALLIDAE											
Porzana fluminea	Australian Spotted Crake										
OTIDIDAE											
Ardeotis australis	Australian Bustard			P4							
BURHINIDAE											
Burhinus grallarius	Bush-stone Curlew			P4							
CHARADRIIDAE											
Elseyornis melanops	Black-fronted Dotterel										
Vanellus tricolor	Banded Lapwing										

Family and Species	Common Name	Conservation Status			EucAcaSpinGrav	EucMxShbSpinGrav	EucMxdShbSand	EucAcaGrasSand	EucWoodSpinSand	EucWoodGrasSand	EucCreekSpinGra
		EPBC Act	WC Act	DEC	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1
TURNICIDAE											
Turnix velox	Little Button-quail						2	1			
CACATUIDAE											
Eolophus roseicapillus	Galah										
Cacatua sanguinea	Little Corella										
Nymphicus hollandicus	Cockatiel										
PSITTACIDAE											
Barnardius zonarius	Australian Ringneck						2	3			18
Melopsittacus undulatus	Budgerigar				11	4	6	4			
Neopsephotus bourkii	Bourke's Parrot										
NEOSITTIDAE											
Daphoenositta chrysoptera	Varied Sittella				1			2	2		
CUCULIDAE											
Centropus phasianinus	Pheasant Coucal										
Chalcites basalis	Horsfield's Bronze-cuckoo				4	1	2			1	
Cacomantis pallidus	Pallid Cuckoo				3						2
STRIGIDAE											
Ninox novaeseelandiae	Boobook Owl										
HALCYONIDAE											
Dacelo leachii	Blue-winged Kookaburra					2					
Todiramphus pyrrhopygius	Red-backed Kingfisher										
Todiramphus sanctus	Sacred Kingfisher										
MEROPIDAE											
Merops ornatus	Rainbow Bee-eater	M	S3		5						
CLIMACTERIDAE											
Climacteris melanura	Black-tailed Treecreeper								2		
PTILINORHYNCHIDAE											
Ptilonorhynchus guttatus	Western Bowerbird				1						2
MALURIDAE											
Malurus leucopterus	White-winged Fairy-wren				2						
Malurus lamberti	Variegated Fairy-wren				4	5			7		6
Stipiturus ruficeps	Rufous-crowned Emu-wren										
Amytornis striatus	Striated Grasswren										
ACANTHIZIDAE											
Smicrornis brevirostris	Weebill				16	13	5	4	7	5	7
Gerygone fusca	Western Gerygone					2					
Acanthiza robustirostris	Slaty-backed Thornbill										
Acanthiza uropygialis	Chestnut-rumped Thornbill										
Acanthiza apicalis	Inland Thornbill										
PARDALOTIDAE											
Pardalotus rubricatus	Red-browed Pardalote				1			3	10	5	
Pardalotus striatus	Striated Pardalote				5					2	2
MELIPHAGIDAE											
Certhionyx variegatus	Pied Honeyeater										
Lichenostomus virescens	Singing Honeyeater				18			9		5	
Lichenostomus keartlandi	Grey-headed Honeyeater				22				5	10	9
Lichenostomus penicillatus	White-plumed Honeyeater				2	7					
Manorina flavigula	Yellow-throated Miner				22		8	1	2		3
Acanthagenys rufogularis	Spiny-cheeked Honeyeater					1					

Family and Species	Common Name	Conservation Status			EucAcaSpinGrav	EucMxShbSpinGrav	EucMxdShbSand	EucAcaGrasSand	EucWoodSpinSand	EucWoodGrasSand	EucCreekSpinGra
		EPBC Act	WC Act	DEC	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1
Epthianura tricolor	Crimson Chat										
Sugomel niger	Black Honeyeater										
Lichmera indistincta	Brown Honeyeater				2					1	5
Melithreptus gularis	Black-chinned Honeyeater										
POMATOSTOMIDAE											
Pomatostomus temporalis	Grey-crowned Babbler					2					
CAMPEPHAGIDAE											
Coracina maxima	Ground Cuckoo-shrike										2
Coracina novaehollandiae	Black-faced Cuckoo-shrike				2	2					
Lalage sueurii	White-winged Triller				2			2	3	3	
PACHYCEPHALIDAE											
Pachycephala rufiventris	Rufous Whistler				12	3				4	1
Colluricincla harmonica	Grey Shrike-thrush				7				1		2
Oreoica gutturalis	Crested Bellbird				7			1	2	2	2
ARTAMIDAE											
Artamus personatus	Masked Woodswallow										
Artamus cinereus	Black-faced Woodswallow				13			2	4	3	
Artamus minor	Little Woodswallow										
Cracticus torquatus	Grey Butcherbird				1						
Cracticus nigrogularis	Pied Butcherbird				5	3	5		1		1
Cracticus tibicen	Australian Magpie				2			1			
RHIPIDURIDAE											
Rhipidura leucophrys	Willie Wagtail				3	1				3	3
CORVIDAE											
Corvus orru	Torresian Crow										
Corvus bennetti	Little Crow										
MONARCHIDAE											
Grallina cyanoleuca	Magpie-lark					1					
PETROICIDAE											
Petroica goodenovii	Red-capped Robin										
Melanodryas cucullata	Hooded Robin				2						
ALAUDIDAE											
Mirafra javanica	Horsfield's Bushlark										
MEGALURIDAE											
Cincloramphus mathewsi	Rufous Songlark				12			3			
Cincloramphus cruralis	Brown Songlark										
Eremiornis carteri	Spinifexbird								3	1	4
HIRUNDINIDAE											
Hirundo neoxena	Welcome Swallow										
Petrochelidon ariel	Fairy Martin										
Petrochelidon nigricans	Tree Martin				5						
NECTARINIIDAE											
Dicaeum hirundinaceum	Mistletoebird					2					1
ESTRILDIDAE											
Taeniopygia guttata	Zebra Finch				5	39					
Emblema pictum	Painted Finch					55					

Appendix E2b – Birds (ecologia Environment Survey 2011)

Family and Species	Conservation Status			CPP 1		CPP 2		CPP 3		CPP 4		CPP 5		CPP 6		CPP 7		CPP 8		CPP 9		CPP 10		CPP 11		CPP 12		CPP 13		CPP 14		CPP 15		CPP 16		CPP 17		CPP 18		19	20	21	22	23	24	Opp	
	EPBC Act	WC Act	DEC	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 1	Ph 2
CASUARIIDAE																																											
Dromaius novaehollandiae																																											
PHASIANIDAE																																											
Coturnix pectoralis																																2		1									
Coturnix ypsilophora					5																1	1										1				1	2						1	
ANATIDAE																																											
Dendrocygna eytoni																														2													
Chenonetta jubata																													2													2	
Anas gracilis																																	2									2	
Anas superciliosa																													1				2										
COLUMBIDAE																																											
Phaps chalcoptera																					2				1			1	3												1		4	1
Ocyphaps lophotes				2	6	1						2	2		10	1				2	2	1	2			1		1	6	2		4	6	3	6	4	6	1		9	1			4	3	18	1
Geophaps plumifera																									3				2			2										1		13	4
Geopelia cuneata				30	50	8	29	14	6	16	10	12	13	20	14	19	3	1	1	15	4	119	5	24	4	30	2	11	6	12	4	23	5	32	3	9		9	6	22	8	10	14	2	6	107	6
Geopelia striata																						3	3		1					20	5			3			1						1	4	
PODARGIDAE																																											
Podargus strigoides																																			1								1	
EUROSTOPODIDAE																																											
Eurostopodus argus																																										8	
AEGOTHELIDAE																																											
Aegotheles cristatus																																										6	3
APODIDAE																																											
Apus pacificus	M		S3			50															205				25																		
ARDEIDAE																																											
Ardea pacifica																																										5	
Egretta novaehollandiae																													5														
ACCIPITRIDAE																																											
Elanus axillaris																					2																						1	
Haliastur sphenurus													1								1									3	9	5	1	1								1	1
Accipiter fasciatus																																											1
Accipiter cirrocephalus																												1						4	3								
Circus assimilis												1																		1												1	
Aquila audax																																	1									10	1
FALCONIDAE																														3	1				1									1
Falco cenchroides									1	1			1						1		3		2			1				3					1						4	2
Falco berigora				5																																							
Falcon peregrinus		S1																											1														
RALLIDAE																																											
Porzana fluminea																													1														
OTIDIDAE																																											
Ardeotis australis			P4																											3													3
BURHINIDAE																																											
Burhinus grallarius			P4																																								8	
CHARADRIIDAE																																											
Elseyornis melanops																														2	1	3											
Vanellus tricolor																														4													
TURNICIDAE																																											
Turnix velox				8		6	1	3									2					1		1					1		18		4	4	1		6		2	2				3	1
CACATUIDAE																																											
Eolophus roseicapillus						2				2					6												2	3	3	3	2	3		2	8	2					2	6		6	2

Family and Species	Conservation Status			CPP 1		CPP 2		CPP 3		CPP 4		CPP 5		CPP 6		CPP 7		CPP 8		CPP 9		CPP 10		CPP 11		CPP 12		CPP 13		CPP 14		CPP 15		CPP 16		CPP 17		CPP 18		19	20	21	22	23	24	Opp	
	EPBC Act	WC Act	DEC	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 1	Ph 2
Cacatua sanguinea																	5						4							8	2	4	6	300	1		2							1	32	1
Nymphicus hollandicus				4				8							2		4			4									5	2	2	34	6	4	6	5			2							
PSITTACIDAE																																														
Barnardius zonarius						8						4		12		1				1	3	3	3	4	1	2	5		5	2		2	2		1	9	3		4		2			3	2	16	1
Melopsittacus undulatus				39	33	4	75	26	60	6	47	111	66	2	50	37		5	7	106	5	25	6	19	2	6	6	6	3	116	5	321	6	10	6	16	3	48	4	125		70	21	2	3	182	12
Neopsephotus bourkii																																												4	
NEOSITTIDAE																																													
Daphoenositta chrysoptera																																								13					
CUCULIDAE																																													
Centropus phasianinus																													1													1			
Chalcites basalis				3		2	1			1	2	2		3				1		1		1	1							3						1		1		2					2		
Cacomantis pallidus				1		6	1	2		2		4		3	1			3	1	2		3		3		3		8			3	1		2				1			2	2			8	1
STRIGIDAE																																													
Ninox novaeseelandiae																																												5	
HALCYONIDAE																																													
Dacelo leachii																				3		5	4							10		1				1							2	1	3	
Todiramphus pyrrhopygius				4	4	9	4	3			3	4	7	5	4	2	3	1	3		1	2	2		1	3	2	1	5	10	2	1		2	4	2		2	5	7	2	2	3	2	1	3	3
Todiramphus sanctus																						8	1		1	1				8						6									1	1
MEROPIDAE																																													
Merops ornatus	M	S3																					2		1					2	1							1	1				1	1	10	1
CLIMACTERIDAE																																													
Climacteris melanura									2		4																													8			16	
PTILINORHYNCHIDAE																																													
Ptilonorhynchus guttatus							2						1		2							2	1	5		7	2		1	1				1								1	6	11	8
MALURIDAE																																													
Malurus leucopterus						2					3	9	13																		1		2	1										15	
Malurus lamberti					2					1		2	5					6		2	4	12	3		1		1		3	12	4				1	6			2		5	6	13	3	3	13	7
Stipiturus ruficeps																																												2	4	
Amytornis striatus																		27	1																										9	
ACANTHIZIDAE																																													
Smicrornis brevirostris				7	23		12	8	8	1	20	3	6	5	11	7	24	2	5	9	5	9	5	7		15	6		2	1	5	6	2	2	4	16	6	5	6	18	8	7	15	6	6	40	13
Gerygone fusca																													3	1					6	1	6								1	
Acanthiza robustirostris																																													
Acanthiza uropygialis																													5						3		3								6	
Acanthiza apicalis																																				1										
PARDALOTIDAE																																													
Pardalotus rubricatus				5	9	6	15	5	2		2			1	3	6	5					6	5	6	3	4	2			1		8	2					9	6	10	2	7	4		5	9	5
Pardalotus striatus					2	2	4		7		6		1	5	6	7	6	1	1	3			1	1	1	6	4				5				3		2	3	3	1	1	2	4		2	27	6
MELIPHAGIDAE																																													
Certhionyx variegatus																																													
Lichenostomus virescens				8	9	15	11	14	4		1	18	9				1		2	2	1	17	2		2			3	1		3			8	6	1	2	12	5	3		12	14	3	5	28	3
Lichenostomus keartlandi					1	7	29	5	26	5	69	1		14	19	17	65	13	7	29	5	3	7	20	6	23	6					7						6	2	24	9		13	4	5	42	17
Lichenostomus penicillatus																				8		13	4		2					49	6	3	3	5										10	1
Manorina flavigula				6	15			3	9					5	20	3	9			2	4		4	5	2	27	6	4	2		1	19	6	2	2	6	2		3	2		3	1	6	4	36	13
Acanthagenys rufogularis												2																4	2						6		1									
Epthianura tricolor									4		38		2																				4									1		4	1
Sugomel niger															1																											3				1
Lichmera indistincta				10	14	1	7	1	3	14	23	1		1	2	3	6			1	2	5	7			14	2	4		5	2			3	1			10	5				25	4	1	14	3
Melithreptus gularis						2	6	2	4		5			1			6						1			2				2																
POMATOSTOMIDAE																																													
Pomatostomus temporalis				2								13	10		7					8	1	5	2				1	2	4	13			3	2	5	16	3						2		3	1
CAMPEPHAGIDAE																																													
Coracina maxima																													1												8			3	

Family and Species	Conservation Status			CPP 1		CPP 2		CPP 3		CPP 4		CPP 5		CPP 6		CPP 7		CPP 8		CPP 9		CPP 10		CPP 11		CPP 12		CPP 13		CPP 14		CPP 15		CPP 16		CPP 17		CPP 18		19	20	21	22	23	24	Opp	
	EPBC Act	WC Act	DEC	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 1	Ph 2
Coracina novaehollandiae						4	2	2	2	3	5	2	1	2	5				1	1	2	5	4	1	3	7	3	1	4	10	5	8	2		1	10	2	1	2	2	1		1	3	6	13	9
Lalage sueurii				12	3	34	4	16	3	1	4	22	1	22	3	11	1			4		25	3		2	2		3		8		10		7		2		2		2			1		2	43	3
PACHYCEPHALIDAE																																														
Pachycephala rufiventris				6	5	2	1	9	3	1	2			5	4	7	1			2	2	9	5	5	3	1	2	3	5	6	6			3	6	18	6	6	3	6		4	5	1	3	11	5
Colluricincla harmonica				3	1	1	3	6	2	8	3	1		5	2	2	7	6	4		1	3	4	9	4	8	4		1	15	3			1	1			3	5	2	3	4	1	1		18	8
Oreoica gutturalis					1	11	7	13	6	11	1	4	2	1	4	7	5	1	3	3		4			2	7	3	6	2					3	5	3	2	1	1	8	3	5	6	3	1	14	1
ARTAMIDAE																																														
Artamus personatus																																														
Artamus cinereus					3	16	3	13	3		11	22	5		5	9	7			6		4	3		1			2		3	8	1	16				5	1	2	10		12			26	6
Artamus minor																		8	1					7	3	1					1	4												30	7
Cracticus torquatus													1														4																		1	
Cracticus nigrogularis				10	1	11	3	8	3	2	1	5	2	3	1	3	3	10	9			13			1	5	3	13	6	1		4	1		3	9	4	1	3	9		3	3	3	3	22	3
Cracticus tibicen				5		3		2				5								6								5	1			7	1			12	1	1		1			2	1	3	1
RHIPIDURIDAE																																														
Rhipidura leucophrys					3	3	1	3	5			4		8	4	4	4		1		3		2			2			5	1	1	2	5	5	6	3	5		2			7	5	1	4	29	10
CORVIDAE																																														
Corvus orru					1			3		3	5	1		2		2	1			6		6					2	2		4	1	4	3		3	3	6		4			2	4	4	15	3
Corvus bennetti																																													1		
MONARCHIDAE																																														
Grallina cyanoleuca													2		2								1		1			6		7	1	35	5			20	5								8	1
PETROICIDAE																																														
Petroica goodenovii																													1							3										
Melanodryas cucullata						4	4	8	7	2	3			4						1	1					1	2	1		1						1	4						2	5	3
ALAUDIDAE																																														
Mirafra javanica				1													2														3		5													
MEGALURIDAE																																														
Cincloramphus mathewsi				50	5	53	7	26	8	13	3	2		4	9	11	9			3	1	60	4		2		3	19		23	4	29	3	48	1	5		21	3	10	2		5	1	3	47	3
Cincloramphus cruralis																																20		6												
Eremiornis carteri				1	1	5	8		4	8	6		7		10	1	5	2		3	6	10	4	10	4	7	4		2	5	3				5			6	2	7	12	9	16	3	2	21	9
HIRUNDINIDAE																																														
Hirundo neoxena																																														1
Petrochelidon ariel																						17								2				6											13	
Petrochelidon nigricans																							3							25	3	9	5	1											1	
NECTARINIIDAE																																														
Dicaeum hirundinaceum																					1		1				3		1	1	1					2			1				2	2	2
ESTRILDIDAE																																														
Taeniopygia guttata				72	3	2	2	4	20	4	5	4	6		9	66	4	16				29	4		1	6		13	4	5	6	14	6	74	6	16		22	3	16		3	2	2	5	41	11
Emblema pictum													2		2			1				3	2	7	1								2					1						1	15	6

Appendix E3a – Reptiles (Coffey Environment Survey 2008)

Family and Species	Common Name	Conservation Status			BD1	BD2	BD3	BD4	BD5	BD6	BD7	BD8	BD9	BD10	BD11	BD12	BD13	BD14	BD15	BD16	BD17	BD18	BD19	BD20
		EPBC Act	WC Act	DEC	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1
DIPLODACTYLIDAE																								
Crenadactylus ocellatus																								
Diplodactylus conspicillatus	Fat-tailed Gecko																				2	1		
Diplodactylus savagei																								
Lucasium stenodactylum	Sand-plain Gecko																							
Lucasium wombeyi							1											1				1		
Rhynchoedura ornata	Beaked Gecko																							
Strophurus elderi	Jewelled Gecko																							
Strophurus strophurus																				1				
Strophurus wellingtonae	Western Spiny-tailed Gecko								3				1									1	1	
GEKKONIDAE																								
Gehyra pilbara										1														
Gehyra punctata																								
Gehyra variegata																								
Heteronotia binoei	Bynoe's Gecko				2	5		1	4	2		1		5	1	4	3	3	1	3	1	1	1	5
Heteronotia spelea	Desert Cave Gecko																							
Oedura marmorata	Marbled Velvet Gecko																							
CARPHODACTYLIDAE																								
Nephrurus wheeleri	Banded Knob-tailed Gecko												1											
Underwoodisaurus seorsus	Barking Gecko																							
PYGOPODIDAE																								
Delma butleri																								
Delma elegans																								
Delma nasuta																						1		
Delma pax																							1	
Delma tincta													1											
Lialis burtonis	Burton's Snake-lizard												2										2	
Pygopus nigriceps	Western Hooded Scaly-foot								1															
SCINCIDAE																								
Carlia munda					3			1	2		1		3	3	3			3	1	2			4	
Carlia triacantha							1		3	1	3	2	3	4	3	7	3	2	4	5	1			
Cryptoblepharus buchananii																								
Cryptoblepharus ustulatus	Russet Snake-eyed Skink																							
Ctenotus duricola					5	8	6		1	6	3	7	1	2	1		2	1		2	1		4	8
Ctenotus grandis					1									3		1	3	1	3	1	1	1	2	
Ctenotus helenae					4			1		1			2	3	5	1	3	2	3	2	1	1		
Ctenotus leonhardii					1			1			1	1		2					2	1	1		1	
Ctenotus pantherinus	Leopard Ctenotus				1	2	3		1			6		1			2	2		6	5	2	2	2
Ctenotus robustus	Eastern Striped Skink																							
Ctenotus rubicundus																								
Ctenotus rutilans																								
Ctenotus saxatilis	Rock Ctenotus						1													1				
Ctenotus schomburgkii																								
Ctenotus serventyi																1								
Cyclodomorphus melanops	Spinifex Slender Blue-tongue				1											1				1				
Egernia formosa																								

Family and Species	Common Name	Conservation Status			BD1	BD2	BD3	BD4	BD5	BD6	BD7	BD8	BD9	BD10	BD11	BD12	BD13	BD14	BD15	BD16	BD17	BD18	BD19	BD20
		EPBC Act	WC Act	DEC	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1	Ph 1
Eremiascincus fasciolatus	Narrow-banded Sand-swimmer																							
Eremiascincus richardsonii	Broad-banded Sand-swimmer																							
Lerista jacksoni																								
Lerista muelleri						2			1			2			1									2
Lerista zietzi																								
Menetia greyii						2				3		1		1										2
Menetia surda																								
Morethia ruficauda exquisita																								
Notoscincus butleri				P4			1	4	3															
Tiliqua multifasciata	Centralian Blue-tongue																			1				
AGAMIDAE																								
Amphibolurus longirostris	Long-nosed Dragon								1															
Caimanops amphiboluroides	Mulga Dragon																							
Ctenophorus caudicinctus	Ring-tailed Dragon						1				1	1	1											
Ctenophorus isolepis	Central Military Dragon					1	1						1				2	1			1	3		1
Diporiphora valens														1										
Pogona minor	Dwarf Bearded Dragon														1	1					1			
Tympanocryptis cephala	Pebble Dragon																							
VARANIDAE																								
Varanus acanthurus	Spiny-tailed Monitor							1		1		1												
Varanus brevicauda	Short-tailed Pygmy Monitor				1	2			1	1			5	6	1	2	2	3	1	3	1		2	2
Varanus bushi	Pilbara Monitor																							
Varanus eremius	Pygmy Desert Monitor				1	2	1	1	2	1	1				4			1	2			2	3	2
Varanus panoptes	Yellow-spotted Monitor																							
Varanus pilbarensis	Pilbara Rock Monitor																							
Varanus tristis	Black-headed Monitor																							
TYPHLOPIDAE																								
Ramphotyphlops ammodytes																								
Ramphotyphlops grypus	Beaked Blind Snake				1								2	1										
Ramphotyphlops pilbarensis																								
Ramphotyphlops ganei																								
PYTHONIDAE																								
Antaresia perthensis	Pygmy Python				1			1																
Antaresia stimsoni	Stimson's Python																							
Aspidites melanocephalus	Black-headed Python																							
Liasis olivaceus barroni	Pilbara Olive Python	VU	S1	VU																				
ELAPIDAE																								
Acanthophis wellsi	Death Adder																							
Brachyurophis approximans	NW Shovel-nosed Snake																		1					
Demansia psammophis cupreiceps	Yellow-faced Whipsnake																							
Demansia rufescens	Rufous Whipsnake																							
Furina ornata	Moon Snake																							
Parasuta monachus	Monk Snake														1									
Pseudechis australis	Mulga Snake																							
Pseudonaja mengdeni	Gwardar					1																		1
Pseudonaja modesta	Ringed Brown Snake																			1				
Suta fasciata	Rosen's Snake																							
Vermicella snelli	Pilbara Bandy Bandy																							

Appendix E3b – Reptiles (ecologia Environment Survey 2011)

Family and Species	Conservation Status			CPP 1		CPP 2		CPP 3		CPP 4		CPP 5		CPP 6		CPP 7		CPP 8		CPP 9		CPP 10		CPP 11		CPP 12		CPP 13		CPP 14		CPP 15		CPP 16		CPP 17		CPP 18		19	20	21	22	23	24	Opp	
	EPBC Act	WC Act	DEC	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 1	Ph 2
DIPLODACTYLIDAE																																												
Crenadactylus ocellatus													1						1																										
Diplodactylus conspicillatus				1		5				1		1										2		1	1		1	9	1	3				3				1				4			
Diplodactylus savagei																		1						2	1	2									1									
Lucasium stenodactylum						1		1				9	1										1					1				2								1	1			
Lucasium wombeyi																										2		2					2											
Rhynchoedura ornata												3																2	1															
Strophurus elderi														1																														
Strophurus strophurus																																												
Strophurus wellingtonae					3	1	2	2										1	2							1	4			1													1	
GEKKONIDAE																																												
Gehyra pilbara								1		2			1								2					12																2		2	
Gehyra punctata								3										6	1			2		2		42																14	
Gehyra variegata					1	1		1														1			2		1	4	4			1	1		4	8	7	1				1			1	
Heteronotia binoei				5				1	1	5	2	1		3	1	1	1		2	2	2	2	6	6		5	7			23	3			3	3			8	2		2		1		3		
Heteronotia spelea																		1						1																			4	
Oedura marmorata																										3																	13	
CARPHODACTYLIDAE																																												
Nephrurus wheeleri																																	1				2			2		2	1	
Underwoodisaurus seorsus																		1	2																									
PYGOPODIDAE																																												
Delma butleri				1																																								
Delma elegans																						1																							
Delma nasuta														1	2	1	2		1			1	3			1		1			2											2			
Delma pax				1				1						1								1		1		1				2							1							
Delma tincta					1									1			1		1	3		1		1	1					1	1		1	1	1					1		1		
Lialis burtonis					2																	1		1	1	1			1		2					1								
Pygopus nigriceps								1		1		4																	1	1				2			1							
SCINCIDAE																																												
Carlia munda				8	2	3			1	7	6	3				2				15	19	26	9	6	3	2	3	8	3	9	5	1	4	14	3	1	2	13	3	1	1	1	2		5	1	
Carlia triacantha				1	1					5																		1							2		2					1				
Cryptoblepharus buchananii																														1														
Cryptoblepharus ustulatus																		5				1		1		2																		20	23
Ctenotus duricola							1	1		1					2	2					2				4	3	1										2		5	3			2			
Ctenotus grandis				3	4	6				6									1			5	1			1		1		2	3				1		6	5					4		
Ctenotus helenae				14	6	5	6	2	7	38	9	19	10	9	1		1			15	30	6	11	3	1	19	13	11	9	7	7	3		27	10	1	3	16	8	7	16	10	11	15	12	2	
Ctenotus leonhardii					1		1		6				6																																
Ctenotus pantherinus				9	3	8				13	12	8		5	22		3			2	7	3		1	3		3		6				8	13			7	1	8	3	11	5	23	12		1
Ctenotus robustus												10									1							5	1	1		19	6	9											
Ctenotus rubicundus																		3						1													1								
Ctenotus rutilans																		4	1																								2			1
Ctenotus saxatilis				14	3	17	1	11		19		5	1	3	1	12	2	28	8	16	12	5	6	47	18	5	13	9	1	3	7	2		4	1			7	2	4	1		1	3	4	3	2
Ctenotus schomburgkii																					2								1																
Ctenotus serventyi							4						1				1		2																				3	2		2				
Cyclodomorphus melanops				1	1		2			4	5	1	2	1					1			2	1	2	1	1		1			1	1		6	1			1							
Egernia formosa																		2				1				1																	2	

Family and Species	Conservation Status			CPP 1		CPP 2		CPP 3		CPP 4		CPP 5		CPP 6		CPP 7		CPP 8		CPP 9		CPP 10		CPP 11		CPP 12		CPP 13		CPP 14		CPP 15		CPP 16		CPP 17		CPP 18		19	20	21	22	23	24	Opp	
	EPBC Act	WC Act	DEC	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2								
Eremiascincus fasciolatus																																3											6	
Eremiascincus richardsonii																																	6											
Lerista jacksoni																2						1										1						1						
Lerista muelleri								1								1		1			3														1	1								
Lerista zietzi																							1	1	1																		3	
Menetia greyii										2		1		1				1				1		3		1		1				1	3	3		4								
Menetia surda																						1																						
Morethia ruficauda exquisita																5	5	2	1		1	1		7	4																	5	
Notoscincus butleri			P4																									1	2											2				
Tiliqua multifasciata				3		2				4		1		1						2		4	1			1		2		6				5					2				2	
AGAMIDAE																																												
Amphibolurus longirostris				1	1	1	2			2										7		2		1	2					1				2	1			23	1				3		
Caimanops amphiboluroides																																												
Ctenophorus caudicinctus				1	1	1	5	2	2	2		3	19	1	20		6	1			8		2	1	3	3	8			3				1	1	1			3	4			2	4		42
Ctenophorus isolepis					1	2	2					5									1		1							1															2
Diporiphora valens							1		1				3																												1				1
Pogona minor						3		2			3	3	3				2												1									6			3	1		
Tympanocryptis cephala																																			3									
VARANIDAE																																												
Varanus acanthurus									2			1		7	3	2	2		2					3	2	1			5	3	3			2	1				2	1	2	1		4	1	
Varanus brevicauda				2				2														1	1					1					1					1					1		
Varanus bushi						1						1				1														1						1		2			1	1		1	
Varanus eremius				1					1			3	1																2	1			1									1		
Varanus panoptes				4					1																					2		1										1	
Varanus pilbarensis																																											1	
Varanus tristis									4																															1	1		2	
TYPHLOPIDAE																																												
Ramphotyphlops ammodytes																						1																						
Ramphotyphlops grypus										1																				1						1							
Ramphotyphlops pilbarensis													1															2													1		
Ramphotyphlops ganei																												1															
PYTHONIDAE																																												
Antaresia perthensis				1											1			2								1																	1	
Antaresia stimsoni				1		1																1				3		2				1				2						7	2
Aspidites melanocephalus																																											1	
Liasis olivaceus barroni	VU	S1	VU																																								1	
ELAPIDAE																																												
Acanthophis wellsi											1																																	
Brachyurophis approximans						2				1				1		1		1		1		1		1		2				1						2						1		
Demansia psammophis cupreiceps								1	1	2	2				2	1				1	1					3				1		1	1			1	1		2	3			1		2		1
Demansia rufescens																			1							1																	1		
Furina ornata															1																												1		
Parasuta monachus										2				3								1						1				1	1											1
Pseudechis australis				1		1				1		3								1						3		1	2			2		1		1	1			1			1	3	1
Pseudonaja mengdeni						3						1		1					1				1						1			1											1	
Pseudonaja modesta												2																																
Suta fasciata				1										1																							1							

Family and Species	Conservation Status			CPP 1		CPP 2		CPP 3		CPP 4		CPP 5		CPP 6		CPP 7		CPP 8		CPP 9		CPP 10		CPP 11		CPP 12		CPP 13		CPP 14		CPP 15		CPP 16		CPP 17		CPP 18		19	20	21	22	23	24	Opp	
	EPBC Act	WC Act	DEC	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 1	Ph 2
Vermicella snelli																													1															

Appendix E3a – Amphibians (ecologia Environment Survey 2011)*

Family and Species	Common Name	CPP 1		CPP 2		CPP 3		CPP 4		CPP 5		CPP 6		CPP 7		CPP 8		CPP 9		CPP 10		CPP 11		CPP 12		CPP 13		CPP 14		CPP 15		CPP 16		CPP 17		CPP 18		19	20	21	22	23	24	Opp	
		Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 2	Ph 1	Ph 2
HYLIDAE																																												
Cyclorana maini	Main's Frog	119		19		4		2		72		1		1		2		2		19		2		10		237		275		216		365		47		2								1	
Litoria rubella	Little Red Tree Frog															4																		7										1	
MYOBATRACHIDAE																																												
Pseudophryne douglasi	Gorge Toadlet													2																															
Uperoleia russelli	Northwest Toadlet																			1								1																	

* No amphibians were recorded during the Coffey Environment survey