Eastern Ridge Revised Proposal
Vertebrate Fauna Environmental Impact Assessment
November 2015

Prepared for
BHP Billiton Iron Ore Pty Ltd

astron

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Approval

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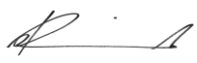
			Name	**Signature**
A	21/05/2015	C. Pengelly	S. Pearse	
B	15/07/2015	C. Pengelly	R. Archibald	
C	18/11/2015	C. Pengelly	S. Pearse	
0	19/11/2015	C. Pengelly	S. Pearse	

Abbreviations

Abbreviation	Definition
Assessment Areas	The following operational areas that are not already approved under existing Ministerial Statements (Figure 1): • potential impacts from Orebody 24 modifications (extension to maximum disturbance boundary (MDB) primarily for OSAs and roads) • potential impacts from Orebody 32 modifications (extension to MDB) • potential impacts from Orebody 25 West mining operations • potential impacts (where applicable) from below water table (BWT) mining at Orebody 24.
BHP Billiton Iron Ore	BHP Billiton Iron Ore Pty Ltd
BoM	Bureau of Meteorology
BWT	Below water table
DoE	Department of the Environment (Commonwealth)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Commonwealth) (now DoE)
Eastern Ridge Development Envelope	Amalgamation of existing Ministerial Statements to manage the Eastern Ridge mining operations and revised Proposal into one new Ministerial Statement (Figure 1).
EIA	Environmental Impact Assessment
EPA	Environmental Protection Authority (State)
EP Act	*Environmental Protection Act 1986* (State)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ha	Hectares
km	Kilometres
m	Metres
MDB	Maximum Disturbance Boundary
mm	Millimetre
MNES	Matters of National Environmental Significance (under the EPBC Act)
MS	Ministerial Statement
OSA	Overburden Storage Area
Parks and Wildlife	Department of Parks and Wildlife (State)
The Proposal	The Eastern Ridge Development Envelope proposal to be submitted under Part IV of the EP Act; includes the four Assessment Areas described above
WC Act	*Wildlife Conservation Act 1950* (State)

Executive Summary

BHP Billiton Iron Ore Pty Ltd is proposing to amalgamate existing Ministerial Statements at Orebody 24, Orebody 25 and Orebody 32 East to manage the Eastern Ridge mining operations with one new Ministerial Statement, the 'Eastern Ridge Revised Proposal (the Proposal)' and manage the area with a single Development Envelope ('Eastern Ridge Development Envelope'). Astron was engaged to undertake an environmental impact assessment of potential impacts to fauna and fauna habitats within the Proposal area, within a local and regional context. This Environmental Impact Assessment addresses the operational areas (known as 'Assessment Areas') that are not already approved under existing Ministerial Statements including:

- potential impacts from Orebody 24 modifications (extension to maximum disturbance boundary);
- potential impacts from Orebody 32 modifications (extension to maximum disturbance boundary);
- potential impacts from the new Orebody 25 West mining operations; and
- potential impacts (where applicable) from below water table mining at Orebody 24.

To date, 11 surveys have been conducted over parts of the Development Envelope; four Level 2 terrestrial fauna surveys, three Level 1 terrestrial fauna surveys and four Level 1 and targeted fauna surveys. In addition, four surveys; one Level 2, two Level 1 and one Level 1 and targeted fauna surveys, have been conducted within the vicinity of the Development Envelope. These surveys provide detailed information on the fauna assemblages of the Proposal area and the wider region. Astron considers that more than adequate information is available from the previous surveys to assess the risk of development on terrestrial vertebrate fauna.

Fauna habitats and their importance to fauna recorded within the Eastern Ridge Development Envelope include: Gorge/Gully (high), Hill Crest/Slope (moderate), Stony Plain (low), Sand Plain (high), Mulga (moderate), Drainage Area (moderate), Major Drainage Line (high) and Minor Drainage Line (high). Some areas were cleared or disturbed and of no habitat value. The fauna habitats of high importance; Gorge/Gully, Major Drainage Line, Minor Drainage Line and Sand Plain were only present as small areas within the total area for all four Assessment Areas; 0.1%, 1%, 5% and 7% respectively. Most fauna habitat types present were also considered to be widely represented and common throughout the Pilbara region. It is considered that the impact of clearing associated with the modifications is unlikely to be significant, particularly when considered in the context of the already approved areas. The fauna habitats represented within the Proposal area are typical of the Pilbara region and therefore do not have high ecosystem functional value.

A review of fauna databases and previous fauna surveys conducted within the Eastern Ridge Development Envelope suggest that there are unlikely to be any characteristics of the amphibian, reptile, bird and mammal assemblages that are of particular significance for the region. A total of 322 terrestrial vertebrate fauna species, comprising eight amphibian species, 94 reptile species, 172 bird species and 48 mammal species (including 12 introduced) have been previously recorded within the vicinity of the Proposal area. This included 23 conservation significant species, five of which have been previously recorded and assessed within the Eastern Ridge Development Envelope; the Ghost Bat, Western Pebble-mound Mouse, Peregrine Falcon, Rainbow Bee-eater and Pilbara Olive Python. Only two species, the Pilbara Olive Python and Rainbow Bee-eater, occur within the three Assessment Areas that have not previously been assessed (excluding the Orebody 24 Approved Maximum Disturbance Boundary (MDB)). The clearing of vegetation is likely to result in the loss of some terrestrial vertebrate species that are not highly mobile nor have the ability to move away

from disturbance, however, is unlikely to be significant at a local or regional level should the Proposal proceed.

Seven Pilbara Olive Python records exist within the Development Envelope, five of which were within the Orebody 24 MDB Extension Assessment Area. This local Pilbara Olive Python population may be considered an 'important population' as defined by the Department of the Environment (2013) as it is at the southern extent of its geographic range; however, this is not confirmed. Regionally, populations are considered stable and sizeable and the species may be more common than previously indicated, with suitable habitat likely to be widespread throughout the Pilbara region. Individuals may be impacted depending on direct impact areas from the Proposal and whether individuals would move out of the proposed impact areas to similar habitat that extends north of the Orebody 24 MDB Extension Assessment Area. Loss of suitable habitat and potentially individuals, may lead to a local reduction in the area of occupancy for the Pilbara Olive Python, and possibly a decrease in the size of a population if deemed to be an 'important population' under the Department of the Environment guidelines.

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1 Introduction

1.1 Proposal Overview

BHP Billiton Iron Ore Pty Ltd is proposing to amalgamate existing Ministerial Statements at Orebody 24, Orebody 25 and Orebody 32 East to manage the Eastern Ridge mining operations with one new Ministerial Statement, the 'Eastern Ridge Revised Proposal (the Proposal)' and manage the area with a single Development Envelope (the 'Eastern Ridge Development Envelope'; Figure 1). As part of this approvals process, an Environmental Impact Assessment (EIA) is required to assess the potential impacts of additional disturbance and changes to mining operations that will also be assessed as a revised Proposal with a single Development Envelope.

At Eastern Ridge mining operations, iron ore is mined using conventional open pit methods and crushed at the Orebody 24 and 25 crushers. Crushed ore is then railed to the Newman hub or directly to Port, based on business requirements. The Eastern Ridge mining operation is located on Mineral Lease 244SA and is approximately three kilometres (km) northeast of Newman. Eastern Ridge is comprised of existing mining operations at Orebody 24, 25 and 32 East (currently under referral) and Orebody 25 West (new mining operations).

1.2 Scope of Works

Astron was engaged by BHP Billiton Iron Ore to complete a Vertebrate Fauna EIA as part of the environmental approvals process for the Eastern Ridge revised Proposal to be managed under a single development envelope (Eastern Ridge Development Envelope; Figure 1).

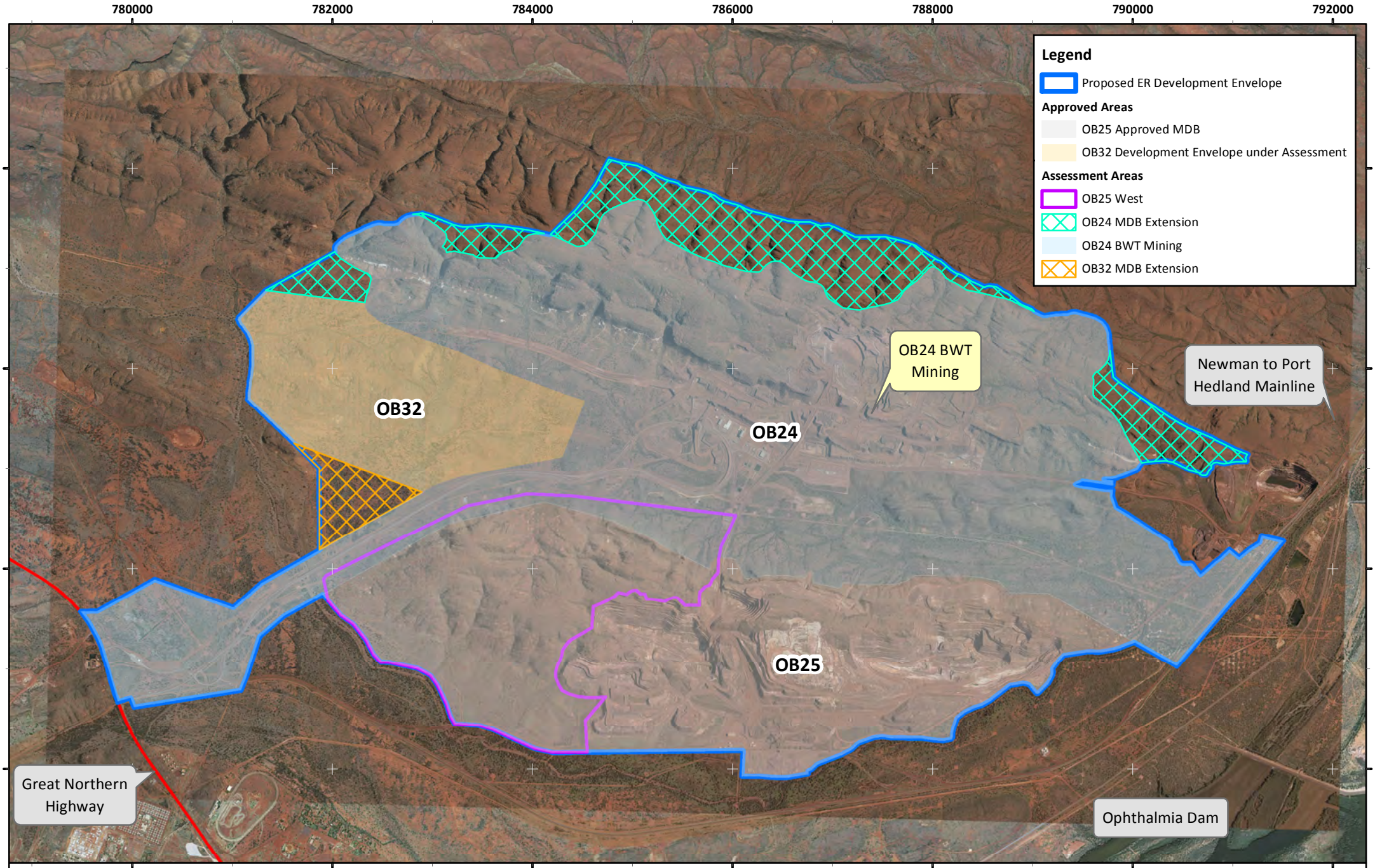
A number of extensions to disturbance areas, pit areas and access to below water table ore for these existing approvals will be referred through this approvals process. It will include seeking approval for new mining operations at Orebody 25 West and associated infrastructure, including the establishment of ancillary infrastructure, haul roads and roads, stockpiles and overburden storage areas (OSAs) and rehabilitation requirements.

In this EIA, Astron provide an assessment of the potential impacts to vertebrate fauna resulting from the revised Proposal. Baseline surveys have previously been undertaken in the Eastern Ridge Development Envelope and surrounds. This assessment identifies potential and credible vertebrate fauna impacts, potential receptors, potential impact pathways and the potential magnitude of the impacts.

The EIA addresses the operational areas (known as "Assessment Areas") that are not already approved under existing Ministerial Statements (Figure 1) including:

- potential impacts from Orebody 24 modifications (extension to maximum disturbance boundary (MDB) primarily for OSAs and roads);
- potential impacts from Orebody 32 modifications (extension to MDB);
- potential impacts from Orebody 25 West mining operations; and
- potential impacts (where applicable) from below water table (BWT) mining at Orebody 24; disturbance is already approved at Orebody 24 and the assessment is only on any potential change as a result of groundwater drawdown.

An assessment of the cumulative potential impacts for the above four modifications in the context of the already approved disturbance areas is also provided.



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Eastern Ridge Revised Proposal - Vertebrate Fauna Environmental Impact Assessment

Figure 1: Proposed Eastern Ridge Development Envelope

Datum: GDA 1994 - Projection: MGA Zone 50 - Scale: 1:48,000 (A4)

0 1 2 3 Km

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Author: J. Oates | Drawn: W. An | Date: 19-11-2015 | Figure Ref: 2454-15-BIDR-1Rev0_151119_Fig01

1.3 Previous Technical Studies

BHP Billiton Iron Ore has commissioned a number of terrestrial fauna surveys over both the Assessment Areas and surrounding tenements. Survey reports within the vicinity of, and overlapping with, the Eastern Ridge Development Envelope are shown in Figure 2 and Table 1 and 2.

Table 1: Summary of previous surveys that overlap the Eastern Ridge Development Envelope.

Report title	Author	Year of survey	Content	Assessment Areas			
				Orebody 24 MDB extension	Orebody 24 BWT mining	Orebody 32 MDB extension	Orebody 25 West
Orebody 25 Targeted Vertebrate Fauna Survey	Biologic	2013	Level 1 fauna and targeted assessment of a 13 km^2 area adjacent to Orebody 25, located ~3 km north east of Newman		✓	✓	✓
OB 24 Targeted Vertebrate Fauna Survey	Biologic	2013	Level 1 fauna and targeted assessment of a 46 km^2 area, located ~8 km east of Newman	✓	✓		
OB 37 Level 1 Vertebrate Fauna Assessment	Eco Logical	2012	Level 1 fauna survey of a 29 km^2 area, located south of the Eastern Ridge area		✓		
Eastern Ridge (OB 23/24/25) Fauna Assessment	ENV	2011	Level 1 fauna assessment of the Eastern Ridge study area, located ~8 km northeast of Newman and covers 88.31 km^2	✓	✓	✓	✓
Biological Survey Myopic Exploration Leases	Onshore and Biologic	2009	Level 1 fauna assessment at the VCP_36 study area; and targeted significant fauna habitat search along proposed exploration corridors (access tracks, drill lines and drill pads) within the VCP_Myopic study area (State Agreement Lease 70/270)	✓	✓	✓	

Report title	Author	Year	Content	Assessment Areas			
Jimblebar Linear Development Terrestrial Vertebrate Fauna Assessment	Outback Ecology	2009	Level 2 fauna survey at six trapping sites within a linear corridor ~23 km in length and located ~14 km east of Newman		✓		
Report for Myopic Project Area, Newman Flora and Fauna Assessment	GHD	2008	Level 1 fauna survey over the Myopic Project Area; covers approximately 3,600 ha	✓	✓	✓	✓
OB 24 Flora And Fauna Assessment Phase II	ENV	2006	Level 2 fauna survey at five trapping sites over the survey area, located ~10 km north east of Newman		✓		
OB 24 Expansion Biological Survey	ecologia	2004	Level 2 fauna survey at six trapping sites over the survey area, located ~8 km north east of Newman	✓	✓	✓	✓
Baseline Biological & Soil Surveys and Mapping for ML244SA West of the Fortescue River	Biota	2001	Baseline survey of the vegetation, flora, fauna and soils of the remainder of the western section of ML244SA west of the Fortescue River. Includes the Mt. Whaleback mine and a number of satellite Orebodies (23 to 26, 28 to 30, 32, 33, 35, 37 & 38)	✓	✓	✓	✓
Jimblebar Rail Spur Biological Assessment Survey	ecologia	1996	Level 2 fauna survey at two trapping sites within the survey area, located ~5 km east of Newman	✓	✓		

Table 2: Summary of previous surveys within the vicinity of the Eastern Ridge Development Envelope.

Report title	Author	Year of survey	Content
Mt Whaleback AML 7/244 Flora & Vegetation And Vertebrate Fauna Review	Onshore	2013	Review and summary of previous terrestrial fauna survey reports for Mt Whaleback project area
Ninga Level 1 Vertebrate Fauna Assessment	Eco Logical	2013	Level 1 fauna and targeted assessment
OB 35 and Western Ridge Vertebrate Fauna Survey	Biologic	2011	Level 2 two-season survey
OB 42/43 Flora, Vegetation and Fauna Assessment Summary Letter and Recommendations	ENV	2011	Level 1 fauna survey

768000 774000 780000 786000 792000 798000

7428000 7422000 7416000 7410000

Legend

Proposed ER Development Envelope (10/04/2015)

Surveys over the Proposal area

- Biologic Environmental Survey (2014) OB25 Targeted Vertebrate Fauna Survey
- Biologic Environmental Survey (2014) OB24 Targeted Vertebrate Fauna Survey
- Eco Logical Australia (2012) Orebody 37 level 1 vertebrate fauna assessment
- ENV Australia (2011) Eastern Ridge (OB23/24/25) Fauna Assessment
- Outback Ecology Services (2009) Jimblebar Linear Development Vertebrate Fauna Assessment
- Onshore Environmental Consultants (2009) Myopic Exploration Lease Biological Survey
- GHD Australia (2008) Myopic Flora and Fauna Assessment
- ENV Australia (2006) Orebody 24 Flora and Fauna Assessment Phase II
- Ecologia Environment (2004) Orebody 24 Expansion Biological Survey
- Biota Environmental Sciences (2001) Baseline Biological and Soil Surveys and Mapping for ML244SA West of the Fortescue River
- Ecologia Environment (1996) Jimblebar Rail Spur Biological Assessment Survey

Surveys within the vicinity of the Proposal area

- Eco Logical Australia (2013) Ninga Level 1 Vertebrate Fauna Assessment
- Onshore Environmental (2013) Flora & Vegetation and Vertebrate Fauna Review - Mt Whaleback AML 7/244
- Biologic Environmental Survey (2011) Orebody 35 and Western Ridge Vertebrate Fauna Study
- ENV Australia (2011) Orebody 42/43 Flora, Vegetation and Fauna Assessment

Biota Environmental Sciences (2001)
Baseline Biological and Soil Surveys and Mapping for
ML244SA West of the Fortescue River

Biologic Environmental Survey (2014)
OB24 Targeted Vertebrate Fauna Survey

ENV Australia (2006)
Orebody 24 Flora and Fauna Assessment Phase II

Ecologia Environment (1996)
Jimblebar Rail Spur Biological Assessment Survey

Onshore Environmental Consultants (2009)
Myopic Exploration Lease Biological Survey

Ecologia Environment (2004)
Orebody 24 Expansion Biological Survey

GHD Australia (2008)
Myopic Flora and Fauna Assessment

Eco Logical Australia (2013)
Ninga Level 1 Vertebrate Fauna Assessment

Biologic Environmental Survey (2014)
OB25 Targeted Vertebrate Fauna Survey

Outback Ecology Services (2009)
Jimblebar Linear Development
Vertebrate Fauna Assessment

ENV Australia (2011)
Orebody 42/43
Flora, Vegetation and Fauna Assessment

Biologic Environmental Survey (2013)
Flora & Vegetation and Vertebrate Fauna Review -
Mt Whaleback AML 7/244

Eco Logical Australia (2012)
Orebody 37 level 1 vertebrate fauna assessment

Biologic Environmental Survey (2010)
Orebody 35 Vertebrate Fauna Study

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Eastern Ridge Revised Proposal - Vertebrate Fauna Environmental Impact Assessment

Figure 2: Location of previous fauna surveys within and in the vicinity of the Development Envelope

Datum: GDA 1994 - Projection: MGA Zone 50 - Scale: 1:100,000 (A3)

0 2 4 6 Km

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Author: J. Oates | Drawn: W. An | Date: 19-11-2015 | Figure Ref: 2454-15-BIDR-1Rev0_151119_Fig02

2 Legislative Context

2.1 Environmental Impact Assessment for Fauna

The *Environmental Protection Act 1986* (EP Act) provides for the referral and EIA of proposals and schemes likely, if implemented, to have a significant effect on the environment. The Act requires the Environmental Protection Authority (EPA) to provide, in its report to the Minister for Environment, what it considers to be the key environmental factors identified in the course of an assessment.

The EPA uses environmental factors and associated objectives as the basis for assessing whether a proposal or scheme's impact on the environment is acceptable.

2.1.1 EPA Objective for Fauna

The EPA's objective for terrestrial fauna according to the *Environmental Assessment Guideline for Environmental Factors and Objectives* is "to maintain representation, diversity, viability and ecological function at the species, population and assemblage level" (EPA 2013).

2.1.2 Relevant State and Federal Legislation

A suite of legislation relevant to biodiversity conservation in Western Australia includes the EP Act, the *Conservation and Land Management Act 1984*, and in particular, the *Wildlife Conservation Act 1950* (WC Act).

Under the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), proposed actions which have the potential to have a significant impact on a matter of national environmental significance must be referred to the Commonwealth Minister for the Environment for a decision as to whether assessment is required under the provisions of that Act.

Assessments must adequately address the potential impacts on matters of national environmental significance (MNES) in order to comply with the provisions of the EP Act and be accredited under the EPBC Act.

The following guidance and policy documents were considered during this EIA:

- Department of the Environment (DoE) (2013) *Matters of National Environmental Significance. Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999;*
- EPA (2013) *Environmental Assessment Guideline for Environmental factors and objectives*, Environmental Assessment Guidelines No. 8;
- EPA (2004) *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*, Guidance Statements No. 56;
- EPA (2002) *Terrestrial Biological Surveys as an Element of Biodiversity Protection*, Position Statements No. 3; and
- EPA and Department of Conservation and Environment (DEC) (2010) *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment.*

2.2 Existing Approvals

There are a number of existing Ministerial Statements (MS) that govern BHP Billiton Iron Ore in the surrounding mining areas:

- Orebody 25 mining operations are operated under MS 712;
- Orebody 24 mining operations are operated under MS 834; and
- Orebody 32 East mining operations is currently in preparation for referral to the EPA.

Orebody 23 mining operations are operated under MS 478 and are not in scope for this approvals process.

3 Environmental Context

3.1 Physical Environment

3.1.1 Climate

The Eastern Ridge Development Envelope is located in the Pilbara region of Western Australia. The Pilbara has an arid-tropical climate with two distinct seasons, a hot summer from October to April and a mild winter from May to September. The nearest accessible climate data is available from the Bureau of Meteorology (BoM) Newman Aero weather station located approximately 9 km south-east of the Eastern Ridge Development Envelope. The area experiences a wide temperature range, with an average annual maximum daytime temperature of 32°C (1996 to 2014; BoM 2015). The hottest month is January, with average maximum temperatures of 39.1°C and the coolest month is June with average maximum temperatures of 22.9°C (Figure 3; BoM 2015).

The Newman area has an average annual rainfall of 317.1 millimetres (mm) (1971 to 2015) (BoM 2015) with the majority of rainfall occurring during the summer months. February typically has the highest average monthly rainfall of 74.9 mm (Figure 3; BoM 2015). Summer rainfall is typically associated with tropical storms in the north, or tropical cyclones that cross the coast and move inland. Winter rainfall is commonly the result of cold fronts.

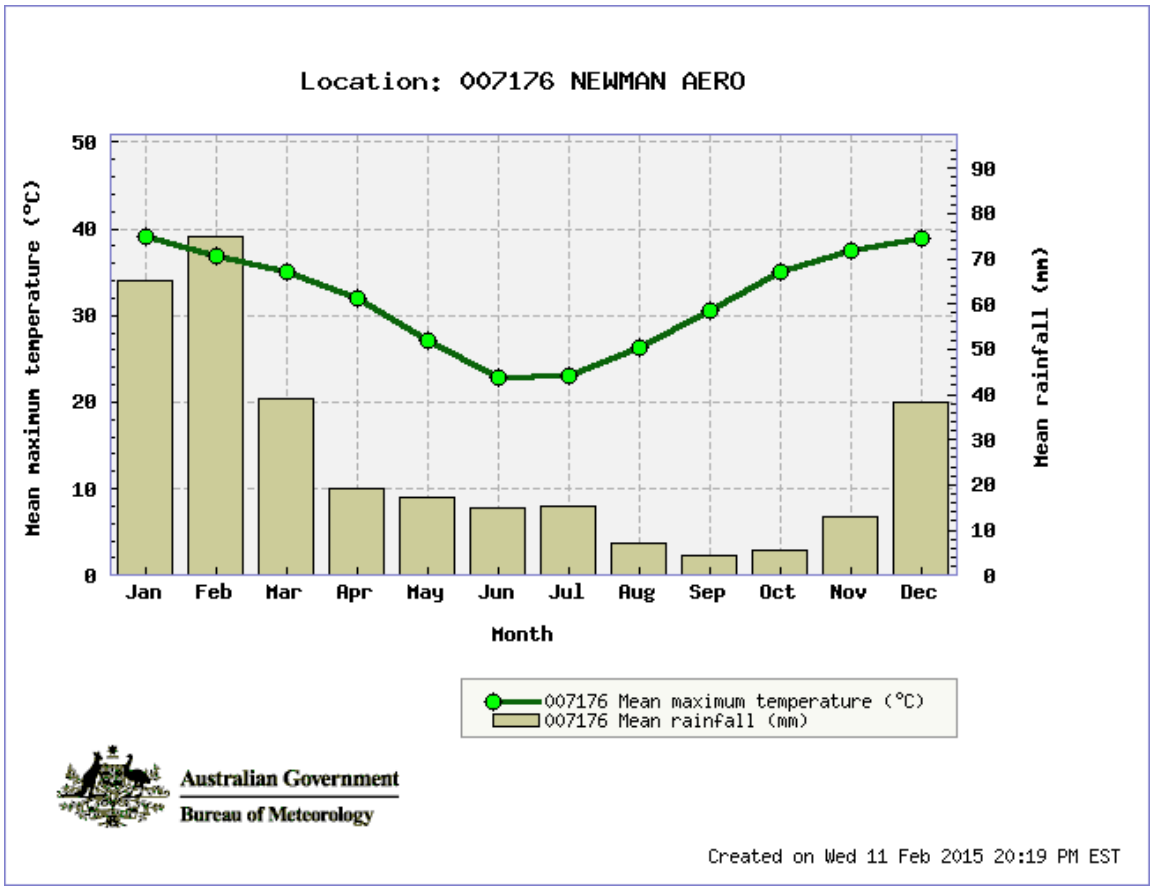


Figure 3: Climate data for Newman Aero Station (Station 7176). Average annual rainfall data has been calculated from 1971 to 2015 and average maximum temperature has been calculated from 1996 to 2014 (BoM 2015).

3.1.2 Geology, Landform and Soils

Seven geological units occur across the Assessment Areas (Table A.1; Appendix A), based largely on mapping at a scale of 1:250,000 and augmented by more recent 1:1,000,000 scale and regional compilation maps (Stewart et al. 2008).

The soils within the Assessment Areas (Table A.1; Appendix A) have been mapped by Northcote et al. (1968) as:

- **Fa13:** Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes. Associated are gravel-strewn loamy red duplex soils (Dr2.33 and Dr2.32) on the limited areas of dissected pediments, while deep uniform loams (Um5.52) and earthy clay soils (Uf6.71) occur on the valley plains.
- **BE6:** Extensive flat and gently sloping plains, which sometimes have a surface cover of gravels and on which red-brown hardpan frequently outcrops: chief soils are shallow earthy loams (Um5.3), with associated (Gn) soils of units My5O and Mz23.
- **Mz25:** Plains associated with the Fortescue valley; there is a surface cover of stony gravels close to the ranges and hills: chief soils are acid red earths (Gn2.11) with some neutral red earths (Gn2.12); red-brown hardpan is absent. Associated are areas of calcareous earths (Gc) and loams (Um1) on calcrete (kunkar) and some hard red (Dr) soils around creek lines.

Land systems of the Western Australian rangelands were mapped by the Department of Agriculture outlining the distributions, and providing comprehensive descriptions of, biophysical resources including soil and vegetation condition (van Vreeswyk et al. 2004). Five land systems occur in the survey (Table A.1; Appendix A); the Boolgeeda, Elimunna, Newman, River and Rocklea systems.

3.1.3 Surface Water and Hydrology

Homestead Creek passes though the current Orebody 24 approved MDB at right angles to the Orebody 24 rail loop. Homestead Creek also passes adjacent to the western and southern boundaries of the Eastern Ridge Development Envelope, with a 50 metre (m) buffer.

3.2 Biological Environment

3.2.1 Vegetation

Pre-European vegetation was mapped across the Pilbara region at a scale of 1: 1,000,000 (Beard 1975). Three broad vegetation units are found within the Assessment Areas (Table A.1; Appendix A) and include units 82 (Hummock grassland; low tree steppe; Snappy Gum over *Triodia wiseana*), 29 (Sparse low woodland; mulga, discontinuous in scattered groups) and 18 (Low woodland; mulga (*Acacia aneura*).

A number of flora and vegetation surveys have been conducted within the Assessment Areas (Biota 2001; ecologia 2004a, 2004b; ENV 2006; GHD 2008; Onshore and Biologic 2009). Consolidated vegetation associations within the Assessment Areas provided by BHP Billiton Iron Ore are presented in Table A.2 (Appendix A) and are comprised of 19 described vegetation units within eight habitat types.

3.2.2 Fauna Habitats

Consolidated fauna habitat mapping within the Eastern Ridge Development Envelope provided by BHP Billiton Iron Ore are presented in Table 3 and mapped in Figure 4. Importance to fauna rating criteria for fauna habitats is detailed in Appendix B. Eight fauna habitats were recorded within the Assessment Areas:

- Gorge/Gully;
- Hill Slope/Crest;
- Stony Plain;
- Sand Plain;
- Mulga;
- Drainage Area;
- Major Drainage Line; and
- Minor Drainage Line.

Some cleared/disturbed areas were also present within some of the Assessment Areas and are discussed in Section 3.2.2.9.

3.2.2.1 *Gorge/Gully*

Gorge/Gully habitat is a common feature of the Pilbara (especially within the Hamersley Range). They tend to be narrow, linear features and hence represent a small proportion of the total land area; however they represent important shelter or roosting habitat for a number of MNES, including the Pilbara Olive Python, Pilbara Leaf-nosed Bat and Northern Quolls. They may also support other listed species such as *Anilios ganei* and Ghost Bat.

Caves and rock pools are most often encountered in this habitat type. Both these habitat features also act as refugia for fauna during harsher conditions (e.g. dry and hot). Therefore, Gorge/Gully habitat is considered of high importance for fauna. Small areas of Gorge/Gully habitat (Table 3) occurs within:

- Orebody 24 MDB extension assessment area; and
- BWT assessment within the Orebody 24 approved MDB.

3.2.2.2 *Hill Slope/Crest*

Hill Crest/Slope habitat is considered to generally have low habitat value as a result of its decreased vegetation complexity and low diversity of microhabitats. However, boulder piles/rock outcrops were scattered within this habitat and are a notable habitat feature for fauna. Rock outcrops provide denning and nesting habitats and also act as refugia for fauna during harsher conditions (e.g. dry and hot). Extensive areas of Hill Crest/Slope habitat are also common and widespread throughout the Pilbara.

In addition, the Western Pebble-mound Mouse is somewhat restricted to this habitat type, and other conservation significant species such as the Long-tailed Dunnart may utilise this habitat. Therefore it is considered to be of moderate value for fauna. Hill Slope/Crest habitat (Table 3) occurs within:

- Orebody 24 MDB extension assessment area;
- BWT assessment within the Orebody 24 approved MDB;
- Orebody 32 East MDB extension assessment area; and
- Orebody 25 West operations assessment area.

3.2.2.3 *Stony Plain*

Stony Plain habitat is widespread and common throughout the Pilbara region and although there are a few species of conservation significance that may utilise this habitat type, they are not restricted to this habitat type. Therefore, it is considered to be of low value for fauna. Stony Plain habitat (Table 3) occurs within:

- Orebody 24 MDB extension assessment area; and
- BWT assessment within the Orebody 24 approved MDB.

3.2.2.4 *Sand Plain*

Large representations of Sand Plain habitat are located at the border of the Hamersley and Fortescue subregions and then extensively within the Chichester subregion. Although this habitat generally has low vegetation complexity and diversity of microhabitats, it potentially provides burrowing and foraging habitat for the Brush-tailed Mulgara. Therefore, it is considered to be of high importance to fauna. Sand Plain habitat (Table 3) occurs within:

- Orebody 24 MDB extension assessment area;
- BWT assessment within the Orebody 24 approved MDB;
- Orebody 32 MDB extension assessment area; and
- Orebody 25 West operations assessment area.

3.2.2.5 *Mulga*

Mulga habitat is considered to have moderate value for fauna, as it supports a relatively unique and diverse faunal assemblage, with some species largely restricted to this habitat type. A number of conservation significant species are likely to occur within Mulga habitat but are not restricted to this habitat type. It is a common, but patchy habitat throughout the Pilbara, especially within the Hamersley and southern Chichester subregion. Mulga habitat (Table 3) occurs within:

- BWT assessment area within the Orebody 24 approved MDB.

3.2.2.6 *Drainage Area*

Drainage Area habitat generally exhibits a moderate diversity of microhabitats, with some tree hollows and woody debris (logs and leaf litter). In addition, soils can be sandy in places, making it suitable for digging and burrowing animals. Conservation significant fauna likely to occur in this habitat type includes the Rainbow Bee-Eater, Peregrine Falcon and Grey Falcon. Due to the microhabitat diversity and the number of conservation significant species this habitat may support, this habitat type has been classified as having moderate value. Drainage Area habitat (Table 3) occurs within:

- BWT assessment within the Orebody 24 approved MDB;

- Orebody 32 MDB extension assessment area; and
- Orebody 25 West operations assessment area.

3.2.2.7 *Major Drainage Line*

Major Drainage Line habitat tends to be relatively narrow, linear features, and therefore only represent a small proportion of the total land area. The vegetation adjacent to the main channel(s) is usually denser, taller and more diverse than adjacent terrain.

In addition, this habitat potentially supports many conservation significant fauna species (e.g. Rainbow Bee-eater), as well as providing potential breeding and/or foraging sites for Peregrine and Grey Falcons, and shelter and dispersal habitat for Pilbara Olive Pythons. Therefore, Major Drainage Line habitat is considered to be of high importance to fauna.

Major Drainage Line habitat (Table 3) occurs within very small areas of:

- BWT assessment within the Orebody 24 approved MDB; and
- Orebody 25 West operations assessment area.

3.2.2.8 *Minor Drainage Line*

Minor Drainage Line habitat is considered to be of high value due to the micro niche diversity and therefore the ability to support a wide suite of species, as well as species of conservation significance, including the Pilbara Olive Python. In addition, semi-permanent rock pools were recorded within this habitat (Figure 4; Biologic 2014b). However, it is a common habitat in the Hamersley Range adjacent to the Eastern Ridge Development Envelope.

Minor Drainage Line habitat is likely to act as a wildlife corridor, as the denser vegetation structure and potential pools of surface water following a significant rainfall event allow dispersal opportunities for some species. There is little connectivity within the Eastern Ridge Development Envelope due to existing operations; however, there is connectivity through the Minor Drainage Line habitat to the north of the Orebody 24 MDB extension assessment area, which feeds into a Major Drainage Line. Minor Drainage Line habitat (Table 3) occurs within:

- Orebody 24 MDB extension assessment area;
- BWT assessment within the Orebody 24 approved MDB;
- Orebody 32 MDB extension assessment area; and
- Orebody 25 West operations assessment area.

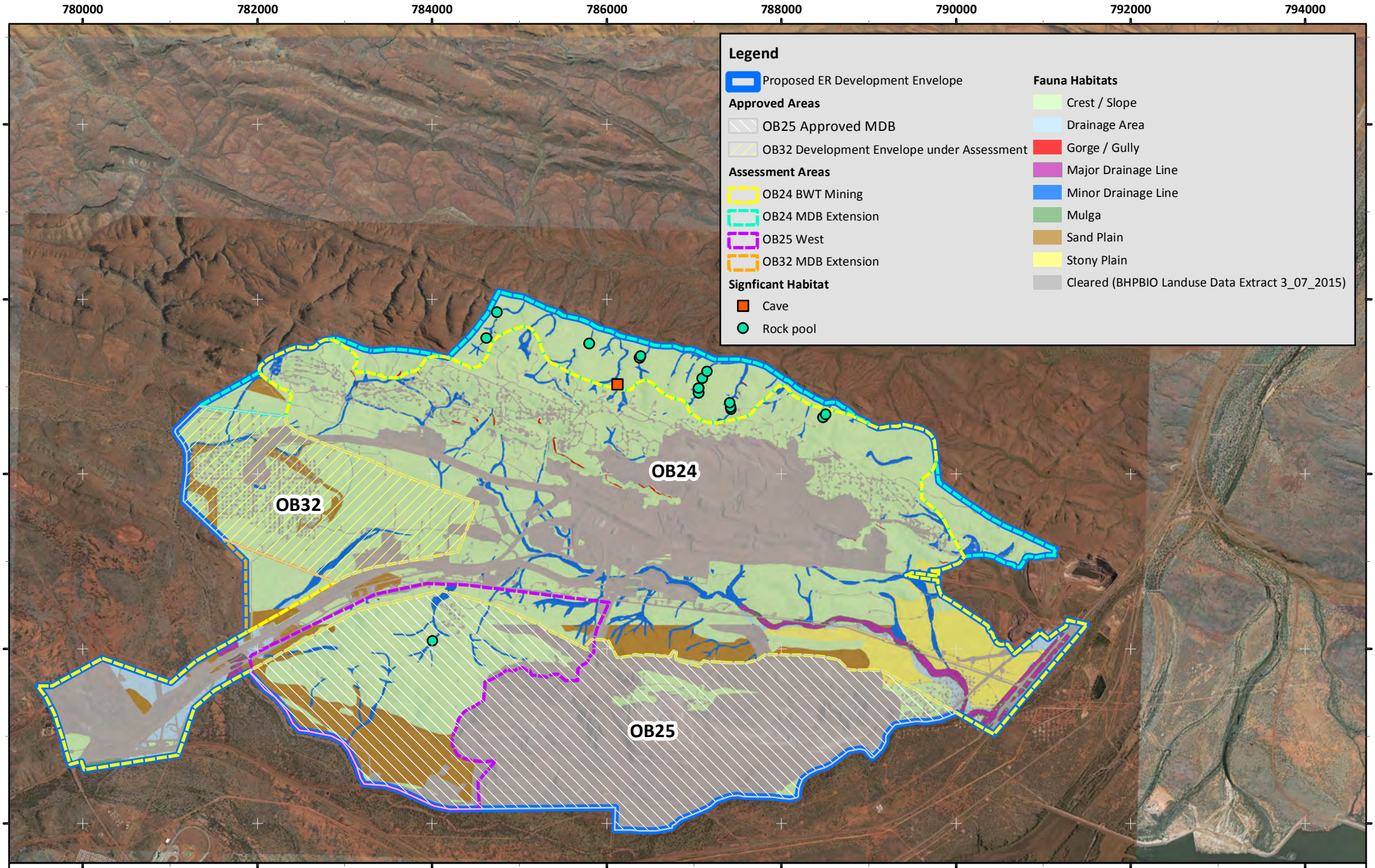
3.2.2.9 *Cleared*

Cleared/disturbed areas were considered to have no habitat value due to the level of disturbance and lack of vegetation. Within the assessment areas for this report, cleared/disturbed areas (Table 3) occur within:

- Orebody 24 MDB extension assessment area;
- BWT assessment within the Orebody 24 approved MDB;
- Orebody 32 MDB extension assessment area; and
- Orebody 25 West operations assessment area.

Table 3: Consolidated fauna habitats within the Development Envelope.

Fauna habitat	Description	Importance rating	Extent within Orebody 24 MDB extension area (ha)	Extent within Orebody 24 BWT mining area (ha)	Extent within Orebody 32 East MDB extension area (ha)	Extent within Orebody 25 West operations area (ha)
Gorge/Gully	Gorges/Gully habitat are deeply incised rugged, steep-sided valleys cut into the surrounding landscape. Caves and rock pools are most often encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred.	**High** - Represents important shelter or roosting habitat for Pilbara Olive Python, Ghost Bat, Pilbara Leaf-nosed Bat and Northern Quolls. They may also support the blind snake *Anilios ganei*. In addition Gorge/Gully habitats generally contain important habitat features such as caves, rocky outcrops and water pools that provide refuge for many species.	0.44	2.47		
Hill Crest/Slope	Hill crest/slope habitat is typically dominated by *Eucalyptus* woodlands, *Acacia* and *Grevillea* shrublands and *Triodia* species low hummock grasslands. Rocky outcrops are scattered within this habitat and are a notable habitat feature for fauna.	**Moderate**- Tends to be more open and structurally simple than other fauna habitats. However, the Western Pebble-mound Mouse typically inhabits this habitat type as it contains the rocky scree with which it builds its mounds. *Anilios ganei* and Long-tailed Dunnart may also utilise this habitat.	287.44	967.51	41.47	346.53
Stony Plain	Stony Plain habitat typically occurs in the low lying parts at the base of the low hills. Mainly supports hard spinifex (and occasionally soft spinifex).There are localised depositions of sand within this habitat, particularly adjacent to the Minor Drainage Line habitat.	**Low**- Few species of conservation significance that may utilise this habitat type, the Western Pebble-mound Mouse is often encountered in this habitat. However, none of the conservation significant species are likely to be restricted to this habitat type.	0.14	123.35		
Sand Plain	Sand Plain habitat is characterised by relatively deep sandy soils supporting dense spinifex grasslands and sparse shrubs. This habitat transitions into patches of Mulga in places.	**High** - Mulgara and Greater Bilby potentially utilise the finer sandy habitats for burrows and foraging. The blind snake *Anilios ganei* occurs in this habitat type.	4.47	94.83	6.32	135.02
Mulga	Mulga habitat typically occurs in the lower lying parts and includes Mulga groves on stony soils with spinifex.	**Moderate** - Mulga habitat potentially supports species such as the blind snake *Anilios ganei*. Mulga also supports a relatively unique and diverse faunal assemblage, with some species largely restricted to this habitat type.		2.85		
Drainage Area	The Drainage Area habitat typically occurs in the low lying parts. The vegetation structure of this habitat type consists of spinifex grassland of with scattered trees to low woodland of *Acacia* species and eucalypts.	**Moderate** - A moderate diversity of microhabitats was present, with tree hollows and woody debris (logs and leaf litter). In addition, the soils were suitable for digging and burrowing animals. Conservation significant fauna likely to occur in this habitat type included the Rainbow Bee-Eater, Grey Falcon and Peregrine Falcon.		46.69	0.71	0.25
Major Drainage Line	Major Drainage Line habitat comprises mature River Red Gums (*Eucalyptus camaldulensis*) and Coolibahs (*E. victrix*) over river pools. Open, sandy or gravelly riverbeds characterise this habitat type. In ungrazed areas, the vegetation adjacent to the main channel or channels is denser, taller and more diverse than adjacent terrain.	**High** - This habitat could support many significant bird species including the Rainbow Bee-eater. This habitat also provides potential breeding and/or foraging sites for Peregrine and Grey Falcons. Eucalypt species typically contain tree hollows used by parrots and owls for roosting and nesting. They also provide habitat and dispersal opportunities for Pilbara Olive Python.		38.30		0.40
Minor Drainage Line	Minor Drainage Line consists of *Acacia* low woodland sometimes with scattered Eucalypts. The understorey generally lacks density and often consists solely of sparse tussock grassland, particularly Buffel Grass (**Cenchrus ciliaris*). The substrate can be sandy in places but generally consists of a loam gravel or stone.	**High** - Minor drainage lines have the potential to provide habitat for a number of conservation significant fauna, such as the Pilbara Olive Python and Rainbow Bee-eater, but these species are not restricted to this habitat type. Minor drainage line habitat is likely to act as a wildlife corridor for dispersal and movement of fauna. Semi-permanent rock pools were also recorded within this habitat type.	22.74	96.73	3.81	26.49
Cleared	Habitat that has been cleared or disturbed, mainly for drill pads.	**No habitat value**	4.21	930.94	1.08	70.42



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Eastern Ridge Revised Proposal - Vertebrate Fauna Environmental Impact Assessment

Figure 4: Fauna habitat mapping within the Development Envelope

Datum: GDA 1994 - Projection: MGA Zone 50 - Scale: 1:55,000 (A4)

0 1 2 3 Km

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Author: J. Oates | Drawn: W. An | Date: 19-11-2015 | Figure Ref: 2454-15-BIDR-1Rev0_151119_Fig04

3.2.3 Fauna Species and Assemblages

Fauna assemblages in the Assessment Areas have been compiled from surveys conducted within and surrounding the Assessment Areas and records from *NatureMap* (Department of Parks and Wildlife (Parks and Wildlife) 2015), and EPBC Act *Protected Matters Search Tool* (DoE) 2015) (Appendix C).

A total of 322 terrestrial vertebrate fauna species have been previously recorded within the vicinity of the Assessment Areas. This includes eight amphibian species, 94 reptile species, 172 bird species and 48 mammal species (including 12 introduced mammal species). Many of these species are unlikely to occur in the Assessment Areas on a regular basis since these records are from a large area encompassing a wide range of habitats, particularly the waterbird species.

Of those species previously recorded, 23 are species of conservation significance, including two reptiles, 13 birds and eight mammals that have the potential to occur within the Assessment Areas (Table 5 and Appendix C). The conservation significant fauna likely to occur within the Assessment Areas are discussed in Section 3.2.4. The likelihood of conservation significant species occurring within the Orebody 24 BWT mining Assessment Area was based on the original EIA for the approved Orebody 24 MDB (BHP Billiton Iron Ore 2010). Disturbance associated with above water table mining at Orebody 24 is approved and further assessment in this report is only against potential changes related to BWT mining. The criteria for determining the likelihood of conservation significant species occurring within the other three Assessment Areas is detailed in Appendix B.

Table 4: Survey effort and results of surveys where part or all of the survey area occurs within the Eastern Ridge Development Envelope.

Report		Orebody 25 Targeted Vertebrate Fauna Survey	Orebody 24 Targeted Vertebrate Fauna Survey	Orebody 37 Level 1 Vertebrate Fauna Assessment	Eastern Ridge (Orebody 23/24/25) Fauna Assessment	Jimblebar Linear Development Terrestrial Vertebrate Fauna Assessment	Biological Survey Myopic Exploration Leases	Report for Myopic Project Area, Newman Flora and Fauna Assessment	Orebody 24 Flora And Fauna Assessment Phase II	Orebody 24 Expansion Biological Survey	Baseline Biological and Soil Surveys and Mapping for ML244SA West of the Fortescue River	Jimblebar Rail Spur Biological Assessment Survey
Author		Biologic	Biologic	Eco Logical	ENV	Outback Ecology	Onshore/Biologic	GHD	ENV	ecologia	Biota	ecologia
Year		2014	2013	2012	2011	2009	2009	2008	2006	2004	2001	1996
Survey type		Level 1 and targeted fauna survey	Level 1 and targeted fauna survey	Level 1 fauna survey	Level 1 fauna survey	Level 2 fauna survey	Level 1 fauna and targeted survey	Level 1 fauna survey	One season Level 2 fauna survey	One season Level 2 fauna survey	Desktop review and ground-truthing of fauna habitat	One season Level 2 fauna survey
Type of sampling		Habitat assessments Active searches Bird censuses Bat recordings Motion sensitive cameras Opportunistic searches	Habitat assessments Active searches Bird censuses Bat recordings Motion sensitive cameras Opportunistic searches	Habitat assessments Active searches Bat recordings Motion sensitive cameras Opportunistic searches	Habitat assessments Active searches Bird censuses Bat recordings Opportunistic searches	Habitat assessments Bird censuses Bat recordings Trapping Active searches Opportunistic searches	Habitat assessments Active searches Bird censuses Bat recordings Opportunistic searches	Habitat assessments Opportunistic searches	Habitat assessments Bird censuses Bat recordings Trapping Active searches Opportunistic searches	Habitat assessments Bird censuses Bat recordings Trapping Active searches Opportunistic searches	Habitat assessments	Trapping Bird censuses Active searches Opportunistic searches
Results	**Amphibians**	0	3	1	2	4	0	0	3	0	3	2
	Reptiles	6	51	11	13	49	7	6	34	22	55	7
	Birds	28	85	65	46	82	48	37	67	65	109	59
	Mammals	13	26	16	10	23	10	8	16	16	26	4
	Conservation significant species	• Rainbow Bee-eater • Pilbara Olive Python	• Brush-tailed Mulgara • Pilbara Leaf-nosed Bat • Ghost Bat • Western Pebble-mound Mouse • Peregrine Falcon • Rainbow Bee-eater • Pilbara Olive Python	• Great Egret • Rainbow Bee-eater	• Western Pebble-mound Mouse • Rainbow Bee-eater • Pilbara Olive Python	• Western Pebble-mound Mouse • Rainbow Bee-eater • *Anilios ganei*	• Western Pebble-mound Mouse	• Western Pebble-mound Mouse • Peregrine Falcon	• Ghost Bat • Western Pebble-mound Mouse • Pilbara Olive Python	• Rainbow Bee-eater	• Pilbara Leaf-nosed Bat • Ghost Bat • Western Pebble-mound Mouse • Long-tailed Dunnart • Peregrine Falcon • Pilbara Olive Python	• Peregrine Falcon

3.2.4 Conservation Significant Species

Conservation significant species that have been recorded within the Eastern Ridge Development Envelope are shown in Figure 5 and Table 5. An assessment of the likelihood of other conservation significant species occurring within the Eastern Ridge Development Envelope is detailed in Table 5.

3.2.4.1 *Orebody 24 BWT Mining*

Based on the original EIA for Orebody 24, the following conservation significant fauna species have been recorded from the BWT Assessment Area:

- Ghost Bat – echolocation calls were recorded by ENV (2006) outside a series of suitable roost caves as well as within Major Drainage Line habitat;
- Western Pebble-mound Mouse – mounds were recorded within Hill Crest/Slope and Stony Plain habitats (ecologia 1998; ENV 2011a) but are likely to be cleared from mining;
- Peregrine Falcon – one individual was recorded from Hill Crest/Slope habitat (Biologic 2014b);
- Rainbow Bee-eater – five records from Drainage Area, Stony/Sand Plain/ Hill Crest/Slope and Minor Drainage Line habitats (ENV 2011a; Biologic 2014a, 2014b); and
- Pilbara Olive Python – an individual was recorded in Gorge/Gully habitat by ENV (2006).

Other species likely to occur within the Assessment Area include: Fork-tailed Swift; and blind snake *A. ganei* (Table 5).

3.2.4.2 *Orebody 24 MDB Extension*

The following conservation significant fauna species have been recorded from the OB24 Assessment Area:

- Rainbow Bee-eater – an individual was recorded within Minor Drainage Line habitat by Biologic (2014b); and
- Pilbara Olive Python – two individuals in water pools within Minor Drainage Line habitats. Remains of another individual were recorded by Biologic (2014b); one individual within Gorge/Gully habitat by ENV (2011a) and one individual within gully habitat by ENV (2006).

Other species likely to occur within the Assessment Area include: Long-tailed Dunnart; Ghost Bat, likely for foraging purposes (one possible feeding roost cave was recorded by Biologic (2014b)); Pilbara Leaf-nosed Bat, for foraging purposes; Western Pebble mound Mouse; Fork-tailed Swift; Grey and Peregrine Falcons, for foraging purposes and possibly nesting purposes; and blind snake *Anilios ganei* (Table 5).

3.2.4.3 *Orebody 25 West*

The following conservation significant fauna species have been recorded from the Assessment Area:

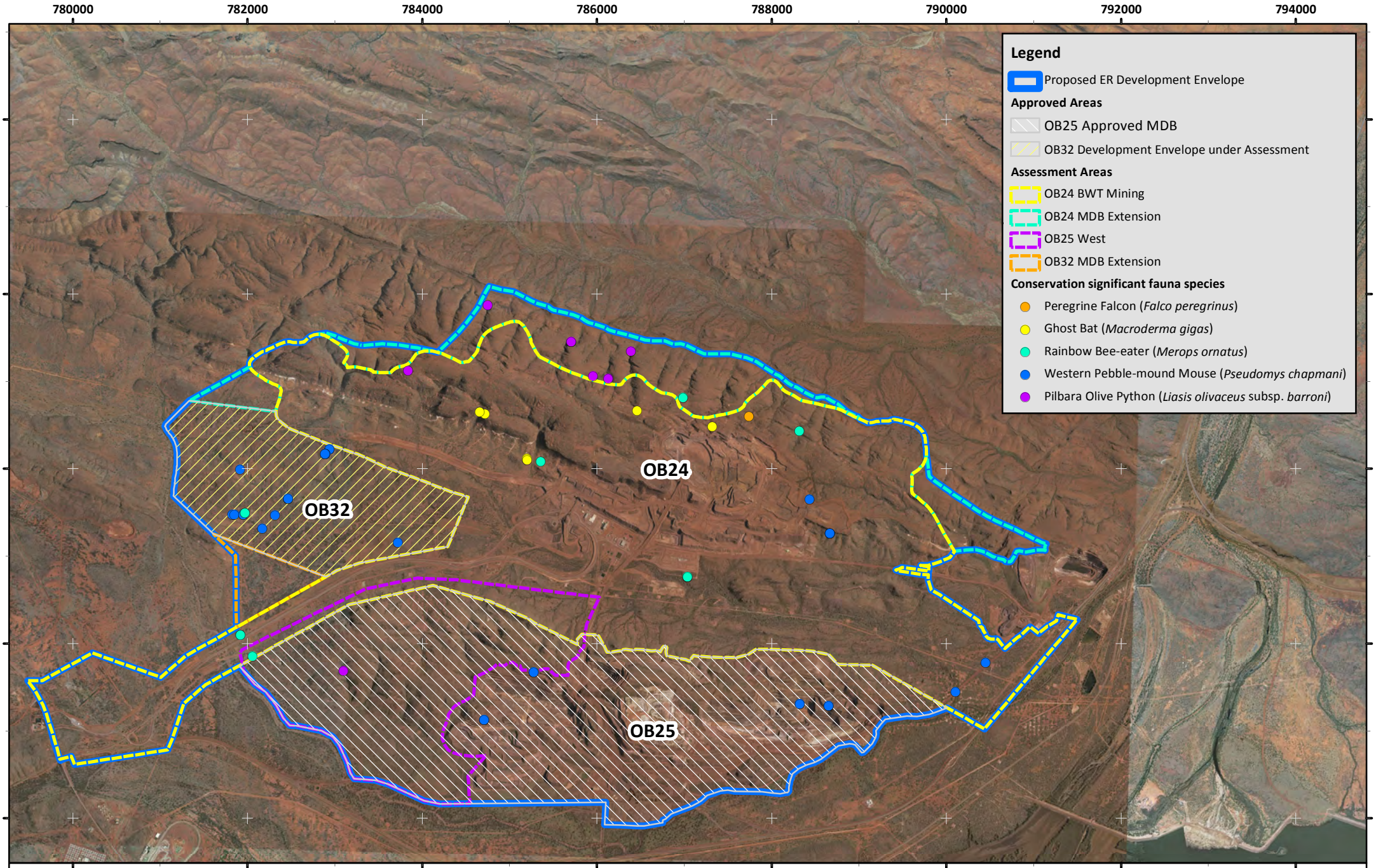
- Rainbow Bee-eater – one individual was recorded within Stony/Sand Plain habitat by Biologic (2014a); and
- Pilbara Olive Python – one individual was recorded within Minor Drainage Line habitat by Biologic (2014a).

Other species likely to occur within the Assessment Area include: Long-tailed Dunnart; Western Pebble-mound Mouse; Fork-tailed Swift; Grey and Peregrine Falcons; and blind snake *A. ganei* (Table 5).

3.2.4.4 *Orebody 32 MDB Extension*

No conservation significant fauna species have been recorded from the Assessment Area.

Other species likely to occur within the Assessment Area include: Long-tailed Dunnart; Western Pebble mound Mouse; Fork-tailed Swift; Grey and Peregrine Falcons; Rainbow Bee-eater; and blind snake *A. ganei* (Table 5).



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Eastern Ridge Revised Proposal - Vertebrate Fauna Environmental Impact Assessment

Figure 5: Conservation significant fauna species records within the Development Envelope

Datum: GDA 1994 - Projection: MGA Zone 50 - Scale: 1:55,000 (A4)

0 1 2 3 Km

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Author: J. Oates | Drawn: W. An | Date: 19-11-2015 | Figure Ref: 2454-15-BIDR-1Rev0_151119_Fig05

Table 5: Conservation significant species recorded within the Assessment Areas.

Species	Conservation significance	Preferred habitat	Preferred habitats likely to be utilised within the Assessment Areas	Records	Likelihood of occurring within the Orebody 24 MDB extension area	Likelihood of occurring within the Orebody 24 BWT mining area (based on original EIA; BHP Billiton Iron Ore 2010)	Likelihood of occurring within the Orebody 32 MDB extension area	Likelihood of occurring within the Orebody 25W operations area
Mammals								
Northern Quoll *Dasyurus hallucatus*	EPBC Act Endangered WC Act Schedule 2	Northern Quolls favour rocky areas such as ranges, escarpments, mesas, gorges, breakaways, boulder fields, major drainage lines and treed creeklines, as well as structurally diverse woodland or forest areas containing large diameter trees, termite mounds or hollow logs (DSEWPaC 2011).	Gorge/Gully Major Drainage Line	Closest record is from the main access bridge into Whaleback (Onshore 2013) ~ 4 km to the south west of the Eastern Ridge Development Envelope. Record was a road kill observation and no other evidence of this species has been found within the area.	Unlikely	Unlikely	Unlikely	Unlikely
Long-tailed Dunnart *Sminthopsis longicaudata*	Parks and Wildlife Priority 4	Its habitat includes Acacia, rocky screes with hummock grass and shrubs, and tall open shrubland and woodlands (Burbidge et al. 2008).	Hill Crest/Slope	Previous record in Whaleback area (ecologia 1998), ~9 km south-west of the Eastern Ridge Development Envelope.	Likely	Possible	Likely	Likely
Ghost Bat *Macroderma gigas*	WC Act Schedule 3	Roosts in deep complex caves beneath bluffs of low rounded hills, granite rock piles and abandoned mines (Armstrong and Anstee 2000).	Gorge/Gully and Hill Crest/Slope for roosting. Gorge/Gully, Major Drainage Line and Minor Drainage Line for foraging.	Five records of Ghost bats and caves have been recorded within the Eastern Ridge Development Envelope (ENV 2006, 2011a).	Likely for foraging (one possible feeding roost cave recorded by Biologic 2014b).	**Recorded – roosting and foraging records**	Possible for foraging	Possible for foraging
Pilbara Leaf-nosed Bat *Rhinonicteris aurantia*	EPBC Act Vulnerable WC Act Schedule 3	Hot, humid roost caves. Forages in gorge/ gully habitat and along watercourses, particularly where water is present.	Gorge/Gully and Hill Crest/Slope for roosting. Gorge/Gully, Major Drainage Line and Minor Drainage Line for foraging.	No confirmed records within the Eastern Ridge Development Envelope. Calls of this species have been recorded from gorge/gully and minor drainage line habitats between 500 m and 2 km north west of the Eastern Ridge Development Envelope (Biologic 2014b).	Likely for foraging	Possible for foraging	Possible for foraging	Possible for foraging
Western Pebble-mound Mouse *Pseudomys chapmani*	Parks and Wildlife Priority 4	Gentler slopes of rocky ranges where ground is covered with a stony mantle and vegetated by spinifex, often with sparse overstorey of eucalypts and scattered shrubs (Start 2008).	Hill Crest/Slope Stony Plain	Several records within the Eastern Ridge Development Envelope (ecologia 1998; ENV 2011a) and numerous records within 20 km (Biologic 2011, 2014a, 2014b; Onshore and Biologic 2009; Eco Logical 2013a).	Likely	**Recorded**	Likely	Likely
Birds								
Fork-tailed Swift *Apus pacificus*	EPBC Act Migratory WC Act Schedule 5	Entirely aerial within the Pilbara region.	Entirely aerial so will not utilise habitats	Recorded from Eastern Ophthalmia Range (ecologia 2004b) and Orebody 31 (ENV 2011c) ~20 km to the east of the Eastern Ridge Development Envelope.	Likely	Likely	Likely	Likely
Eastern Great Egret *Ardea modesta*	EPBC Act Migratory WC Act Schedule 5	Favoured breeding habitat includes wooded swamps and river pools with *Eucalyptus camaldulensis* and *Melaleuca argentea* (Johnstone and Storr 1998).	Major Drainage Line	Recorded from Orebodies 35 (Biologic 2011), 37 (Eco Logical 2012) and 42/43 (ENV 2011b) ~1.5 to 2 km to the south east of the Eastern Ridge Development Envelope.	Unlikely	Possible on seasonal basis	Unlikely	Possible on seasonal basis

Species	Conservation significance	Preferred habitat	Preferred habitats likely to be utilised within the Assessment Areas	Records	Likelihood of occurring within the Orebody 24 MDB extension area	Likelihood of occurring within the Orebody 24 BWT mining area (based on original EIA; BHP Billiton Iron Ore 2010)	Likelihood of occurring within the Orebody 32 MDB extension area	Likelihood of occurring within the Orebody 25W operations area
Cattle Egret *Ardea ibis*	EPBC Act Migratory WC Act Schedule 5	Utilises a variety of natural and anthropogenic habitats and occurs in tropical and temperate grasslands, inland wetlands, wooded lands and farm land.	Major Drainage Line	Nearest record is from Ophthalmia Dam (Parks and Wildlife 2015).	Unlikely	Possible on seasonal basis	Unlikely	Possible on seasonal basis
Glossy Ibis *Plegadis falcinellus*	EPBC Act Migratory WC Act Schedule 5	Preferred habitat for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood plains, wet meadows, swamps, reservoirs, sewage ponds, rice fields and cultivated areas under irrigation.	Major Drainage Line	Nearest record is from Ophthalmia Dam (Parks and Wildlife 2015).	Unlikely	Possible on seasonal basis	Unlikely	Possible on seasonal basis
Grey Falcon *Falco hypoleucos*	WC Act Schedule 3	Although this species is uncommon and sparsely distributed, it has an extensive foraging range. Favours timbered lowland plains, particularly Acacia shrublands that are crossed by tree-lined watercourses, but frequents other grassland and woodland habitats.	Gorge/Gully and Major Drainage Line for nesting. All habitats for foraging.	Nearest record is from rocky hill top habitat at Ninga (Eco Logical 2013a) ~7 km to the east of the Eastern Ridge Development Envelope.	Possible for nesting Likely for foraging	Possible for foraging	Likely for foraging	Likely for foraging
Peregrine Falcon *Falco peregrinus*	WC Act Schedule 7	Cosmopolitan, will hunt in any habitat, soaring at height or from a perch; often near cliffs (Armstrong and Anstee 2000). Nests on rocky ledges in tall, vertical cliff faces and tall trees associated with drainage lines.	Gorge/Gully and Major Drainage Line for nesting. All habitats for foraging.	One record from within the Eastern Ridge Development Envelope (Biologic 2014b).	Possible for nesting Likely for foraging	**Recorded**	Likely for foraging	Likely for foraging
Australian Painted Snipe *Rostratula australis*	EPBC Act Endangered WC Act Schedule 2	Inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans.	Major Drainage Line	No confirmed records in the Assessment Areas or surrounds.	Unlikely	Possible	Unlikely	Possible on seasonal basis
Migratory waders (Oriental Plover *Charadrius veredus*, Common Sandpiper *Actitis hypoleucos*, Sharp-tailed Sandpiper *Calidris acuminata*, Pectoral Sandpiper *Calidris melanotus*, Long-toed Stint *Calidris subminuta*)	EPBC Act Migratory WC Act Schedule 5	Water edges including coastal, saline and fresh water bodies. Also inland water bodies including bore overflows (Johnstone and Storr 1998).	Major Drainage Line	Records of these species are from outside the Assessment Areas at Ophthalmia Dam, Fortescue River and the tailings dam at Mt Whaleback (ecologia 1998, ENV 2012).	Unlikely	Possible on seasonal basis	Unlikely	Possible on seasonal basis
Rainbow Bee-eater *Merops ornatus*	EPBC Act Migratory WC Act Schedule 5	Lightly wooded, preferably sandy country near water (Johnstone and Storr 1998).	All habitats	Several records from within the Eastern Ridge Development Area (ENV 2011a; Biologic 2014a, b) as well as Orebodies 35, 37 and 42/43 (Biologic 2011; Eco Logical 2012; ENV 2011b).	**Recorded**	**Recorded**	Likely	**Recorded**

Species	Conservation significance	Preferred habitat	Preferred habitats likely to be utilised within the Assessment Areas	Records	Likelihood of occurring within the Orebody 24 MDB extension area	Likelihood of occurring within the Orebody 24 BWT mining area (based on original EIA; BHP Billiton Iron Ore 2010)	Likelihood of occurring within the Orebody 32 MDB extension area	Likelihood of occurring within the Orebody 25W operations area
Reptiles								
Blind snake *Anilios ganei*	Parks and Wildlife Priority 1	Associated with moist gorges and gullies (Wilson and Swan 2010), and potentially with a wide range of other stony habitats.	Gorge/Gully Hill Crest/Slope Stony Plain	Records from Orebody 35 (Biologic 2011) and Jimblebar Linear Development survey area (Outback Ecology 2009). Closest record is 1.5 km to the east of the Eastern Ridge Development Envelope.	Likely	Likely	Likely	Likely
Pilbara Olive Python *Liasis olivaceus barroni*	EPBC Act Vulnerable WC Act Schedule 3	Associated with drainage systems, including areas with localised drainage and semi-permanent watercourses (Bush and Maryan 2011)	Gorge/Gully Major Drainage Line Minor Drainage Line	Recorded from within the Eastern Ridge Development Envelope (ENV 2006, 2011a; Biologic 2014b). Other records from Orebody 25 (Biologic 2014a), 35 (Biologic 2011) and Ninga (Eco Logical 2013a).	**Recorded**	**Recorded**	Possible	**Recorded**

4 Impact Assessment

4.1 Orebody 24 BWT Mining

The impacts from clearing of vegetation within the Orebody 24 approved MDB have already been assessed and approved as part of MS 834. Potential impacts are currently managed in accordance with the Ministerial Conditions. There are no additional changes required with regards to clearing vegetation for access to BWT ore within the Orebody 24 approved MDB. Extension of the approved Orebody 24 MDB to the north, primarily for OSAs and roads, is dealt with in the Orebody 24 MDB extension area impacts assessment section (Section 4.2). There are no additional impacts to fauna habitat or fauna species from BWT mining according to the information provided in the water and flora and vegetation reports (BHP Billiton Iron Ore 2015, Onshore Environmental 2015, RPS 2015).

4.2 Orebody 24 MDB Extension

4.2.1 Fauna Habitat

4.2.1.1 *Local Context*

The clearing of native vegetation required within the OB24 MDB Extension Assessment Area will result in a loss of fauna habitat. The majority of the Assessment Areas are Hill Crest/Slope habitat (287.44 ha; 90% of Assessment Area) followed by Minor Drainage Line (22.74 ha; 7.1%), Sand Plain (4.47 ha; 1.4%), Gorge/Gully (0.44 ha; 0.1%) and Stony Plain (0.14 ha; 0.1%). The Hill Crest/Slope and Stony Plain habitats are common and widespread habitats both within the vicinity of the Proposal and the Pilbara region. The area of Sand Plain habitat within the Assessment Area is small and isolated.

Small isolated areas of Gorge/Gully habitat that contain a number of semi-permanent water pools (Figure 4; Biologic 2014b) are considered important habitat within the local context. The habitat does not appear to be suitable as roosting habitat for bats as only one cave (classified as a potential feeding roost) has been recorded within the Assessment Area (Biologic 2014b). However, the rock pools within this habitat would provide foraging opportunities for the Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python.

The Minor Drainage Line habitats within the Assessment Area would act as a north-south movement corridor, which extend northwards beyond the Assessment Area into a major drainage line and would provide connectivity for fauna to move out of the disturbance area. Minor Drainage Line habitat, however, is common and widespread (although not large in area) within the vicinity of the Proposal. The major drainage line adjacent to the north of the Assessment Area would also provide a major movement corridor for fauna along an east-west axis.

4.2.1.2 *Regional Context*

The Stony Plain habitat was considered of low importance as it does not support many conservation significant species and is common and widespread throughout the Pilbara region The Hill Crest/Slope was considered to be of moderate importance for fauna due to their potential to support some conservation significant species; however, this habitat is also widely represented and common throughout the Pilbara region.

Sand Plain habitat is generally considered of high importance due to its potential to support conservation significant species such as the Brush-tailed Mulgara; however, this species has not been recorded within the Assessment Area and is unlikely to occur within the Assessment Area. In

addition, it is a small isolated patch of Sand Plain habitat only and larger representations of this habitat are located at the border of the Hamersley and Fortescue subregions and then extensively within the Chichester subregion.

The Minor Drainage Line habitats within the Assessment Area were considered to be of high importance due to several records of a conservation significant species (Pilbara Olive Python) within this habitat and the presence of semi-permanent rock pools. The Minor Drainage Line habitats, although considered important for fauna, continue north of the Assessment Areas and feed into a major drainage line. It is likely that similar foraging opportunities for fauna exist within these habitats that would not be impacted by the Proposal. The Minor Drainage Line habitats are likely to provide movement corridors for fauna to move into the adjacent habitat north of the Assessment Area. However, 12 semi-permanent rock pools located within the Minor Drainage Line habitat (Biologic 2014a) that provide foraging opportunities and act as a refuge site for fauna species, particularly for the Pilbara Olive Python, are likely to be lost depending on proposed disturbance areas. Given that only a small area (0.44 ha, 0.1% of Assessment Area) of Gorge/Gully habitat exists and there are other areas of similar (and more representative) habitat within the region, including a large Gorge/Gully system to the west of the Assessment Area, it is considered unlikely that clearing of this habitat would result in a significant impact.

The Gorge/Gully habitat is also considered of high importance to fauna; however, this habitat only represents a small portion of the Assessment Area and is a common feature of the Pilbara, especially within the Hamersley Range.

The loss of the Hill Crest/Slope and small area of Sand Plain habitat is considered unlikely to have an impact within a regional context, given that these fauna habitats are well represented and part or larger intact areas in the immediate vicinity of the Assessment Areas.

4.2.2 Fauna Species

4.2.2.1 *Local Context*

Extension of the Orebody 24 MDB, primarily for OSAs and roads, will involve clearing of vegetation which will ultimately result in the loss of some terrestrial vertebrate species. The majority of fauna species present within the Assessment Area will be present within the local area and have extended home ranges, and impacts on these species are considered likely to be negligible. Birds are generally highly mobile; however, less mobile species including the Pilbara Olive Python previously recorded within the Assessment Area, may be lost if present in the areas of direct impact. The Minor Drainage Line habitat extends north beyond the Assessment Area, which may allow for some movement of this species out of the disturbance area. However, if individuals are present and unable to disperse from the direct impact areas (i.e. individuals sheltering in rock crevices during cooler months), this is likely to result in impacts to this species at a local level.

Four conservation significant bird species (including one species that is entirely aerial) considered likely to occur are highly mobile and generally less reliant on specific habitats within the Assessment Area. Two conservation significant bat species, the Ghost Bat and Pilbara Leaf-nosed Bat, are likely to utilise the Assessment Area for foraging purposes, particularly given the number of semi-permanent rock pools recorded within the Minor Drainage Line and Gorge/Gully habitats. The loss of the rock pools within the Minor Drainage Line and Gorge/Gully habitats will result in a shift to other similar habitats for these species. For the other three species (*A. ganei,* Long-tailed Dunnart and Western Pebble-mound Mouse) likely to occur impacts are likely to be minimal given that their preferred habitats are well represented within the Pilbara, similar habitats exist adjacent to the Assessment Area and there are no records from within the Assessment Area.

4.2.2.2 *Regional Context*

The Rainbow Bee-eater was also recorded within the Assessment Area but is unlikely to be impacted as it is a highly mobile species and not restricted to any of the fauna habitats within the Assessment Area. The Pilbara Olive Python was recorded from five locations within the Minor Drainage Line habitat of the Assessment Area. Although there may be some opportunity for individuals of this species to move out the Assessment Area with connectivity to similar habitats in the north, individuals are likely to be lost if present and unable to disperse from the proposed disturbance areas. This is likely to result in impacts to this species at a local level as discussed in Section 4.1.2.1. In addition, this local Pilbara Olive Python population may be considered an 'important population' as defined by DoE (2013) as it is at the southern extent of its geographic range. If so, then the Proposal may potentially have an impact on this species at a regional scale according to some of the impact criteria for a vulnerable species (Table 6; DoE 2013).

Additional conservation significant species considered likely to occur or utilise the Assessment Area are unlikely to be significantly impacted in a regional context. The Minor Drainage Line habitat that is potentially utilised by the Ghost Bat and Pilbara Leaf-nosed Bat for foraging continues north of the Assessment Area and feeds into a major drainage line. It is likely that similar foraging opportunities for the bat species exist within these habitats that would not be impacted by the Proposal and given bats are mobile species; they should not be significantly impacted. In addition, the assessment area provides very limited roosting habitat potential, as only one cave (classified as a potential feeding roost) has been recorded within the area.

Table 6: Assessment of the Pilbara Olive Python within Orebody 24 MDB Extension Assessment Area according to the EPBC Act significant impact guidelines (DoE 2013).

Significant impact criteria for a Vulnerable species (DoE 2013)	Assessment for the Pilbara Olive Python within the Orebody 24 MDB Extension Assessment Area
The project will lead to a long-term decrease in the size of an important population of a species.	The DoE (2013) indicate important populations may include those populations that are near the limits of the species range. The Assessment Area is situated at the southern limit of the Pilbara Olive Python's known distribution, although there are previous records of the species approximately 20 km to the south and east. The recording of five Pilbara Olive Pythons within the Assessment Area (it is unknown if they are the same or different individuals as surveys were conducted over several years) and the rarity of encounters with this subspecies, suggests the Assessment Area may support an important population of Pilbara Olive Python. However, the rarity of this species may be also due to its cryptic nature, as it is known to shelter in rocky breakaways and crevices during the cooler winter months (Swan 2007). Populations are considered stable and sizeable across known sites of the Pilbara (Pearson 2003) and may be more common than previously indicated. For example, there are another 12 records within 20 km of the Eastern Ridge Development Envelope and 84 records within 300 km of the Eastern Ridge Development Envelope (BHP Billiton Iron Ore database records). In addition, at least seven individuals were recorded from the North Star study area, north of the Eastern Ridge Development Envelope, with four individuals recorded from one pool (ecologia 2013). Clearing of the Minor Drainage Line and Gorge/Gully habitat is likely to reduce the size of this local population over the long term, but whether it is considered an important population is uncertain.
The project will reduce the area of occupancy of an important population.	A total of 23.66 ha of preferred habitat (Minor Drainage Line and Gorge/Gully habitats) was identified in the Assessment Area, which will reduce the area of occupancy for what may be an important Pilbara Olive Python population at the southern extent of its range. The loss of this habitat will result in a reduction of occupancy of the same amount; however, it is uncertain if this population would constitute an important population. Recent predictive modelling undertaken for this species shows that suitable habitat is widespread throughout the Pilbara region (Biologic 2012; Eco Logical 2013b). In addition, a large proportion of Pilbara Olive Python habitat is conserved in Karijini National Park (Pearson 2003), approximately 200 km to the north west of the Assessment Area.
The project will fragment an existing important population into two or more populations.	The Proposal is unlikely to pose a barrier to Pilbara Olive Python dispersal given that the Minor Drainage Line habitat runs north-south and extends into a Major Drainage Line to the north which would continue to provide movement east-west and will not fragment the existing population. In addition, the Minor Drainage Line habitat extends north beyond the Assessment Area, allowing for movement of this species out of the disturbance area.
The project will adversely affect habitat critical to the survival of a species.	The Minor Drainage Line and Gorge/Gully habitat within the Assessment Area is not considered habitat critical to the survival of the Pilbara Olive Python. A large portion of Pilbara Olive Python habitat is conserved in Karijini National Park (Pearson 2003), approximately 200 km to the north west of the Assessment Area. In addition, similar habitat to that within the Assessment Area is located adjacent (north) and is of similar or better condition.
The project will disrupt the breeding cycle of an important population.	If, as discussed above, this population is found to be an 'important population', then depending on the timing of the associated clearing and construction activities, there may be a disruption the breeding cycle of the local Pilbara Olive Python population. For example, disturbance may hinder the dispersal of males when searching for females from June to August or if caves/crevices harbouring females are disturbed during mating or egg incubation from October to January.

Significant impact criteria for a Vulnerable species (DoE 2013)	Assessment for the Pilbara Olive Python within the Orebody 24 MDB Extension Assessment Area
The project will modify, destroy, remove or isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.	The area of preferred habitat for the Pilbara Olive Python within the Assessment Area is a small area (23.66 ha or 7% of the Assessment Area). It is also assessed as small when considered in the context of local and regional species distribution and suitable habitat available in the Pilbara region. Although there will be a loss of local habitat, a decline in the species population both locally and regionally, is expected to be minimal. In addition, similar habitat to that within the Assessment Area is located adjacent (north) and is of similar or better condition.
The project will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.	An increase in feral cats and dogs may increase predation of Pilbara Olive Pythons and competition for food resources. However, given that the Proposal is for extension to existing operations rather than new operations it is considered unlikely that the Proposal will result in an increased feral population.
The project will introduce disease that may cause the species to decline.	Disease is currently not implicated in the decline of Pilbara Olive Python, and the proposal is unlikely to introduce new diseases into the environment.
The project will interfere substantially with the recovery of the species	The Minor Drainage Line and Gorge/Gully habitat within the Assessment Area is not considered habitat critical to the recovery of the Pilbara Olive Python.

4.3 Orebody 25 West

4.3.1 Fauna Habitat

4.3.1.1 *Local Context*

The clearing of native vegetation required within the Assessment Area will result in a loss of fauna habitat. The majority of the Assessment Area is Hill Crest/Slope habitat (346.53 ha; 59.8% of Assessment Area) followed by Sand Plain (135.02 ha; 23.3%), Minor Drainage Line (26.49 ha; 4.6%), Major Drainage Line (0.4 ha; 0.1%) and Drainage Area (0.25 ha; 0.1%). Approximately 70.42 ha (12.2%) is already cleared or disturbed. The Hill Crest/Slope, Minor Drainage Line and Drainage Area habitats are common habitats within the vicinity of the Proposal. The Major Drainage Line and Drainage Area habitats are only small fragments within the Assessment Area. The Sand Plain habitat is a large portion of the Assessment Area; however, large representations of this habitat also occur to the north east of the Assessment Area.

Fragmentation of habitat resulting from the clearing of vegetation is unlikely to have a further impact, as the Assessment Area is bounded by mining and infrastructure to the north, east and south; and associated haul road to the east. Clearing of the Assessment Area is unlikely to restrict fauna movements. Instead, the most likely dispersal/movement corridor is Homestead Creek, situated just to the west of the Assessment Area. Homestead Creek will not be affected by clearing and is unlikely to be impacted due to potential drawdown from dewatering or changes in surface water drainage from Orebody 25 West operations and should continue to function as a movement corridor for fauna.

4.3.1.2 *Regional Context*

The fauna habitats within the Assessment Area were considered of moderate to high importance for fauna. The Sand Plain habitat was considered of high importance due to its potential to support the Brush-tailed Mulgara. However, this species has not been recorded within the Assessment Area. In addition, larger representations of this habitat are located at the border of the Hamersley and Fortescue subregions and then extensively within the Chichester subregion. The Hill Crest/Slope and Drainage Area habitats were considered to be of moderate importance for fauna due to their potential to support some conversation significant species. However, these fauna habitat types are also widely represented and common throughout the Pilbara region. The Minor Drainage Line habitats within the Assessment Area were considered to be of high importance due to the recorded presence of a threatened species (Pilbara Olive Python) within this habitat and the presence of a semi-permanent rock pool. Only one semi-permanent rock pool was recorded from within the Assessment Area and given that suitable adjacent habitat in the form of Homestead Creek exists, the loss of this habitat is unlikely to impact this habitat, or conservation significant species that utilise this habitat, on a regional scale.

Given that the fauna habitat types recorded within the Assessment Area are well represented in the region and do not form part of an ecological linkage, it is considered that the impact of clearing the Assessment Area within a regional context would not be significant. The fauna habitats represented within the Assessment Area are typical of the Pilbara region and therefore do not have high ecosystem functional value in terms of the part they play in maintaining ecosystem ecological processes, as defined by the EPA (2002).

4.3.2 Fauna Species

4.3.2.1 *Local Context*

The clearing of vegetation within the Assessment Area will result in the loss of some terrestrial vertebrate species. The majority of fauna species present within the Assessment Area will also be abundant within the local area and have extended home ranges, and impacts on these species are considered likely to be negligible. Birds are generally highly mobile, however, less mobile species are likely to be lost if present in the areas of direct impact.

The Pilbara Olive Python and Rainbow Bee-eater have previously been recorded in the Assessment Area. The Rainbow Bee-eater is unlikely to be impacted as it is a highly mobile species and not restricted to any of the fauna habitats within the Assessment Area. An individual Pilbara Olive Python was recorded from a semi-permanent rock pool within the Minor Drainage Line habitat of the Assessment Area and may be lost if present within the disturbance areas at the time of clearing activities. This species may also be able to traverse the Minor Drainage Line habitat within the Proposal area to adjacent suitable habitat such as Homestead Creek, outside of the Assessment Area. The removal of habitat and potential impact to an individual python is unlikely to impact on the local population.

Other species of conservation significance considered likely to occur within the Assessment Area, include a number of bird species (including one species that is entirely aerial) that are highly mobile and generally less reliant on specific habitats within the Assessment Area. For the other two mammal (Long-tailed Dunnart and Western Pebble-mound Mouse) and one reptile species (*A. ganei*) likely to occur, impacts are likely to be minimal given that their preferred habitats are well represented within the Pilbara, similar habitats exist adjacent to the Assessment Area and there are no records from within the Assessment Area.

4.3.2.2 *Regional Context*

Impacts from clearing and dewatering operations within the Assessment Area are considered unlikely to have a significant impact on the two MNES species recorded within the Assessment Area (Rainbow Bee-eater and Pilbara Olive Python) at a regional scale according to the significant impact criteria (DoE 2013).

Additional conservation significant species are also considered unlikely to be significantly impacted at a regional scale, given some of the species' mobile nature, and that their preferred habitats are well represented and exist adjacent to the Assessment Area.

4.4 Orebody 32 MDB Extension

4.4.1 Fauna Habitat

4.4.1.1 *Local Context*

The clearing of native vegetation required within the Assessment Area will result in a loss of some fauna habitat. The majority of the Assessment Area is Hill Crest/Slope habitat (41.47 ha; 77.7% of the Assessment Area), followed by Sand Plain (6.32 ha; 11.8%), Minor Drainage Line (3.81 ha; 7.1%) and Drainage Area habitat (0.71 ha; 1.3%). The Hill Crest/Slope habitat is extremely widespread and common within the vicinity of the Assessment Area and throughout the Pilbara region. Minor Drainage Line habitats, although not large in area as they are a linear habitat, are a common habitat found in the Hamersley Ranges adjacent to the Assessment Area. There are extensive areas of

Drainage Area habitat to the west of the Assessment Area. The area of Sand Plain habitat within the Assessment Area is small and isolated.

Fragmentation of habitat is unlikely to be an issue due to the existing or proposed mining and infrastructure surrounding the Assessment Area. Clearing of the Assessment Area is unlikely to restrict fauna movements. Instead, the most likely dispersal/movement corridor is Homestead Creek, situated just to the west of the Assessment Area. Homestead Creek will not be affected by the Proposal and will continue to function as a movement corridor for fauna.

4.4.1.2 *Regional Context*

The fauna habitats within the Assessment Area were considered of moderate to high importance for fauna. The Hill Crest/Slope and Drainage Area habitat were considered to be of moderate importance for fauna due to their potential to support some conversation significant species. The Minor Drainage Line habitat was considered of high importance due to its potential for semi-permanent rock pools and to support a number of conservation significant species. However, these fauna habitat types are also widely represented and common throughout the Pilbara region. The Sand Plain habitat was considered of high importance due to its potential to support the Brush-tailed Mulgara. However, this species has not been recorded within the Assessment Area. In addition, the Sand Plain habitat within the Assessment Area is a small isolated patch, whereas larger more intact areas of Sand Plain exist to the north and northwest of the Assessment Area.

Given that the four fauna habitat types recorded within the Assessment Area are well represented in the region and the small size of the Assessment Area, it is considered that the impact of clearing the Assessment Area within a regional context would not be significant. The fauna habitats represented within the Assessment Area are typical of the Pilbara region and therefore do not have high ecosystem functional value.

4.4.2 Fauna Species

4.4.2.1 *Local Context*

The clearing of vegetation within the Assessment Area will result in the loss of some terrestrial vertebrate species in specific locations. Birds are generally highly mobile; however, less mobile species such as some of the mammals, reptiles and amphibians may be lost in areas of direct impact. No conservation significant species were recorded from the Assessment Area.

The majority of fauna species present within the Assessment Area will also be abundant in adjacent areas and have extended home ranges, and impacts on these species are considered likely to be negligible.

4.4.2.2 *Regional Context*

The small area required to be cleared for the Proposal is not likely to impact on conservation significant fauna species or required habitat. It is considered that vegetation clearing within the Assessment Area is unlikely to significantly impact on any terrestrial species listed as conservation significant under the EPBC Act or the WC Act.

No conservation significant species were recorded from the Assessment Area. Additional conservation significant species considered likely to occur or utilise the Assessment Area are also unlikely to be significantly impacted. A number are bird species (including one species that is entirely aerial) that are highly mobile and generally less reliant on specific habitats within the Assessment Area. For the other two mammals and one reptile likely to occur, given that their preferred habitats

are well represented within the Pilbara, similar habitats exist adjacent to the Assessment Area and there are no records from within the Assessment Area, disturbance to the Assessment Area is not expected to have significant impact on these species at a regional scale.

4.5 Indirect Impacts

4.5.1 All Assessment Areas

Indirect impacts from clearing are generally similar across the three Assessment Areas and may include displacement of fauna into adjacent habitat, habitat fragmentation and/or further habitat degradation associated with the construction processes (e.g. dust and weeds) or the increased level of human activity (e.g. feral animals and rubbish). The exception is indirect impacts associated with BWT mining within Orebody 24 approved MDB. These impacts are dealt with separately in Section 4.5.2.

All mobile fauna within future development areas that are able to avoid direct impact will be displaced into adjacent habitat. A characteristic of many arid zone species is their ability to move long distances, for example, some native rodents can move up to 14 km (Dickman et al. 1995). The displacement of fauna into adjacent areas can result in the local area exceeding its carrying capacity, with a subsequent reduction of available resources, and potential mortality or displacement of individuals. The outcome will be that either the same species assemblage will establish a new equilibrium, based on the original carrying capacity of the area, or the excess pressure of local clearing will disrupt the interactions of all species, resulting in the displacement of less robust species.

Habitat degradation may also occur through factors associated with construction activity or increased human activity but can be managed to occur within the disturbance footprint only.

The transmission of weeds into remaining habitat within the Eastern Ridge Development Envelope or adjacent habitat may occur if weed hygiene measures are not implemented. The spread of weeds is most likely to occur along gullies or drainage lines. It is likely to have an adverse impact on the diversity of flora but there is little quantitative data on the effects of weeds on native fauna species. Limited studies indicate that fauna communities are affected by invasive plant species, but these responses may differ according to the taxonomic group in that some species may increase in numbers while others decrease (Grice 2006).

Dust has generally been considered a potential indirect impact on fauna due to the potential to affect vegetation health and ultimately fauna habitat condition. However, recent studies show that dust accumulation from mining projects in semi-arid Australia did not have any impacts on the mortality and recruitment of a threatened flora species or community composition (Matsuki et al. submitted) and therefore are unlikely to impact fauna.

An increase in human activity is often associated with an increase in the abundance of introduced species such as the house mouse and feral cat, which in turn, increases the competition or predation pressure on native fauna species. Little is known about competitive interactions between feral and native species (Dickman 1996) and it is difficult to predict what the impact to native species might be over the life of the Proposal. It is unclear whether the relative numbers of predator and prey will establish a stable equilibrium over the life of the proposal, or whether the increase in feral predators will result in local extinction of small native species. However, given that the Proposal is for extension to existing operations rather than new operations it is considered unlikely that the Proposal will result in an increased feral population.

An increase in mortalities as well as a barrier to fauna movement may also occur with the construction of new roads and increased vehicle traffic; in particular impacting on species such as kangaroos, reptiles including the Pilbara Olive Python, and nocturnal birds.

These indirect impacts have the potential to affect individual species and local species assemblages; however, they are unlikely to have a significant impact on terrestrial fauna assemblages in a regional context, conservation significant fauna species and/or ecosystems of high functional value or that are regionally important. These indirect impacts will continue to be managed as per existing adjacent operations as part of operational management plans.

4.5.2 Orebody 24 and 25 BWT Mining

Considering the Orebody 24 and 25 West BWT mining impacts in isolation (i.e. non-cumulative impact), the impacts from minor groundwater drawdown on vegetation were determined to be low (Onshore Environmental 2015); therefore, potential impacts to fauna are considered to be negligible. Alterations to surface runoff and drainage should not adversely impact the existing surface water regimes, and as such there should be no impacts to fauna.

4.6 Cumulative Impacts

Cumulatively, direct and indirect impacts on native vegetation from mining projects will result in an increased overall loss or modification of remnant vegetation and habitat for species of conservation significance. Cumulatively, it will not increase any reduction in habitat connectivity as the development envelope is one confined area, with large portions of it already cleared and mined. The Eastern Ridge Development Envelope is also constrained by other infrastructure to the south and east. In addition, there are no fauna habitats within the Proposal area that would act as major movement corridors.

No fauna habitats occurring within the four Assessment Areas are restricted to the land systems that are mapped over the Assessment Area. The Eastern Ridge Development Envelope represents no more than 1.5% of the total area within the Pilbara bioregion for any of the five land systems recorded. Similarly, the Eastern Ridge Development Envelope represents <0.09% of the total area within the Pilbara region for any of the three vegetation units (as per Beard 1975) recorded.

4.7 Residual Impacts

There will be minimal residual impacts on fauna as BHP Billiton Iron Ore have advised there is no permanent infrastructure and the Proposal will be remediated and/or rehabilitated according to an approved mine closure plan.

4.8 Eastern Ridge Development Envelope Summary

When the four modifications detailed in Sections 4.1 – 4.4 are assessed in the context of the already approved disturbance areas, the potential impacts associated with the additional clearing of up to 946 ha (22% of the Development Envelope), compared with 4,329 ha already approved or currently being referred within the proposed Eastern Ridge Development Envelope are considered to be minimal. In addition, the impacts to fauna are also considered to be similar as those previously assessed within the Development Envelope. No additional fauna habitat types or conservation significant species were present within the Assessment Areas that were not previously identified and assessed as part of the existing operations.

Although Onshore Environmental (2015) determined that some localised sections of groundwater dependent vegetation were at moderate risk of impacts from the cumulative groundwater drawdown, the potential impacts to fauna are considered minimal, given that only small sections of vegetation may be impacted, and the conservation significant species that may utilise this habitat are likely to be mobile species (i.e. bird species).

5 Discussion

5.1 Adequacy of Surveys

The EPA has indicated that the level of terrestrial fauna survey (i.e. Level 1 or Level 2) required for a development area is assessed on a consideration of ten characteristics (EPA 2004). Astron considers that the Proposal would be considered to have a moderate impact, as five characteristics had a low impact, three had a moderate impact and two had a high impact (Table 7), indicating either a Level 1 or 2 survey would be required.

To date, 11 surveys have been conducted over parts of the Eastern Ridge Development Envelope; four Level 2 terrestrial fauna surveys, three Level 1 terrestrial fauna surveys and four Level 1 and targeted fauna surveys. An additional four surveys; one Level 2 terrestrial fauna survey, two Level 1 terrestrial fauna surveys and one Level 1 and targeted fauna survey, have been conducted within the vicinity of the Eastern Ridge Development Envelope. These surveys provide detailed information on the fauna assemblages in the region. The EPA (2004) suggests a Level 1 terrestrial fauna survey should be conducted if the majority of characteristics are low potential impact. Therefore, Astron considers that more than adequate information is available from the previous surveys conducted over the Assessment Areas to assess the risk of development on terrestrial vertebrate fauna.

Table 7: Assessment of characteristics in defining the scale and nature of impacts on biodiversity (EPA 2004) for the Proposal and level of survey required.

Area characteristic	Scale and nature of impact from the Proposal
Degree of habitat degradation and clearing within region	**LOW** - In either the local area or region: i) in fragmented ecosystems with more than 50% native vegetation or natural areas remaining; or ii) in more extensive ecosystems with more than 50% of vegetation in better condition
Size/scale of proposal/impact	**HIGH** >10 ha - Bioregion Group 1 >50 ha – Bioregion Groups 2-3 >75 ha - Bioregion Group 4
Rarity of vegetation and landforms	**LOW** - Vegetation and landforms that are naturally more Widespread than 10% of local area (15 km radius) and the bioregion.
Significant habitats	**MODERATE** - The vegetation and area characteristics indicate that significant habitats are likely to occur.
Refugia	**LOW** - Refugia are not known from the area or are not found by reconnaissance survey.
Fauna protected under international agreements or treaties, Specially Protected or Priority fauna	**HIGH** i) Species protected by international agreement or treaty (JAMBA/CAMBA), or Specially Protected Fauna are found in the area or in similar habitats in its immediate vicinity during reconnaissance survey; and/or ii) habitat characteristics indicate that species protected by international agreement or treaty (JAMBA/CAMBA), or Specially Protected Fauna species may occur. The presence of several Priority Fauna species may also raise the impact to high.
Other significant fauna or fauna assemblages	**LOW** - Significant species or taxa are not found or likely to be found in the area or in similar habitat in its immediate vicinity.

Area characteristic	Scale and nature of impact from the Proposal
Size of remnant and condition/intactness of habitat and faunal assemblage	**MODERATE** - Area supports a remnant of less than average size and degree of intactness in the district; or the habitat and faunal assemblage is not more intact than that in the district.
Ecological linkage	**LOW** - The area is isolated with no ecological linkages.
Heterogeneity or complexity of the habitat and faunal assemblage	**MODERATE** - The area and/or its immediate surrounds have a similar range of habitats and faunal assemblages relative to the characteristics at the local and regional scale.

5.2 Biodiversity Values

The EPA *Position Statement No. 3* indicates an ecological assessment of a site must consider its biodiversity value at the genetic, species and ecosystem levels, and its ecological functional value at the ecosystem level (EPA 2002). Due to lack of data it is not possible to comment on the biodiversity value at the genetic level; however it is unlikely to be of relevance to the suite of vertebrate fauna within the Eastern Ridge Development Envelope.

Terrestrial vertebrate fauna species present or likely to be present in the Eastern Ridge Development Envelope are generally present elsewhere in the region. A review of fauna databases and previous fauna surveys conducted within the vicinity of the Assessment Areas showed that there are unlikely to be any characteristics of the reptile, bird and mammal assemblages that are of particular significance in the region. The fauna assemblages that have been recorded and that are predicted to occur within the Eastern Ridge Development Envelope are unlikely to be unique for the available habitat types. All vertebrate species likely to occur within the Assessment Areas are distributed widely throughout the region and have been recorded in various other surveys in the bioregion (Appendix A) and are unlikely to be impacted at a regional level should the Proposal proceed.

Seven records of the Pilbara Olive Python have been recorded within the Eastern Ridge Development Envelope, including five records in the newly assessed areas of Orebody 24 MDB extension area and one record in the Orebody 25 West operations area. This local population may be considered an 'important population' as defined by DoE (2013) as it is at the southern extent of its geographic range, and if so, then the Proposal may potentially have a significant impact on this population according to some of the impact criteria for a vulnerable species (DoE 2013).

The fauna habitats represented within the Eastern Ridge Development Envelope are also typical of the Pilbara region, do not provide functions such as movement corridors due to surrounding mining and infrastructure and therefore do not have high ecosystem functional value as defined by the EPA (2002). Clearing associated with the Proposal is unlikely to have an impact on an ecosystem of high functional value nor that is regionally significant. Vegetation clearing is unlikely to have a significant impact on the biodiversity value at the genetic, species and ecosystem levels, particularly when considered in the context of already approved disturbance areas within the larger Eastern Ridge Development Envelope.

5.3 Conclusions

Astron considers that more than adequate information is available from the surveys conducted over the Eastern Ridge Development Envelope to assess the risk of development on terrestrial vertebrate fauna.

Given that the fauna habitat types recorded within the Eastern Ridge Development Envelope are generally typical and well represented in the region, and that the additional maximum clearing required for the modifications (namely Orebody 32 MDB extension, Orebody 24 MDB extension and Orebody 25 West operations) only represents a small portion of the entire Eastern Ridge Development Envelope (22%), the impact of the Proposal is unlikely to have any impact on an ecosystem of high functional value or that is regionally significant.

A review of fauna databases and previous fauna surveys conducted within the vicinity of the Eastern Ridge Development Envelope indicate that the faunal assemblages expected within the Assessment Areas are typical of the Pilbara region and are unlikely to be unique for the habitat types present. Species likely to occur within the Eastern Ridge Development Envelope are distributed widely throughout the region and are unlikely to be significantly impacted at a local or regional level should the Proposal proceed.

Seven Pilbara Olive Python records exist within the Eastern Ridge Development Envelope, five of which were within the Orebody 24 MDB Extension Assessment Area. This local Pilbara Olive Python population may be considered an 'important population' as defined by DoE (2013) as it is at the southern extent of its geographic range; however, this is not confirmed. Regionally, populations are considered stable and sizeable (Pearson 2003) and the species may be more common than previously indicated, with suitable habitat likely to be widespread throughout the Pilbara region, based on predictive species modelling (Biologic 2012; Eco Logical 2013b). Individuals may be impacted depending on direct impact areas from the Proposal and whether individuals would move out of the proposed impact areas to similar habitat that extends north of the Assessment Area. Loss of suitable habitat and potentially individuals, may lead to a local reduction in the area of occupancy for the Pilbara Olive Python, and possibly a decrease in the size of a local population if deemed to be an 'important population' under the guidelines.

In summary, the potential impacts to fauna are also considered to be similar as those previously assessed within the Development Envelope. No additional fauna habitat types or conservation significant species were present within the Assessment Areas that were not previously identified and assessed as part of the existing operations.

6 References

Armstrong, K and Anstee, S 2000, 'The ghost bat in the Pilbara: 100 years on', *Australian Mammalogy,* vol. 22, pp. 93-101.

Beard, JS 1975, *Pilbara - The Vegetation of the Pilbara Area 1:100 000 Vegetation Series*, University of Western Australia Press, Perth.

BHP Billiton Iron Ore 2010, 'Orebody 24/15 Upgrade Project Environmental Protection Statement', BHP Billiton Iron Ore Pty Ltd, Perth.

BHP Billiton Iron Ore 2015, 'Eastern Ridge Revised Proposal – Hydro Data Guidance Notes', Resource Planning Hydrology, BHP Billiton Iron Ore Pty Ltd, Perth.

Biologic 2011, 'Orebody 35 and Western Ridge Vertebrate Fauna Survey', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

Biologic 2012, 'Habitat Modelling for Selected Species of Conservation Significance in the Pilbara', unpublished report for BHP Billiton Iron Ore Pty Ltd, Perth.

Biologic 2014a, 'Orebody 25 Targeted Vertebrate Fauna Survey', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

Biologic 2014b, 'Orebody 24 Targeted Vertebrate Fauna Survey', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

Biota Environmental Sciences 2001, 'Baseline Biological and Soil Surveys and Mapping for ML244SA West of the Fortescue River', unpublished report to BHP Iron Ore Pty Ltd, Perth.

Burbidge, AA, McKenzie, NL and Fuller, PJ 2008, 'Long-tailed Dunnart, *Sminthopsis longicaudata* (Spencer, 1909)', in S Van Dyck and R Strahan (eds.), *The Mammals of Australia 3rd Edition,* New Reed Holland, Sydney, pp. 148-150.

Bureau of Meteorology (BoM) 2015, *Climate Averages for Newman Aero*, viewed February 2015, http://www.bom.gov.au.

Bush, B and Maryan, B 2011, *Field Guide to Snakes of the Pilbara*, Western Australian Museum, Welshpool.

Department of Parks and Wildlife (Parks and Wildlife) 2015, *NatureMap*, viewed February 2015, http://naturemap.dpaw.wa.gov.au/default.aspx.

Department of the Environment (DoE) 2013, *Matters of National Environmental Significance. Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999*, Commonwealth of Australia, Canberra.

DoE 2015, *EPBC Act Protected Matters Search Tool*, viewed May 2015, http://www.environment.gov.au/epbc/pmst/index.html.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2011, *Environment Protection and Biodiversity Conservation Act 1999 referral guidelines for the endangered northern quoll, Dasyurus hallucatus, EPBC Act policy statement 3.25,* Commonwealth of Australia, Canberra.

Dickman, CR 1996, *Overview of the Impact of Feral Cats on Australian Native Fauna,* Australian Nature Conservation Agency, Canberra.

Dickman, CR, Predavec, M and Downey, FJ 1995, 'Long range movements of small mammals in arid Australia: implications for land management', *Journal of Arid Environments,* vol. 31, pp. 441-452.

ecologia 1996, 'Jimblebar Rail Spur Biological Assessment Survey', unpublished report to BHP Iron Ore Pty Ltd, Perth.

ecologia 1998, 'Orebody 23 Extension Biological Assessment Survey', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

ecologia 2004a, 'OB24 Expansion Biological Survey', unpublished report to Mine and Port Development Joint Venture, Perth.

ecologia 2004b, 'Eastern Ophthalmia Range Expansion Biological Survey', unpublished report to BHP Billiton Iron Ore Pty Ltd Perth.

ecologia 2013, 'North Star Magnetite Project – Environmental Scoping Document Response to requested terrestrial fauna items', unpublished document for Fortescue Metals Group, Perth.

Eco Logical Australia 2012, 'Orebody 37 Level 1 Vertebrate Fauna Assessment', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

Eco Logical Australia 2013a, 'Ninga Level 1 Vertebrate Fauna Assessment', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

Eco Logical Australia 2013b, 'Predictive Species Habitat Modelling for Four Species across the Pilbara IBRA', unpublished report for BHP Billiton Iron Ore Pty Ltd, Perth.

ENV Australia 2006, 'OB24 Flora and Fauna Assessment Phase II', unpublished report to Mine and Ports Development Joint Venture Asset Development Projects, Perth.

ENV Australia 2011a, 'Eastern Ridge (OB23/24/25) Fauna Assessment', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

ENV Australia 2011b, Orebody 42/43 Flora, Vegetation and Fauna Assessment Summary Letter and Recommendations', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

ENV Australia 2011c, 'OB31 Fauna Assessment', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

ENV Australia 2012, 'Mount Whaleback Fauna Review and Fauna Assessment', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

Environmental Protection Authority (EPA) 2002, *Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement 3*, EPA, Perth.

EPA 2004, *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, Guidance Statement 56*, EPA, Perth.

EPA 2013, *Environmental Assessment Guideline for Environmental Factors and objectives*, *Environmental Assessment Guidelines No. 8*, EPA, Perth.

EPA and Department of Environment and Conservation (DEC) 2010, *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (eds. BM Hyder, J Dell, and MA Cowan), Perth.

GHD 2008, 'Report for Myopic Project Area, Newman Flora and Fauna Assessment', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

Grice, AC 2006, 'The impacts of invasive plant species on the biodiversity of Australian rangelands', *The Rangeland Journal,* vol. 28, pp. 27-35.

Johnstone, R and Storr, GM 1998, *Handbook of Western Australian Birds Volume 1 - Non-passerines (Emu to Dollarbird)*, Western Australian Museum, Perth.

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

Matsuki, M, Gardener, MR, Smith, A, Howard RK and Gove, A submitted, 'Impacts of dust on plant health, survivorship and plant communities in semi-arid environments'.

Northcote, KH, Beckmann, GG, Bettenay, E, Churchward, HM, Van Dijk, DC, Dimmock, GM, Hubble, GD, Isbell, RF, McArthur, WM, Murtha, GG, Nicolls, KD, Paton, TR, Thompson, CH, Webb, AA and Wright, MJ 1968, *Atlas of Australian Soils, Sheets 1 to 10 with explanatory data,* CSIRO Australia and Melbourne University Press, Melbourne.

Onshore Environmental 2013, 'Mt Whaleback AML 7/244 Flora and Vegetation and Vertebrate Fauna Review', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

Onshore Environmental 2015, 'Eastern Ridge Revised Proposal Flora and Vegetation Impact Assessment', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

Onshore and Biologic 2009, 'Biological Survey Myopic Exploration Leases', unpublished report for BHP Billiton Iron Ore Pty Ltd, Perth.

Outback Ecology 2009, 'Jimblebar Linear Development Terrestrial Vertebrate Fauna Assessment', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

Pearson, D 2003, 'Giant pythons of the Pilbara', *Landscope*, vol. 19(1).

RPS 2015 'Eastern Ridge Mining Operations Amalgamation: Surface Water Environmental Impact Assessment', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

Southgate, R 1990, 'Habitat and diet of the greater bilby *Macrotis lagotis* Reid (Marsupialia: Peramelidae)', in JH Seeback, PR Brown, RL Wallis and CM Kemper (eds.), *Bandicoots and Bilbies*, Surrey Beatty & Sons, Sydney, pp. 303-309.

Start, AN 2008, 'Western Pebble-mouse *Pseudomys chapmani* (Kitchener, 1980)', in S Van Dyck and R Strahan (eds.), *The Mammals of Australia 3rd Edition,* New Reed Holland, Sydney, pp. 621-622.

Stewart, AJ, Sweet, IP, Needham, RS, Raymond, OL, Whitaker, AJ, Liu, SF, Phillips, D, Retter, AJ, Connolly, DP, Stewart, G 2008, *Surface Geology of Australia 1:1,000,000 Scale, Western Australia [Digital Dataset]*, The Commonwealth of Australia, Geoscience Australia, Canberra, http://www.ga.gov.au.

Swan, M 2007, *Keeping and Breeding Australian Pythons*, Mike Swan Herp Books, Lilydale.

Van Vreeswyk, AME, Payne, AL, Leighon, KA, and Hennig, P 2004*, An Inventory and Condition Survey of the Pilbara Region, Western Australia, Technical Bulletin 92*, Department of Agriculture, Perth.

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

Appendix A: Existing Environment Summary Tables

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Table A.1: Geological units, land systems and pre-European vegetation present within the Proposal area.

Unit	Description	Current extent in Pilbara bioregion (ha)	Extent within Orebody 24 MDB extension area (hectare (ha)) and proportion (%)	Extent within Orebody 24 BWT mining area (ha) and proportion (%)	Extent within Orebody 32 MDB extension area (ha) and proportion (%)	Extent within Orebody 25 West area (ha) and proportion (%)
Geological Units						
Achm	Marra Mamba Iron Formation: Chert, ferruginous chert, jaspilite, banded iron-formation, minor shale, siltstone, mudstone.	172,003.24	- -	49.86 0.03	1.81 0.001	12.50 0.007
Ashm	Mount McRae Shale and Mount Sylvia Formation: Interbedded shale, chert, banded iron-formation.	102,208.79	60.52 0.06	439.20 0.43	-	-
Awfj	Jeerinah Formation: Shale, sandstone, siltstone, mudstone, dolomite, local microbanded chert, jaspilite, conglomerate; fine-grained massive rhyolite; mafic tuff with local accretionary lapilli and agglomerate; thin basalt/dolerite and andesitic basalt flows.	249,339.67	-	5.77	-	-
Lch	Hamersley Group: Undivided chert, banded iron-formation, jaspilite, dolomite, mudstone, siltstone.	9,020.71	5.90 0.07	572.57 6.35	3.88 0.04	-
Lchk	Brockman Iron Formation: Banded iron-formation, chert, mudstone and siltstone.	434,051.82	487.45 0.11	546.88 0.13	-	374.62 0.09
Lchw	Weeli Wolli Formation: Banded iron-formation (commonly jaspilitic), mudstone, siltstone; common interlayed metadoleritic sills.	308,223.59	240.74 0.08	319.17 0.10	-	137.12 0.04
Qa	Alluvium 38485: Channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted.	9,299,887.49	-	349.11 0.004	46.11 0.0005	48.98 0.0005
Soils						
Fa13	Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments.	-	319	1952	25	266

Unit	Description	Current extent in Pilbara bioregion (ha)	Extent within Orebody 24 MDB extension area (hectare (ha)) and proportion (%)	Extent within Orebody 24 BWT mining area (ha) and proportion (%)	Extent within Orebody 32 MDB extension area (ha) and proportion (%)	Extent within Orebody 25 West area (ha) and proportion (%)
BE6	Extensive flat and gently sloping plains, which sometimes have a surface cover of gravels and on which red-brown hardpan frequently outcrops.	-	-	306	26	308
Mz25	Plains associated with the Fortescue valley; there is a surface cover of stony gravels close to the ranges and hills.	-	-	27	-	-
Land Systems						
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands	434,645.54	30.44 0.007	536.17 0.12	49.60 0.01	48.74 0.01
Elimunna	Stony plains on basalt supporting sparse acacia and cassia shrublands and patchy tussock grasslands.	18,054.75	-	256.27 1.42	0.35 0.002	31.09 0.172
Newman	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands	1,339,252.86	1,154.22 0.09	1,484.50 0.11	1.86 0.0001	493.33 0.04
River	Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.	31,571.31	-	-	-	-
Rocklea	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.	262,437.64	-	5.16 0.002	-	-
Pre-European Vegetation						
82	Hummock grassland; low tree steppe; Snappy Gum over *Triodia wiseana*	2,169.996.59	1,102.83 0.05	1,983.85 0.09	34.79 0.002	399.82 0.02
29	Sparse low woodland; mulga, discontinuous in scattered groups	784,574.79	-	140.47 0.02	-	-

Unit	Description	Current extent in Pilbara bioregion (ha)	Extent within Orebody 24 MDB extension area (hectare (ha)) and proportion (%)	Extent within Orebody 24 BWT mining area (ha) and proportion (%)	Extent within Orebody 32 MDB extension area (ha) and proportion (%)	Extent within Orebody 25 West area (ha) and proportion (%)
18	Low woodland; mulga (*Acacia aneura*)	580,556.01	-	156.82 0.03	16.99 0.003	173.06 0.03

Table A.2: Vegetation associations recorded within the Proposal area.

Vegetation code	Landform/habitat	Vegetation description	Orebody 24 MDB extension	Orebody 24 BWT mining	Orebody 32 MDB extension	Orebody 25 West
Triodia Hummock Grassland						
SA Tb ChEg SpBeKp	Sand Plains	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Corymbia hamersleyana* and *Eucalyptus gamophylla* over Low Open Shrubland of *Scaevola parvifolia, Bonamia erecta* and *Kennedia prorepens* on red loamy sand on sand plains	✓	✓		✓
HS TsTwTp ElCh AhiAad	Hill Slopes and Low Undulating Hills	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia wiseana* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over Low Open Shrubland of *Acacia hilliana* and *Acacia adoxa* var. *adoxa* on red brown sandy loam on hill slopes	✓	✓	✓	✓
HS Tw ElChHc AanAbAa	Hill Slopes and Low Undulating Hills	Hummock Grassland of *Triodia wiseana* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia, Corymbia hamersleyana* and *Hakea chordophylla* and Open Shrubland of *Acacia ancistrocarpa, Acacia bivenosa* and *Acacia aptaneura* on red sandy loam on hill slopes		✓		
SP Ts Ai	Stony Plains	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with High Open Shrubland of *Acacia inaequilatera* on red brown loamy sand on hill slopes and stony plains		✓		
CP TwTa Es AbPlApy	Calcrete Plains	Hummock Grassland of *Triodia wiseana* and *Triodia angusta* with Open Mallee of *Eucalyptus socialis* subsp. *eucentrica* and Open Shrubland of *Acacia bivenosa, Petalostylis labicheoides* and *Acacia pyrifolia* var. *pyrifolia* on light brown clay loam		✓		
GG Tp ElCfe Dpa	Gorges and Gullies	Hummock Grassland of *Triodia pungens* with Low Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia ferriticola* over Open Shrubland of *Dodonaea pachyneura* on red brown sandy clay loam in gullies		✓		

Vegetation code	Landform/habitat	Vegetation description	Orebody 24 MDB extension	Orebody 24 BWT mining	Orebody 32 MDB extension	Orebody 25 West
HC TpTs El AaAkAsi	Hill Crests and Upper Hill Slopes	Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* over Scattered Tall Shrubs of *Acacia aptaneura*, *Acacia kempeana* and *Acacia sibirica* on red brown loam on hill crests, hill slopes and breakaway slopes	✓	✓	✓	
HC TwTbrTp ElCh AmaGwAb	Hill Crests and Upper Hill Slopes	Hummock Grassland of *Triodia wiseana*, *Triodia brizoides* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over High Open Shrubland of *Acacia maitlandii*, *Grevilllea wickhamii* subsp. *hispidula* and *Acacia bivenosa* on red brown sandy loam on hill crests and upper hill slopes	✓	✓	✓	✓
Triodia Open Hummock Grassland						
SA Tl AanApa ApaAprCh	Sand Plains	Open Hummock Grassland of *Triodia lanigera* with Open Shrubland of *Acacia ancistrocarpa* and *Acacia pachyacra* and Scattered Low Trees of *Acacia paraneura, Acacia pruinocapra* and *Corymbia hamerselyana* on red sandy loam on stony plains.		✓		
Themeda Tussock Grassland						
FP TtEaCc ChEx AdAaAmc	Flood Plains	Tussock Grassland of *Themeda triandra, Eulalia aurea* and **Cenchrus ciliaris* with Low Open Woodland of *Corymbia hamersleyana* and *Eucalyptus xerothermica* over High Open Shrubland of *Acacia dictyophleba, Acacia ancistrocarpa* and *Acacia macrane*		✓		
Eucalyptus Woodland						
MA EcEv AciApyMg CcEaTt	Major Drainage Lines	Woodland of *Eucalyptus camaldulensis* subsp. *refulgens* and *Eucalyptus victrix* over High Open Shrubland of *Acacia citrinoviridis, Acacia pyrifolia* var. *pyrifolia* and *Melaleuca glomerata* over Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Themeda triandra*		✓		

Vegetation code	Landform/habitat	Vegetation description	Orebody 24 MDB extension	Orebody 24 BWT mining	Orebody 32 MDB extension	Orebody 25 West
MA EvAciEc TrcCcrApy CcEaTt	Major Drainage Lines	Woodland of *Eucalyptus victrix, Acacia citrinoviridis* and *Eucalyptus camaldulensis* subsp. *refulgens* over Low Open Shrubland of *Tephrosia rosea* var. *clementii, Corchorus crozophorifolius* and *Acacia pyrifolia* var. *pyrifolia* over Very Open Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Themeda triandra*		✓		
Eucalyptus Low Woodland						
ME TtEaEte ApyAtpPl EvCh	Medium Drainage Lines	Tussock Grassland of *Themeda triandra, Eulalia aurea* and *Eriachne tenuiculmis* with High Shrubland of *Acacia pyrifolia* var. *pyrifolia, Acacia tumida* var. *pilbarensis* and *Petalostylis labicheoides* and Open Woodland of *Eucalyptus victrix* and *Corymbia hamersleyana* on red brown silty loam on medium drainage lines and flood plains	✓	✓	✓	✓
Corymbia Low Open Woodland						
MI CcAa CcCs Tb	Minor Drainage Lines	Low Open Woodland of *Corymbia candida* subsp. *dipsodes* and *Acacia aptaneura* over Open Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* and Very Open Hummock Grassland of *Triodia basedowii* on red brown loam on floodplains and minor drainage lines		✓		✓
Acacia Shrubland						
MI AmoAanPl ChEl TtAin	Minor Drainage Lines	Shrubland of *Acacia monticola, Acacia ancistrocarpa* and *Petalostylis labicheoides* with Scattered Low Trees of *Corymbia hamerselyana* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Tussock Grassland of *Themeda triandra* and *Aristida inaequilatera* on red loamy sand on minor drainage lines	✓	✓	✓	✓
Acacia Low Open Woodland						

Vegetation code	Landform/habitat	Vegetation description	Orebody 24 MDB extension	Orebody 24 BWT mining	Orebody 32 MDB extension	Orebody 25 West
FP AaAciApr AsyAscAb Tp	Flood Plains	Low Open Woodland of *Acacia aptaneura, Acacia citrinoviridis* and *Acacia pruinocarpa* over Open Shrubland of *Acacia synchronicia, Acacia sclerosperma* subsp. *sclerosperma* and *Acacia bivenosa* over Very Open Hummock Grassland of *Triodia pungens*		✓		
Acacia Low Woodland						
FP AaAprAca EffDpeSe AcoDamAin	Flood Plains	Low Woodland of *Acacia aptanerua, Acacia pruinocarpa* and *Acacia catenulata* subsp. *occidentalis* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii, Dodonaea petiolaris* and *Sida ectogama* over Open Tussock Grassland of *Aristida contorta*		✓		
Acacia Low Open Forest						
FP AciAa Cc Bb	Flood Plains	Low Open Forest of *Acacia citrinoviridis* and *Acacia aptanerua* over Tussock Grassland of **Cenchrus ciliaris* over Open Herbs of **Bidens bipinnata* on red brown loamy sand on floodplains		✓		
***Cenchrus Tussock Grassland**						
MA CcCs EvAciAh	Major Drainage Lines	Tussock Grassland **Cenchrus ciliaris* and **Cenchrus setiger* with Low Woodland of *Eucalyptus victrix, Acacia citrinoviridis* and *Atalaya hemiglauca* on brown sandy loam on major drainage lines and adjacent flood plains		✓		
Cleared/disturbed						
Cleared	N/A	N/A		✓		✓

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Appendix B: Fauna Conservation Codes and Likelihood/Importance Criteria

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Table B.1: Categories and definitions for EPBC Act listed flora and fauna species.

Conservation category	Definition
Extinct	Taxa with no reasonable doubt that the last member of the species has died.
Extinct in the wild	Taxa known to survive only in cultivation, in captivity or as a naturalized population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriated seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (E)	Taxa are not critically endangered; and are facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (V)	Taxa are not critically endangered or endangered; and are facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation dependent (CD)	Taxa are the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or the following subparagraphs are satisfied: i) the taxa is a species of fish; ii) the taxa is the focus of a management plan that provides management actions necessary to stop the decline of, and support the recovery of, the taxa so that its chances of long term survival in nature are maximized; iii) the management plan is in force under a law of the Commonwealth or of a State or Territory; iv) Cessation of the management plan would adversely affect the conservation status of the taxa Fish includes all taxa of bony fish, sharks, rays, crustaceans, molluscs and other marine organisms, but does not include marine mammals/reptiles.

Table B.2: Conservation codes for Western Australian flora and fauna.

Code	Conservation category	Definition
S1	Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice and Wildlife Conservation (Rare Flora) Notice under the Wildlife Conservation Act 1950.	Taxa that is rare or likely to become extinct, as critically endangered taxa.
S2	Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice and Wildlife Conservation (Rare Flora) Notice under the Wildlife Conservation Act 1950.	Taxa that is rare or likely to become extinct, as endangered taxa.
S3	Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice and Wildlife Conservation (Rare Flora) Notice under the Wildlife Conservation Act 1950.	Taxa that is rare or likely to become extinct, as vulnerable taxa.
S4	Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice and Wildlife Conservation (Rare Flora) Notice under the Wildlife Conservation Act 1950.	Taxa that is presumed to be extinct.
S5	Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice under the Wildlife Conservation Act 1950.	Birds that are subject to international agreements relating to the protection of migratory birds.
S6	Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice under the Wildlife Conservation Act 1950.	Fauna that are of special conservation need being species dependent on ongoing conservation intervention.
S7	Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice under the Wildlife Conservation Act 1950.	Declared to be fauna that is in need of special protection, otherwise than for the reasons mentioned.

Note: Schedules 5, 6, and 7 are only related to conservation significant fauna.

Table B.3: Priority species under Western Australian *Wildlife Conservation Act 1950*.

Taxa that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora and Priority Fauna Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Taxa 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 taxa require regular monitoring. Conservation Dependent species are placed in Priority 5.

P1: Priority One – Poorly known taxa
Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2: Priority Two – Poorly known taxa
Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3: Priority Three – Poorly known taxa
Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4: Priority Four: Rare, near threatened and other taxa in need of monitoring
(a) Rare. Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. (b) Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5: Priority Five: Conservation dependent taxa
Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxa becoming threatened within five years.

Table B.4: Criteria used to define importance of fauna habitats.

Importance to fauna rating	Criteria
High	Habitat supports threatened fauna species. OR Uncommon habitat that is critical habitat for other conservation significant fauna species, e.g. if habitat is limited in the region and the habitat in the Project area forms a significant portion of the known habitat for a Priority species OR Habitat that only occurs in small isolated areas and is not widespread in the region.
Moderate	Habitat supports other conservation significant fauna species but that are not necessarily restricted to the habitat type within the Project area. OR Habitat supports a particularly diverse and uncommon faunal assemblage or that may act as a corridor for dispersal or movement of fauna.
Low	Habitat is widespread and common throughout the region and does not solely support any conservation significant fauna species.

Table B.5: Criteria used to define likelihood occurrence of conservation significant fauna species.

Likelihood of occurrence	Criteria
Recorded	Species has been recorded within the Proposal area.
Likely	Species has not been recorded from within the Project area, however species has been recorded within 20 km of the Project area and preferred habitat appears to be present.
Possible	Species has not been recorded from within the Proposal area, however species has been recorded within 20 km of the Project area and suitable habitat appears to be present.
Unlikely	Species recorded within 20 km of the Proposal area but suitable habitat does not appear to be present.

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Appendix C: Terrestrial Vertebrate Fauna List

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Table C.1: List of amphibian species recorded from database searches or previous surveys in the vicinity of the Proposal area.

Species name	Common name	Conservation status			Database results		Previous surveys										
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	ecologia (1996)	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore and Biologic (2009)	Outback Ecology (2009)	ENV (2011)	Eco Logical (2012)	Biologic (2014) - OB24	Biologic (2014) - OB25
HYLIDAE																	
Cyclorana maini	Main's Frog				x			x		x							
Cyclorana platycephala	Water-Holding Frog									x							
Litoria rubella	Desert Tree Frog				x		x	x		x			x		x	x	
MYOBATRACHIDAE																	
Pseudophryne douglasi	Douglas' Toadlet				x								x				
Uperoleia russelli	Russell's Toadlet				x		x						x				
Uperoleia saxatilis	Pilbara Toadlet				x												
LIMNODYNASTIDAE																	
Neobatrachus kunapalari	Kunapalari Frog				x								x				
BUFONIDAE																	
Platyplectrum spenceri	Centralian Burrowing Frog				x			x									

Table C.2: List of reptile species recorded from database searches or previous surveys in the vicinity of the Proposal area.

Species name	Common name	Conservation status			Database results		Previous surveys										
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	ecologia (1996)	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore and Biologic (2009)	Outback Ecology (2009)	ENV (2011)	Eco Logical (2012)	Biologic (2014) - OB24	Biologic (2014) - OB25
CHELUIDAE																	
Chelodina steindachneri	Flat-shelled Turtle				x			x					x				
AGAMIDAE																	
Ctenophorus caudicinctus	Ring-tailed Dragon				x			x	x	x	x	x	x	x	x	x	x
Ctenophorus isolepis	Crested Dragon				x			x				x	x	x	x	x	x
Ctenophorus maculatus					x												
Ctenophorus nuchalis	Central Netted Dragon				x								x		x		
Ctenophorus reticulatus	Western Netted Dragon				x			x									
Lophognathus longirostris					x		x	x		x		x	x	x	x	x	
Pogona minor					x			x			x	x					
Tympanocryptis cephalus	Pebble Dragon				x												
DIPLODACTYLIDAE																	
Diplodactylus conspicillatus	Fat-tailed Gecko				x			x	x				x				
Diplodactylus mitchelli					x												
Diplodactylus savagei	Yellow-spotted Pilbara Gecko				x			x	x				x				x
Lucasium stenodactylum	Pale-snouted Ground Gecko				x			x	x	x			x				
Lucasium wombeyi					x			x	x								
Oedura marmorata	Marbled Velvet Gecko				x			x		x		x	x				
Rhynchoedura ornata	Beaked Gecko				x			x	x				x				
Strophurus elderi					x								x				
Strophurus wellingtonae					x			x		x			x				
CARPHODACTYLIDAE																	
Nephrurus wheeleri	Banded Knob-tailed Gecko				x			x	x	x							
GEKKONIDAE																	
Gehyra pilbara					x												
Gehyra punctata	Spotted Rock Dtella				x			x		x			x				x
Gehyra variegata	Tree Dtella				x		x	x					x	x	x		x
Heteronotia binoei	Bynoe's Gecko				x		x	x		x			x				
Heteronotia planiceps					x												
Heteronotia spelea	Desert Cave Gecko				x			x		x							
PYGOPODIDAE																	
Delma butleri	Unbanded Delma				x												
Delma elegans	Pilbara Delma				x												
Delma haroldi					x			x									
Delma nasuta					x			x	x								

Species name	Common name	Conservation status			Database results		Previous surveys										
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	ecologia (1996)	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore and Biologic (2009)	Outback Ecology (2009)	ENV (2011)	Eco Logical (2012)	Biologic (2014) - OB24	Biologic (2014) - OB25
Delma pax					x			x	x				x		x	x	
Lialis burtonis	Burton's legless lizard				x			x		x				x			
Pygopus nigriceps	Hooded Scaly foot							x		x			x				
SCINCIDAE																	
Carlia munda					x		x	x	x	x			x	x	x	x	
Carlia triacantha	Desert Rainbow Skink				x			x					x	x	x		
Cryptoblepharus buchananii					x												
Cryptoblepharus ustulatus					x			x								x	
Ctenotus ariadnae					x												
Ctenotus duricola					x				x		x		x				
Ctenotus grandis					x				x				x				
Ctenotus helenae					x			x	x	x			x				
Ctenotus leonhardii					x			x					x				
Ctenotus pantherinus	Leopard Ctenotus				x			x	x				x	x	x	x	
Ctenotus rubicundus					x			x	x								
Ctenotus rutilans	Pilbara Rusty Ctenotus				x											x	
Ctenotus saxatilis	Rock Ctenotus				x			x	x	x			x	x		x	
Ctenotus schomburgkii	Barred Wedge-tailed Ctenotus													x			
Ctenotus serventyi																x	
Ctenotus uber					x					x			x				
Cyclodomorphus melanops	Slender Blue-tongue				x			x					x				
Egernia cygnitos	Pygmy Spiny-tailed Skink (western)				x												
Egernia depressa	Pygmy Spiny-tailed Skink				x			x	x				x	x			
Egernia formosa	Crevice Skink				x				x	x						x	
Eremiascincus richardsonii	Broad-banded Sand Swimmer				x			x									
Lerista bipes					x								x				
Lerista macropisthopus macropisthopus	Unpatterned Robust Slider														x		
Lerista muelleri					x		x						x				
Lerista neander					x			x					x				
Lerista zietzi					x			x		x			x				
Menetia greyii	Dwarf Skink				x		x						x		x		
Menetia surda					x												
Morethia ruficauda	Fire-tailed Skink				x		x	x		x	x		x	x		x	
Proablepharus reginae														x		x	

Species name	Common name	Conservation status			Database results		Previous surveys										
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	ecologia (1996)	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore and Biologic (2009)	Outback Ecology (2009)	ENV (2011)	Eco Logical (2012)	Biologic (2014) - OB24	Biologic (2014) - OB25
Tiliqua occipitalis	Western Blue-tongue									x							
Tiliqua multifasciata	Central Blue-tongue				x		x						x				
VARANIDAE																	
Varanus acanthurus	Spiny-tailed Monitor				x			x	x	x		x	x				
Varanus brevicauda	Short-tailed Pygmy Monitor				x												
Varanus bushi	Pilbara Mulga Monitor				x												
Varanus caudolineatus	Stripe-tailed Monitor				x			x					x				
Varanus giganteus	Perentie				x			x		x			x				
Varanus gouldii	Bungarra or Sand Monitor				x							x	x				
Varanus panoptes	Yellow-spotted Monitor				x			x									
Varanus pilbarensis	Pilbara Rock Monitor				x			x		x							
Varanus tristis	Black-headed Monitor				x			x	x	x			x				
TYPHLOPIDAE																	
Anilios ammodytes													x				
Anilios ganei				P1	x								x				
Anilios grypus								x					x				
Anilios hamatus													x				
BOIDAE																	
Antaresia perthensis	Pygmy Python				x			x	x	x			x				
Antaresia stimsoni	Stimson's Python				x					x			x				
Aspidites melanocephalus	Black-headed Python				x												
Liasis olivaceus barroni	Pilbara Olive Python	VU	S3		x	x											x
ELAPIDAE																	
Acanthophis wellsi	Pilbara Death Adder				x			x		x							
Brachyurophis approximans	Shovel-nosed Snake				x			x		x			x				
Demansia psammophis	Yellow-faced Whipsnake				x								x				
Demansia rufescens	Rufous Whipsnake				x			x									
Furina ornata	Moon Snake				x					x							
Parasuta monachus	Inland Hooded Snake				x			x									
Pseudechis australis	Mulga Snake				x			x		x							
Pseudonaja mengdeni	Western Brown Snake				x				x	x							
Pseudonaja modesta	Ringed Brown Snake				x					x							
Pseudonaja nuchalis	Gwardar												x				
Suta fasciata	Rosen's Snake				x			x									
Suta punctata	Spotted Snake				x												
Vermicella snelli	Bandy bandy				x								x				

Table C.3: List of bird species recorded from database searches or previous surveys in the vicinity of the Proposal area.

Species name	Common name	Conservation status			Database results		Previous surveys										
		EPBC Act	WC Act	DPaW	Nature Map	EPBC Protected Matters	ecologia (1996)	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	Outback Ecology (2009)	ENV (2011)	Eco Logical (2012)	Biologic (2014) - OB24	Biologic (2014) - OB25
CASUARIIDAE																	
Dromaius novaehollandiae	Emu				x		x						x		x		
PHASIANIDAE																	
Coturnix pectoralis	Stubble Quail				x												
Coturnix ypsilophora	Brown Quail				x												
ANSERANATIDAE																	
Anseranas semipalmata	Magpie Goose				x												
ANHINGIDAE																	
Anhinga melanogaster	Darter												x		x		
ANATIDAE																	
Anas gracilis	Grey Teal				x		x	x							x		
Anas rhynchotis	Australasian Shoveler				x												
Anas superciliosa	Pacific Black Duck				x		x	x							x		
Aythya australis	Hardhead				x										x		
Chenonetta jubata	Australian Wood Duck				x										x		
Cygnus atratus	Black Swan				x			x							x		
Dendrocygna arcuata	Wandering Whistling Duck				x								x				
Dendrocygna eytoni	Plumed Whistling-duck				x												
Malacorhynchus membranaceus	Pink-eared Duck				x			x									
Stictonetta naevosa	Freckled Duck				x												
Tadorna tadornoides	Australian Shelduck				x			x							x		
RALLIDAE																	
Fulica atra	Eurasian Coot				x			x							x		
Gallirallus philippensis	Buff-banded Rail				x												
Gallinula ventralis	Black-tailed Native Hen														x		
Porphyrio porphyrio	Purple Swamphen				x												
Porzana pusilla	Baillon's Crake				x												
Porzana tabuensis	Spotless Crake				x												
PODICIPEDIDAE																	
Podiceps cristatus	Great Crested Grebe				x										x		
Poliocephalus poliocephalus	Hoary-headed Grebe				x												
Tachybaptus novaehollandiae	Australasian Grebe				x			x									
COLUMBIDAE																	
Geophaps plumifera	Spinifex Pigeon				x			x	x	x	x	x	x	x	x	x	x
Geopelia cuneata	Diamond Dove				x		x	x	x	x		x	x		x	x	x
Geopelia humeralis	Bar-shouldered Dove				x												
Geopelia striata	Peaceful Dove				x							x	x				
Ocyphaps lophotes	Crested Pigeon				x		x	x	x	x	x	x	x	x	x	x	
Phaps chalcoptera	Common Bronzewing				x			x			x		x			x	

Species name	Common name	Conservation status			Database results		Previous surveys										
		EPBC Act	WC Act	DPaW	Nature Map	EPBC Protected Matters	ecologia (1996)	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	Outback Ecology (2009)	ENV (2011)	Eco Logical (2012)	Biologic (2014) - OB24	Biologic (2014) - OB25
PODARGIDAE																	
Podargus strigoides	Tawny Frogmouth				x					x						x	
EUROSTOPODIDAE																	
Eurostopodus argus	Spotted Nightjar				x		x	x	x	x	x	x					
AEGOTHELIDAE																	
Aegotheles cristatus	Australian Owlet-nightjar				x			x	x				x			x	
APODIDAE																	
Apus pacificus	Fork-tailed Swift	Mi	S5			x											
PHALACROCORACIDAE																	
Phalacrocorax carbo	Great Cormorant				x										x		
Phalacrocorax melanoleucos	Little Pied Cormorant						x	x							x		
Phalacrocorax sulcirostris	Little Black Cormorant				x		x						x		x		
Phalacrocorax varius hypoleucos	Pied Cormorant				x										x		
PELECANIDAE																	
Pelecanus conspicillatus	Australian Pelican				x										x		
CICONIIDAE																	
Ephippiorhynchus asiaticus	Black-necked Stork				x												
ARDEIDAE																	
Ardea ibis	Cattle Egret	Mi	S5		x	x											
Ardea intermedia	Intermediate Egret				x												
Ardea modesta	Eastern Great Egret	Mi	S5			x		x							x		
Ardea pacifica	White-necked Heron				x			x					x		x		
Egretta novaehollandiae	White-faced Heron				x		x	x					x		x		
Nycticorax caledonicus	Rufous Night-Heron				x												
THRESKIORNITHIDAE																	
Platalea flavipes	Yellow-billed Spoonbill				x		x						x				
Platalea regia	Royal Spoonbill				x			x									
Plegadis falcinellus	Glossy Ibis	Mi	S5		x												
Threskiornis molucca	Australian White Ibis				x												
Threskiornis spinicollis	Straw-necked Ibis				x												
ACCIPITRIDAE																	
Aquila audax	Wedge-tailed Eagle				x			x	x	x	x	x	x				
Haliaeetus leucogaster	White-bellied Sea-eagle				x											x	
Accipiter cirrocephalus	Collared Sparrowhawk				x			x	x								
Accipiter fasciatus	Brown Goshawk				x		x	x					x			x	
Circus approximans	Swamp Harrier				x												
Circus assimilis	Spotted Harrier				x			x	x			x					
Elanus axillaris	Black-shouldered Kite				x		x	x	x						x		
Lophoictinia isura	Square-tailed Kite						x								x		
Haliastur sphenurus	Whistling Kite				x		x	x	x	x	x	x	x	x	x	x	

Species name	Common name	Conservation status			Database results		Previous surveys										
		EPBC Act	WC Act	DPaW	Nature Map	EPBC Protected Matters	ecologia (1996)	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	Outback Ecology (2009)	ENV (2011)	Eco Logical (2012)	Biologic (2014) - OB24	Biologic (2014) - OB25
Milvus migrans	Black Kite				x			x			x		x		x		
Hamirostra melanosternon	Black-breasted Buzzard				x					x			x				
Hieraaetus morphnoides	Little Eagle				x		x	x		x		x		x	x		
FALCONIDAE																	
Falco berigora	Brown Falcon				x			x	x	x		x	x	x		x	
Falco cenchroides	Australian Kestrel				x			x	x	x	x	x	x	x	x	x	
Falco longipennis	Australian Hobby				x		x	x	x	x			x	x		x	
Falco peregrinus	Peregrine Falcon		S7		x		x	x			x					x	
Falco hypoleucos	Grey Falcon		S3		x												
BURHINIDAE																	
Burhinus grallarius	Bush Stone-curlew				x												
OTIDIDAE																	
Ardeotis australis	Australian Bustard				x			x				x	x	x	x		x
RECURVIROSTRIDAE																	
Cladorhynchus leucocephalus	Banded Stilt				x												
Himantopus himantopus	Black-winged Stilt				x			x									
Recurvirostra novaehollandiae	Red-necked Avocet				x			x									
CHARADRIIDAE																	
Charadrius veredus	Oriental Plover	Mi	S5			x											
Elseyornis melanops	Black-fronted Dotterel				x		x	x					x				
ROSTRATULIDAE																	
Rostratula australis	Australian Painted Snipe	EN	S2			x											
SCOLOPACIDAE																	
Actitis hypoleucos	Common Sandpiper	Mi	S5		x												
Calidris acuminata	Sharp-tailed Sandpiper	Mi	S5		x												
Calidris melanotos	Pectoral Sandpiper	Mi	S5		x												
Calidris subminuta	Long-toed Stint	Mi	S5		x												
LARIDAE																	
Larus novaehollandiae	Silver Gull				x												
TURNICIDAE																	
Turnix velox	Little Button-quail				x		x	x				x	x	x	x		
GLAROLIDAE																	
Stiltia isabella	Australian Pratincole				x												
CACATUIDAE																	
Eolophus roseicapillus	Galah				x			x		x	x	x	x	x	x	x	x
Cacatua sanguinea	Little Corella				x		x	x		x	x		x	x	x	x	
Nymphicus hollandicus	Cockatiel				x		x	x	x	x		x	x	x	x		x
PSITTACIDAE																	
Barnardius zonarius	Australian Ringneck				x		x	x	x	x	x	x	x	x	x	x	x
Psephotus varius	Mulga Parrot				x			x								x	
Melopsittacus undulatus	Budgerigar				x		x	x	x	x	x	x	x	x	x		x

Species name	Common name	Conservation status			Database results		Previous surveys										
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Neopsephotus bourkii	Bourke's Parrot				x												
CUCULIDAE																	
Centropus phasianinus	Pheasant Coucal				x				x	x			x		x		
Chalcites basalis	Horsfield's Bronze Cuckoo				x		x	x	x	x			x				
Chalcites osculans	Black-eared Cuckoo				x			x					x	x			
Cacomantis pallidus	Pallid Cuckoo				x		x	x	x	x			x	x			
STRIGIDAE																	
Ninox connivens	Barking Owl				x												
Ninox novaeseelandiae	Southern Boobook				x		x	x	x	x			x			x	x
TYTONIDAE																	
Tyto javanica	Eastern Barn Owl				x			x	x								
HALCYONIDAE																	
Dacelo leachii	Blue-winged Kookaburra				x		x	x	x	x			x	x	x	x	
Todiramphus pyrrhopygius	Red-backed Kingfisher				x		x	x	x	x		x	x	x			
Todiramphus sanctus	Sacred Kingfisher				x		x	x		x			x		x		
MEROPIDAE																	
Merops ornatus	Rainbow Bee-eater	Mi	S5		x	x	x	x	x		x	x	x	x	x	x	x
CLIMACTERIDAE																	
Climacteris melanura	Black-tailed Treecreeper				x												
PTILINORHYNCHIDAE																	
Ptilonorhynchus guttatus	Western Bowerbird				x			x	x	x				x	x	x	
MALURIDAE																	
Amytornis striatus whitei	Striated Grasswren				x			x	x	x		x	x			x	
Malurus lamberti	Variegated Fairy-wren				x		x	x	x	x	x	x	x	x	x	x	x
Malurus leucopterus	White-winged Fairy-wren				x			x	x	x		x	x	x	x		
Malurus splendens	Splendid Fairy-wren				x				x				x				
ACANTHIZIDAE																	
Pyrrholaemus brunneus	Redthroat				x			x									
Smicrornis brevirostris	Weebill				x		x	x	x	x	x	x	x	x	x	x	x
Gerygone fusca	Western Gerygone				x			x	x	x	x		x	x			
Gerygone mungi	Desert Gerygone				x												
Acanthiza apicalis	Inland Thornbill				x			x	x				x				
Acanthiza chrysorrhoa	Yellow-rumped Thornbill				x			x					x				
Acanthiza robustirostris	Slaty-backed Thornbill				x			x									
Acanthiza uropygialis	Chestnut-rumped Thornbill				x		x	x		x			x	x			
PARDALOTIDAE																	
Pardalotus rubricatus	Red-browed Pardalote				x		x	x	x	x			x				
Pardalotus striatus	Striated Pardalote				x		x	x	x	x		x	x				
MELIPHAGIDAE																	
Acanthagenys rufogularis	Spiny-cheeked Honeyeater				x			x	x	x	x	x	x				x
Conopophila whitei	Grey Honeyeater				x			x					x				

Species name	Common name	Conservation status			Database results		Previous surveys										
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Lichenostomus keartlandi	Grey-headed Honeyeater				x			x	x	x		x	x	x		x	x
Lichenostomus penicillatus	White-plumed Honeyeater						x	x	x	x		x	x	x	x		x
Lichenostomus plumulus	Grey-fronted Honeyeater							x									
Lichenostomus virescens	Singing Honeyeater							x	x	x	x	x	x	x	x	x	x
Lichmera indistincta	Brown Honeyeater				x		x	x	x	x		x	x	x	x		
Melithreptus gularis	Black-chinned Honeyeater				x		x	x	x	x			x		x		
Purnella albifrons	White-fronted Honeyeater				x		x	x	x								
Sugomel niger	Black Honeyeater				x							x	x	x			
Manorina flavigula	Yellow-throated Miner				x			x	x	x		x	x	x	x	x	x
Epthianura tricolor	Crimson Chat				x			x					x		x	x	x
Epthianura aurifrons	Orange Chat				x												
POMATOSTOMIDAE																	
Pomatostomus superciliosus	White-browed Babbler				x			x								x	
Pomatostomus temporalis	Grey-crowned Babbler				x		x	x	x	x		x	x	x	x	x	x
PSOPHODIDAE																	
Psophodes occidentalis	Western Wedgebill				x												
CAMPEPHAGIDAE																	
Coracina maxima	Ground Cuckoo-shrike				x				x			x				x	
Coracina novaehollandiae	Black-faced Cuckoo-shrike				x		x	x	x	x	x	x	x		x	x	
Lalage tricolor	White-winged Triller				x		x	x	x	x		x	x				
PACHYCEPHALIDAE																	
Pachycephala rufiventris	Rufous Whistler				x		x	x	x	x	x	x	x	x	x		
Colluricincla harmonica	Grey Shrike-thrush				x		x	x	x	x	x	x	x	x	x	x	x
Oreoica gutturalis	Crested Bellbird				x		x	x	x	x		x	x	x			
ARTAMIDAE																	
Artamus cinereus	Black-faced Woodswallow				x			x		x	x	x	x	x		x	
Artamus cyanopterus	Dusky Woodswallow				x												
Artamus minor	Little Woodswallow				x			x	x	x	x					x	x
Artamus personatus	Masked Woodswallow				x			x							x		
Artamus superciliosus	White-browed Woodswallow				x										x		
Cracticus nigrogularis	Pied Butcherbird				x		x	x	x	x	x	x	x	x	x	x	x
Cracticus tibicen	Australian Magpie				x			x	x	x	x	x	x	x		x	
Cracticus torquatus	Grey Butcherbird				x			x		x	x			x			x
RHIPIDURIDAE																	
Rhipidura albicauda	White-tailed Fantail				x		x										
Rhipidura fuliginosa	Grey Fantail				x			x				x					
Rhipidura leucophrys	Willie Wagtail				x		x	x	x	x	x	x	x	x	x	x	x
CORVIDAE																	
Corvus bennetti	Little Crow				x			x								x	
Corvus coronoides	Australian Raven															x	

Species name	Common name	Conservation status			Database results		Previous surveys										
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Corvus orru	Torresian Crow				x		x		x	x	x	x	x	x			
MONARCHIDAE																	
Grallina cyanoleuca	Magpie-lark				x		x	x	x	x	x	x	x	x	x	x	x
PETROICIDAE																	
Petroica goodenovii	Red-capped Robin				x		x	x					x			x	
Melanodryas cucullata	Hooded Robin				x			x	x	x		x		x			
ALAUDIDAE																	
Mirafra javanica	Horsfield's Bushlark				x					x					x		
ACROCEPHALIDAE																	
Acrocephalus australis	Australian Reed-Warbler				x			x					x				
MEGALURIDAE																	
Cincloramphus cruralis	Brown Songlark				x			x						x	x		
Cincloramphus mathewsi	Rufous Songlark				x		x	x		x			x				x
Eremiornis carteri	Spinifexbird				x			x	x	x		x			x	x	x
Megalurus gramineus	Little Grassbird				x												
HIRUNDINIDAE																	
Cheramoeca leucosterna	White-backed Swallow				x			x	x				x				
Hirundo neoxena	Welcome Swallow				x												
Petrochelidon ariel	Fairy Martin				x		x	x					x		x		
Petrochelidon nigricans	Tree Martin				x		x	x		x			x		x		
NECTARINIIDAE																	
Dicaeum hirundinaceum	Mistletoebird				x		x	x	x	x			x				x
ESTRILDIDAE																	
Emblema pictum	Painted Finch				x		x	x	x	x	x	x	x	x		x	
Neochmia ruficauda subclarescens	Star Finch (western)				x		x			x			x				
Taeniopygia guttata	Zebra Finch				x		x	x	x	x	x	x	x	x	x	x	x
MOTACILLIDAE																	
Anthus australis	Australasian Pipit				x			x	x				x				

Table C.4: List of mammal species recorded from database searches or previous surveys in the vicinity of the Proposal area.

Species name	Common name	Conservation status			Database results		Previous surveys										
		EPBC Act	WC Act	DPaW	Nature Map	EPBC Protected Matters	ecologia (1996)	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	Outback Ecology (2009)	ENV (2011)	Eco Logical (2012)	Biologic (2014) - OB24	Biologic (2014) - OB25
TACHYGLOSSIDAE																	
Tachyglossus aculeatus	Echidna				x			x		x			x			x	
DASYURIDAE																	
Dasykaluta rosamondae	Little Red Kaluta				x			x	x				x			x	
Dasyurus hallucatus	Northern Quoll	EN	S2			x											
Ningaui timealeyi	Pilbara Ningaui				x			x								x	
Planigale maculata	Common Planigale				x			x									
Pseudantechinus roryi	Rory's Antechinus				x			x									
Pseudantechinus woolleyae	Woolley's Pseudantechinus				x			x								x	
Sminthopsis crassicaudata	Fat-tailed Dunnart				x												
Sminthopsis longicaudata	Long-tailed Dunnart			P4	x			x									
Sminthopsis macroura	Stripe-faced Dunnart				x			x								x	x
Sminthopsis ooldea	Ooldea Dunnart				x			x									
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart				x								x			x	
THYLACOMYIDAE																	
Macrotis lagotis	Bilby, Dalgyte	VU	S3			x											
MACROPODIDAE																	
Macropus robustus	Common Wallaroo, Euro				x			x	x	x	x	x	x		x	x	x
Macropus rufus	Red Kangaroo, Marlu				x		x	x			x	x	x	x		x	
Petrogale lateralis lateralis	Black-flanked Rock Wallaby	VU	S2		x												
Petrogale rothschildi	Rothschild's Rock-wallaby				x			x				x	x		x	x	
NOTORYCTIDAE																	
Notoryctes caurinus	Northern Marsupial Mole	EN				x											
MEGADERMATIDAE																	
Macroderma gigas	Ghost Bat		S3		x					x							
HIPPOSIDERIDAE																	
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	S3		x	x										x	
EMBALLONURIDAE																	
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat				x								x	x	x	x	x
Taphozous georgianus	Common Sheathtail-bat				x								x	x		x	x
Taphozous hilli	Hill's Sheathtail-bat				x			x									
MOLOSSIDAE																	
Chaerephon jobensis	Northern Freetail-bat				x								x	x	x	x	x
Mormopterus beccarii	Beccari's Freetail-bat				x			x						x	x	x	x
Tadarida australis	White-striped Freetail-bat				x		x					x		x	x		x
VESPERTILIONIDAE																	
Chalinolobus gouldii	Gould's Wattled Bat				x							x	x	x	x	x	x
Nyctophilus geoffroyi	Lesser Long-eared Bat				x											x	x
Scotorepens balstoni	Inland Broad-nosed Bat							x									

Species name	Common name	Conservation status			Database results		Previous surveys										
		EPBC Act	WC Act	DPaW	Nature Map	EPBC Protected Matters	ecologia (1996)	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	Outback Ecology (2009)	ENV (2011)	Eco Logical (2012)	Biologic (2014) - OB24	Biologic (2014) - OB25
Scotorepens greyii	Little Broad-nosed Bat				x			x	x				x	x	x	x	x
Vespadelus finlaysoni	Finlayson's Cave Bat				x			x				x	x	x	x	x	x
MURIDAE																	
**Mus musculus*	House Mouse				x	x	x	x	x	x			x				
Notomys alexis	Spinifex Hopping-mouse				x			x							x	x	
Pseudomys chapmani	Western Pebble-mound Mouse			P4	x			x	x		x	x	x	x		x	
Pseudomys desertor	Desert Mouse				x			x		x							
Pseudomys hermannsburgensis	Sandy Inland Mouse				x			x		x			x				
**Rattus* sp.	Rat										x						
Zyzomys argurus	Common Rock-rat				x			x		x			x			x	
BOVIDAE																	
**Bos taurus*	European Cattle				x		x						x		x		
**Capra hircus*	Goat										x						
CAMELIDAE																	
**Camelus dromedarius*	Camel				x	x							x				
CANIDAE																	
**Canis lupus familiaris*	Domestic Dog					x							x		x		
**Canis lupus dingo*	Dingo				x			x			x	x	x		x		x
**Vulpes vulpes*	Red Fox					x				x							
EQUIDAE																	
**Equus caballus*	Horse					x									x		
**Equus asinus*	Donkey				x	x							x				
FELIDAE																	
**Felis catus*	Cat				x	x			x	x	x	x	x		x		x
LEPORIDAE																	
**Oryctolagus cuniculus*	Rabbit				x	x		x		x		x	x		x		