JUNE 2008

RAIL OPERATIONS

RGP5 FAUNA SURVEY: QUARRY 1

IRON ORE

bhpbilliton

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EXECUTIVE SUMMARY

BHP Billiton Iron Ore Pty Ltd (BHPBIO) is currently proposing to implement a range of projects to expand the capacity of its existing Western Australia Iron Ore operations; the overall project is known as Rapid Growth Project 5 (RGP5). One such project is the construction of laydown areas and offices in the Quarry 1 lease as part of the duplication of BHPBIO's existing Newman to Port Hedland rail.

The purpose of this study was to assess the vertebrate fauna assemblages and habitats of the area within and around Quarry 1 on special lease 3116/3687 (located adjacent to chainage 29.0), approximately 25 km south of Port Hedland, immediately north of Mooka Siding.

The assessment comprised a desktop survey and field reconnaissance, designed in consideration of the Environmental Protection Authority's Guidance Statement No. 56: *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (2004) and Position Statement No. 3: *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002)

The desktop survey revealed that 226 species of vertebrate fauna may occur, including 22 species of conservation significant fauna, comprising 16 species of rare fauna (nine mammals, five birds and two reptiles) and six species of migratory bird. Of these, a total of 20 vertebrate species were observed, comprising one native mammal, ten birds and nine reptiles. An ANABAT survey was conducted at the base of the Quarry but no species were recorded.

Table S 1.1– Faunal assemblage of the Quarry 1 project area, as well as the number of species previously recorded, or expected to occur in the general area.

Source	Mammals	Birds	Reptiles	Amphibians	Total
Birdata		122			
WAM Faunabase	11(*7)	13	59	8	91(*7)
DEC	3	2	1	0	6
DEH	3	9	1	0	13
FMG Rail (Biota, 2004)	10(*0)	53	44	6	107
Repeater 1 (*ecologia*, 2008)	0(*1)	11	4	0	15(1)
Field Guides	29(*7)	127	66	5	227(*7)
Bing to Walla (*ecologia*, 2008)	1(*1)	43	10	1	55(*1)
This Survey	**1(*0)**	**10**	**9**	**0**	**20**
Total	32(*7)	140	79	8	266

During the reconnaissance survey in April, scats resembling that of the Northern Quoll (*Dasyurus hallucatus*), listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*, were recorded throughout much of the rocky-scree area near the base of the quarry. Later, during a survey in May, Elliott traps were set up and left at Quarry 1 overnight. Two male and two female Northern Quoll were captured, indicating that the species does occur in the project area.

In light of the results of this survey, a management plan addressing potential impacts to the Northern Quoll population at Quarry 1 is being drafted for submission to stakeholders as an independent document.

The following management recommendations have arisen as a result of the risk analysis conducted.

1. Minimise clearing of habitats thought to support rare fauna such as the Northern Quoll.
2. Areas cleared as part of construction should be rehabilitated as soon as practicable once they are no longer required.
3. Utilise existing access tracks where possible to avoid further habitat fragmentation.
4. Contractors should be made aware that Western Pebble-mound Mouse mounds, Brush-tailed Mulgara, Greater Bilby and Rainbow Bee-eater burrows may be present and that these should be avoided if found.
5. Utilise BHPBIO weed management procedures.
6. Isolate and remove all waste, particularly food waste, from the work area on a regular basis. Maintain food waste in sealed containers when on site.
7. Prevent the deliberate feeding of wild fauna, particularly feral predators.
8. Fire prevention strategies should be an integral component of CRAWs for construction contractors.
9. Ensure that fire extinguishers are available to work personnel and that they are trained in their use.
10. Avoid smoking near or parking vehicles over dry vegetation, particularly spinifex (*Triodia* spp.) or Buffel Grass (**Cenchrus ciliaris*).
11. Dust suppression measures such as road watering and progressive rehabilitation of disturbed areas should be used (as per BHPBIO EMS).
12. Noise suppression measures may be considered to reduce impact to native fauna (as per BHPBIO EMS).
13. If rare fauna are observed on roads at night, consider a reduction in speed limits or avoidance of nocturnal works in that area.

Table S 1.2– Conformance of project to relevant EPA Position Statement No. 3

Requirement	Relevance to Project	Project Compliance
Impact on Biodiversity	Where impact on biodiversity cannot be avoided, the proponent must demonstrate that the impact will not result in unacceptable loss.	An independent report regarding the management plan for the population of Northern Quolls recorded at Quarry 1 is being drafted.
State, National and International Agreements, Legislation and Policy on Biodiversity	Information gathered for environmental impact assessment in Western Australia meets State, National and International Agreements, Legislation and Policy in regard to biodiversity conservation.	State, national and international agreements were referenced in the production of this report. Impacts to species listed under relevant legislature are addressed in Section 6.1.
EPA Standards, Requirements and Protocols	The quality of information and scope of field surveys meets the standards, requirements and protocols as determined and published by the EPA.	The current survey conforms to a Level 1 survey, comprising a desktop review and reconnaissance survey as per the EPA Guidance Statement No. 56. In addition, Elliott traps were used to confirm the presence of Northern Quolls at Quarry 1 (*Dasyurus hallucatus* – EPBC Endangered).
Biodiversity Conservation and Ecological Function Values	Sufficient information is provided to address biodiversity conservation and ecological function values.	Background literature and database searches were performed and provide a context to the information collected and environmental risks assessed. Fauna assemblages and habitats observed during this survey are described in Section 4. Potential impacts to rare fauna are discussed in Section 6. An independent report regarding the management plan for the population of Northern Quolls recorded at Quarry 1 is being drafted.
State Biological Databases	Terrestrial biological surveys will be made publicly available and will contribute to the bank of data available for the region.	Survey data will be submitted to DEC for inclusion into their database.

1 INTRODUCTION

1.1 PROJECT OVERVIEW

BHP Billiton Iron Ore Pty Ltd (BHPBIO) is proposing to implement a range of projects to expand the capacity of its existing Western Australian Iron Ore operations; the overall project is known as Rapid Growth Project 5 (RGP5). One of the projects involves the construction of laydown areas and offices in the Quarry 1 lease for the BHPBIO Newman to Port Hedland rail line duplication.

Calibre-Engenium commissioned *ecologia* Environment (*ecologia*) to undertake a Level 1 vertebrate fauna survey of the area of potential disturbance within Quarry 1. The assessment comprised a desktop study and reconnaissance survey, designed in consideration of the Environmental Protection Authority's (EPA) Guidance Statement No. 56: Terrestrial Fauna Surveys for *Environmental Impact Assessment* (*EIA*) *in Western Australia* (2004) and Position Statement No. 3: *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002). The field survey was conducted on the 21st of April 2008.

1.2 LOCATION

The project area is situated adjacent to chainage 29.0 on special lease 3116/3687, approximately 25 km south of Port Hedland, immediately north of Mooka Siding (Figure 1.1).

1.3 LEGISLATIVE FRAMEWORK

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

The Precautionary Principle

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

The Principle of Intergenerational Equity

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

The Principle of the Conservation of Biological Diversity and Ecological Integrity

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

Projects undertaken as part of the EIA process are required to address guidelines produced by the EPA, in this case Guidance Statement No. 56: *Terrestrial Fauna Surveys for Environmental Impact in Western Australia* (EPA 2004), and principles outlined in the

EPA's Position Statement No. 3: Terrestrial Biological Surveys as an *Element of Biodiversity Protection* (EPA 2002).

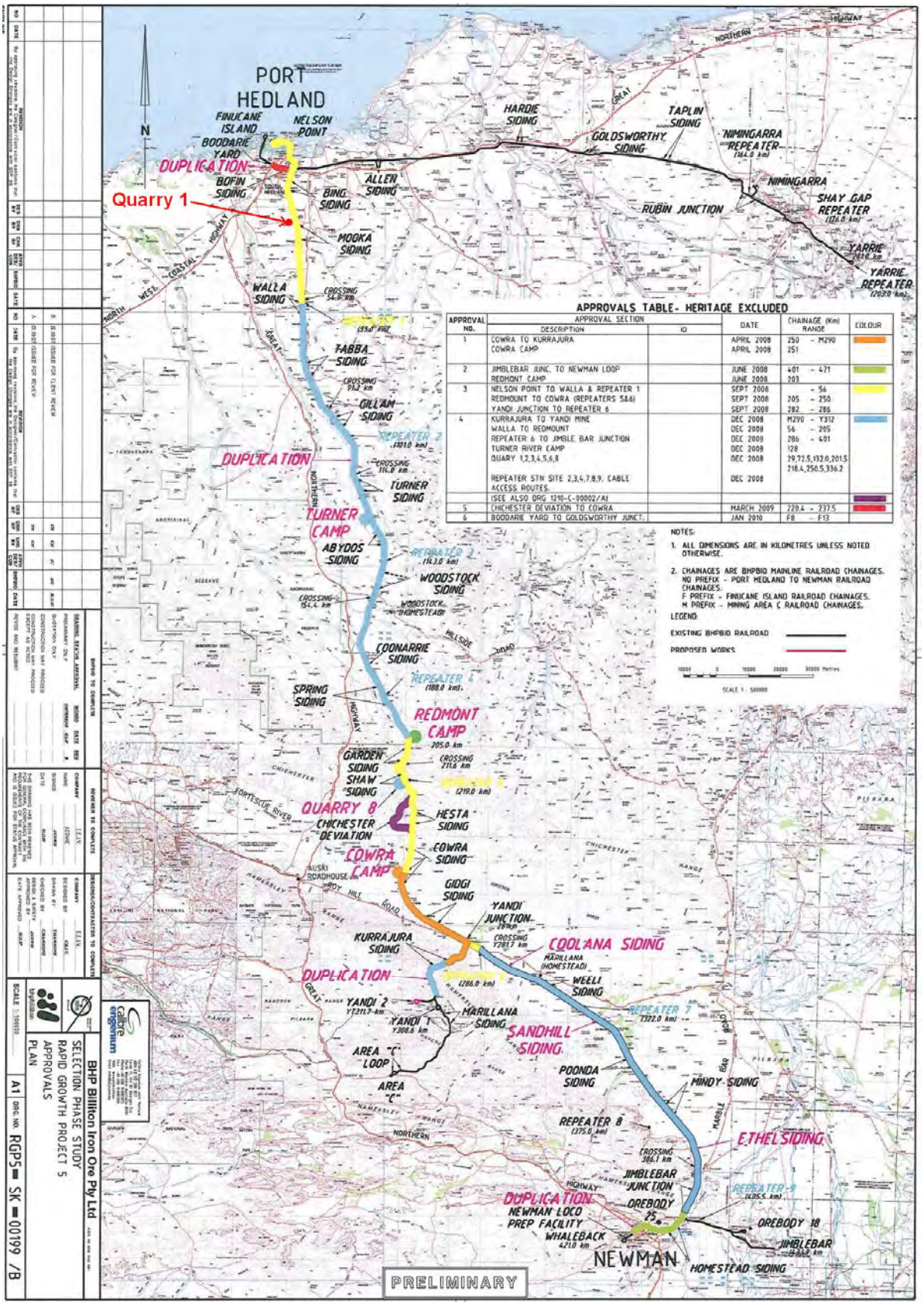

Figure 1.1 – Location of Quarry 1

Native flora and fauna in Western Australia are protected at a Federal level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and at a State level under the *Wildlife Conservation Act 1950* (WC Act).

The EPBC Act was developed to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance, to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources, and to promote the conservation of biodiversity. The EPBC Act includes provisions to protect native species and ensure the conservation of migratory species.

The WC Act was developed to provide for the conservation and protection of wildlife in Western Australia. The current listing was gazetted in January 2008.

1.4 SURVEY OBJECTIVES

BHPBIO commissioned *ecologia* Environment (*ecologia*) to undertake a baseline biological survey of the vertebrate fauna of the Quarry 1 study area as part of the environmental impact assessment for the project.

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

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

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

The survey aims were to undertake a survey that satisfies the requirements documented in EPA's Guidance Statement No. 56 and Position Statement No. 3, providing:

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

2 EXISTING ENVIRONMENT

2.1 CLIMATE

Climatic data were collated from Port Hedland weather station (B.O.M. 2008) and are shown in Figure 2.1. The project area experiences hot, dry conditions from September until December. High temperatures and rainfall continue until the end of March, after which temperatures and rainfall begin to drop. Winter daytime averages are relatively mild (above 25°C) with cool nights. Rainfall declines until October before the onset of cyclonic weather in December.

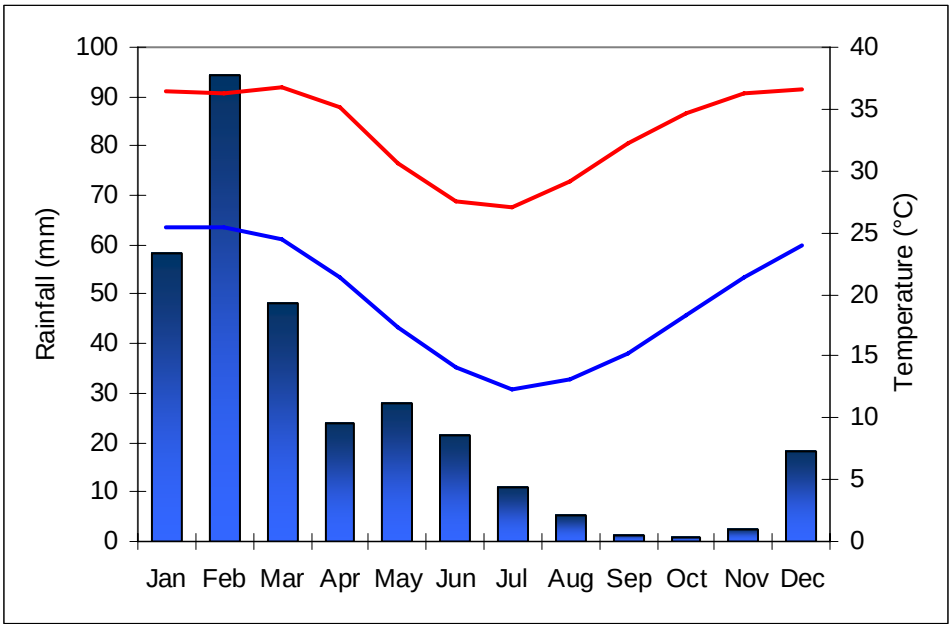

Figure 2.1 – Climate data from Port Hedland

2.2 LAND SYSTEMS

An inventory of the land systems occurring in the Pilbara was completed by Van Vreeswyk *et al.* (2004). The survey aimed to provide a comprehensive description and mapping of the biophysical resources of the region, as well as an evaluation of the condition of soils and vegetation throughout. Quarry 1 is situated on the boundary of the Macroy and Uaroo land systems (Table 2.1 and Figure 2.2 – Land Systems at Quarry 1).

Table 2.1 – Land systems in the Quarry 1 project area

Land System	Habitat	Total area in the Pilbara (km^2)	Approx. survey area (km^2)	Proportion of total known area in survey area (%)
Macroy Land type 8	Stony plains and occasional tor fields based on granite, supporting hard and soft spinifex grasslands	13,095	0.43	< 0.004
Uaroo Land type 11	Broad sandy plains supporting shrubby hard and soft Spinifex grasslands	7,681	0.31	< 0.005

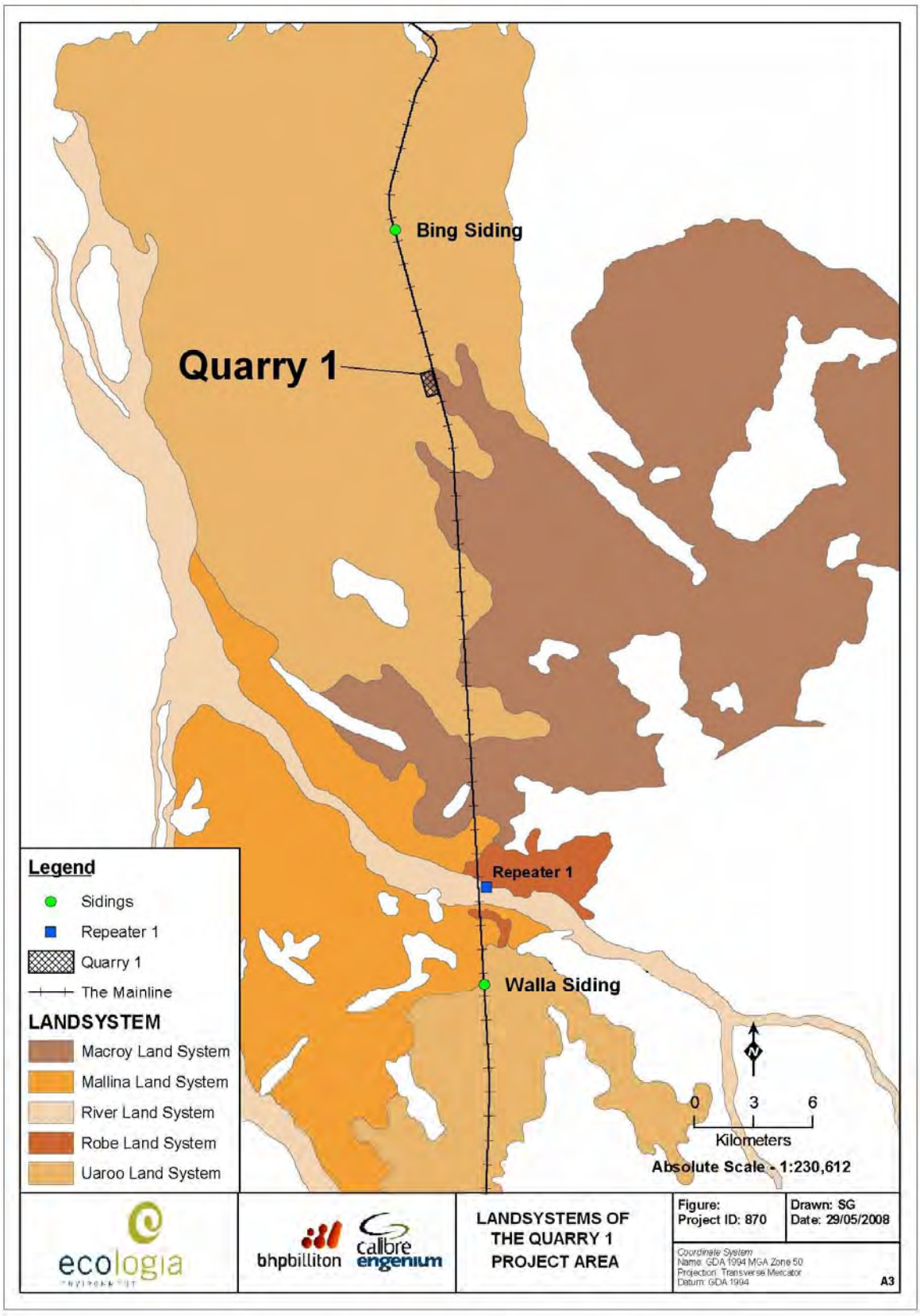

Figure 2.2 – Land Systems at Quarry 1

2.3 BIOGEOGRAPHY

Quarry 1 is on the boundary of the Roebourne (PIL-4) and Chichester (PIL-1) subregions of the Pilbara bioregion in Western Australia (Figure 2.3).

The Chichester subregion is described as "Undulating Archaean granite and basalt plains including significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* (formerly *Triodia pungens*) hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges" (Kendrick and McKenzie, 2001).

The Roebourne subregion is summarized as follows: "Quaternary alluvial and older colluvial, coastal and sub-coastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*. Uplands are dominated by *Triodia* hummock grasslands. Ephemeral drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands. Samphire, *Sporobolus* and mangal occur on marine alluvial flats and river deltas." (Kendrick and Stanley, 2001).

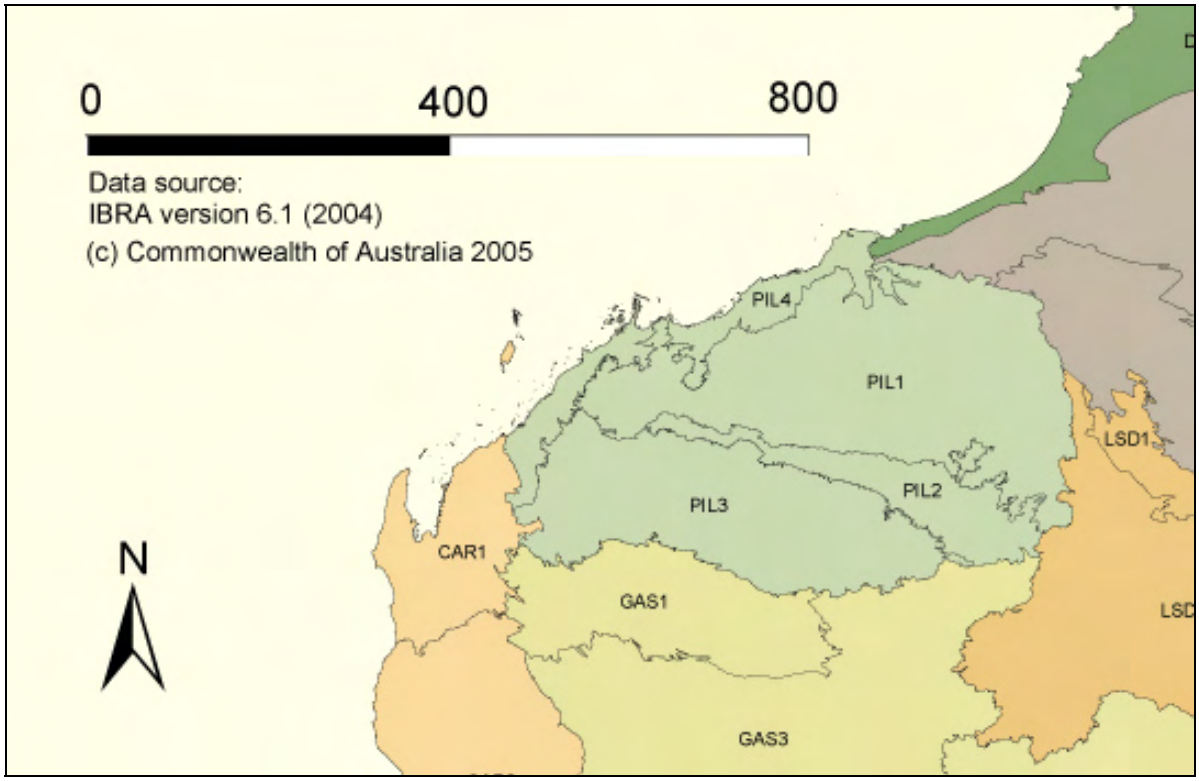

Figure 2.3 – Biogeographical subregions of north Western Australia

2.4 VEGETATION

Beard (1975) shows the survey area is located in the northern extent of the Fortescue Botanical Region of the Pilbara. The vegetation is dominated by a shrub steppe of *Acacia pyrifolia* over mixed hummock grasses, dominantly *Triodia pungens* on the granite plains.

3 SURVEY METHODS

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

The project area is located in the Pilbara biogeographic region. Based on the location and scale of development, Guidance Statement No. 56 recommends a Level 1 survey comprising a desktop review, to provide sufficient background information on the fauna habitats and assemblages of the project area, and a reconnaissance field survey, to assess the accuracy of the information compiled in the desktop study.

3.1 DETERMINATION OF SURVEY SAMPLING DESIGN AND INTENSITY

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

Table 3.1 – Factors likely to influence survey design (from EPA 2004; 12-13).

FACTOR	RELEVANCE	COMMENT
Bioregion – level of existing survey/ knowledge of the region and associated ability to predict accurately.	Pilbara bioregion is well studied.	Published literature and unpublished survey reports were available when developing the survey design. The survey was structured to focus on recording fauna habitats and their potential for harbouring conservation significant fauna.
Landform special characteristics/ specific fauna/ specific context of the landform characteristics and their distribution and rarity in the region.	Landforms are 'man-made' and unique to the area.	The project area consisted of a low granite rise with emergent boulders on a rocky substrate, into which a quarry has been excavated, forming a man made ephemeral pool with rocky scree, steep rocky cliff sides, and graded soft-soiled shoreline. These man-made elements are unique in this area of the Pilbara.
Lifeforms, life cycles, types of assemblages and seasonality (e.g. migration) of species likely to be present.	Optimal survey conditions occur after cyclonic rain.	The Pilbara did not receive significant rainfall due to cyclonic events; however, several areas did receive rainfall. Standing water was observed in drainage ditches adjacent to the rail access road to the north and south of Quarry 1. Animal activity was high on the day of survey with dozens of individual reptiles recorded. No amphibians were recorded during the survey.

FACTOR	RELEVANCE	COMMENT
Level of existing knowledge and results of previous regional sampling (e.g. species accumulation curves, species/ area curves).	Little previous survey work has been conducted in the area surrounding the project.	Data were available from a report on the fauna of the FMG rail corridor (Biota 2004) located to the west of Quarry 1. The information presented was not suitable for the generation of species accumulation curves. Further information has subsequently been collected by *ecologia* along the rail line including Level 1 survey between Bing and Walla sidings including a survey at Repeater 1 (*ecologia* 2008)
Number of different habitats or degree of similarity between habitats within a survey area.	The vegetation of the project area was similar throughout.	Numerous fauna habitats were encountered, shown in Table 3.2 and discussed in Section 4.2. Transects were undertaken to assess and describe the various fauna habitats present within the project area.
Climatic constraints (e.g. temperature or rainfall that preclude certain sampling methods).	April follows the period of significant rainfall in the Pilbara and temperatures are warm.	The temperature at time of survey was approximately 30°C and numerous active reptiles were observed. None of the sampling methods utilised were precluded by climatic constraints.
Sensitivity of the environment to the proposed activities.	No particularly sensitive habitats were encountered.	The project area consisted of a low granite rise with emergent boulders on rocky substrate, into which a quarry has been excavated, forming a man made ephemeral pool with rocky scree, steep rocky cliff sides, and graded soft-soiled shoreline. These man-made elements are unique in this are of the Pilbara and provide ideal habitat for Northern Quolls (*Dasyurus hallucatus*) – EPBC Endangered.
Size, shape and location of the proposed activities.	The project area contains unique (man-made) fauna habitat.	Transects across the project area were surveyed to provide the most effective means of surveying the fauna habitats present.
Scale and impact of the proposal.	The project area is approximately four square kilometres, adjacent to the existing BHPBIO rail line.	During transects zoologists ensured that all major fauna habitats were described in order to determine the potential for conservation significant fauna to occur throughout the lease area.

3.2 LITERATURE REVIEW AND DATABASE SEARCHES

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

- Western Australian Museum (WAM) Faunabase
- Birds Australia Birdata
- Department of Environment and Water protected matters database
- DEC's Threatened fauna database
- *ecologia* (2008a) RGP5 Fauna Survey: Bing to Walla Siding and Repeater 1. Unpublished report for BHPBIO.
- *ecologia* (2008b) RGP5 Fauna Survey: Turner River Camp Expansion. Unpublished report for BHPBIO.
- Biota (2004) Fauna habitats and Fauna assemblage of the proposed FMG Stage A rail corridor (Unpublished report for FMG).

3.3 SURVEY TIMING

The reconnaissance survey was conducted in early autumn on 21st April 2008. A brief follow up survey used 24 baited Elliott traps at Quarry 1 overnight on the 7th of May 2008 to confirm the presence of Northern Quolls (*Dasyurus hallucatus*), an EPBC-listed Endangered species likely to inhabit the area based on secondary evidence (numerous scats) recorded during the April survey.

3.4 SITE LOCATIONS

Site vegetation and fauna habitat descriptions and photographs are given in Table 3.2 below.

Table 3.2 – Quarry 1 fauna habitat descriptions and site photographs

SITE VEGETATION DESCRIPTION AND FAUNA HABITATS	SITE PHOTO
Very disturbed rocky area of quarry. Ephemeral pool at base of cliff. Sparse soft grasses but generally bare ground. Fauna habitats: jumbled rocky scree, soft clayey soil.	
Very disturbed. Ephemeral pool with shallow gradient suitable for waders, and jumbled rocks provide dens for Northern Quoll and refuge for pythons. Fauna habitats: jumbled rocky scree, soft clayey soil, ephemeral waterbody.	

SITE VEGETATION DESCRIPTION AND FAUNA HABITATS	SITE PHOTO
Highly disturbed, recently cleared area of previously impacted quarry. Mixed low shrubs including *Acacia* spp. and *Senna notabilis* on fine red soil. Fauna habitats: soft soil.	 
Permanent pool at base of cliff, gradient shallow in places. Shore vegetation sparse to nil. Pool may provide suitable habitat for frogs and fishes.	
Bunded area above quarry. Sparse *Triodia* hummocks and other soft grasses over soft soil. Fauna habitats: soft soil and ground cover (spinifex) suitable for fossorial and terrestrial reptiles.	

SITE VEGETATION DESCRIPTION AND FAUNA HABITATS	SITE PHOTO
Natural granite rocky area. Cracks and crevices providing numerous fauna microhabitats and potential Northern Quoll den sites. Fauna habitats: natural rocky outcrop, soil pockets, spinifex.	
Moderately dense *A. bivenosa* over open *A. stellaticeps* over medium height, moderately dense *Triodia* hummock grassland. Fauna habitats: some spinifex, ground cover, sandplain soil.	
Sparse *Acacia* shrubland (including *A. ancistrocarpa* and *A. stellaticeps* on red, sandy soil supporting dense – moderately dense *Triodia* spp. hummocks. Fauna habitats: spinifex, sandy soil.	

SITE VEGETATION DESCRIPTION AND FAUNA HABITATS	SITE PHOTO
Previously burnt area (2-5 years). Moderately dense *Triodia* hummock grassland on red, sandy soil. Fauna habitats: sandy soil and spinifex.	
Sparse to open *Acacia ancistrocarpa* shrubland, over moderately dense, medium sized *Triodia* hummock grassland on light soil with continuous small quartz pebbles. Fauna habitats: soft, sandy drainage channel, spinifex.	
Eroded drainage line through moderately dense *Acacia ancistrocarpa* shrubland over moderately dense *Triodia* hummock grassland on red sandy soil. Drainage line is rocky. Fauna habitats: sand pockets in rocky channel, spinifex, rocks at surface may provide shelter to smaller lizards.	

SITE VEGETATION DESCRIPTION AND FAUNA HABITATS	SITE PHOTO
Recently burnt area (<1 yr). Regrowth of sparse soft grasses including weeds (**Cenchrus ciliaris*) and isolated *Triodia* hummocks. Vegetation in background is unburnt sparse *Acacia* shrubland (including *A. tumida*) over dense, medium size *Triodia* hummock grassland. Fauna habitats: soft sandy soil.	

3.5 SAMPLING METHODS

Two zoologists conducted transects across the project area over a four hour period between 2 pm and 6 pm. During this time, all vertebrate fauna and fauna habitats encountered were recorded.

Along each transect, fauna habitats were hand searched for cryptic species, which comprised searching beneath the bark of dead trees, breaking open old logs, stumps and dead free-standing trees, investigating burrows, overturning logs and stones and recording tracks, diggings and scats encountered.

3.6 ANIMAL ETHICS

Surveying was conducted as per *ecologia*'s Animal Ethics Code of Practice, which conforms to Section 5 of the Australian code of practice for the care and use of animals for scientific purposes (Australian Government 2004: 39-43) (NHMRC 2004).

In all cases, fauna were identified in the field and released at the point of capture.

3.7 TAXONOMY AND NOMENCLATURE

Nomenclature for mammals and amphibians within this report are as per the WAM's Faunabase. Nomenclature for birds is according to Christidis and Boles (2008) and reptiles according to Wilson and Swan (2008). Field guides available for identification are listed in Table 3.3.

Table 3.3 – Field guides used for identification

Family	Field Guide
Mammals	Menkhorst and Knight (2001)
Skinks	Storr *et al*. (1999)
Bats	Churchill (1998), Menkhorst and Knight (2001)
Dragons	Cogger (2000), Storr *et al*. (1983)
Birds	Simpson and Day (2004)
Varanids	Cogger (2000), Storr *et al*. (1983)
Snakes	Storr *et al*. (2002)
Geckos	Storr *et al.* (1990), Cogger (2000)
Reptiles	Cogger (2000), Wilson and Swan (2008)
Legless Lizards	Storr *et al*. (1990), Cogger (2000)
Amphibians	Tyler *et al.* (2000), Cogger (2000)

3.8 DATA ANALYSIS

Species richness

The number of species present (species richness) is the simplest and most intuitive representation of species diversity (Magurran 2004) and was the basic indicator of diversity used in this study. It can be defined as the number of species of a given taxon in the chosen assemblage.

3.9 IMPACT RISK ASSESSMENT

A risk assessment (APPENDIX B) was conducted to determine potential impacts arising from the proposed activities on vertebrate fauna inhabiting or potentially occupying the project area. In addition, the residual impacts following the implementation of management strategies identified in this document (Section 7). The significance of the risks were classified as either “High” (site/issue specific management programmes required, advice/approval from regulators required), “Medium” (specific management and procedures must be specified) or “Low” (managed by routine procedures).

3.10 SURVEY TEAM

The survey was planned and executed by Dr Stewart Ford and Simon Pynt, BSc.

4 RESULTS

4.1 FAUNA ASSEMBLAGES

A total of 266 vertebrate species potentially occur in the Quarry 1 area, 20 of which were recorded during this survey. These included a single native mammal, ten bird species and 9 reptile species (Table 4.1).

Table 4.1– Faunal Assemblage of the Quarry 1 project area

Source	Mammals	Birds	Reptiles	Amphibians	Total
Birdata		122			
WAM Faunabase	11(*7)	13	59	8	91(*7)
DEC	3	2	1	0	6
DEH	3	9	1	0	13
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This Survey	**1(*0)**	**10**	**9**	**0**	**20**
Total	32(*7)	140	79	8	266

*Values in brackets indicate the number of feral species

4.1.1 MAMMALS

Thirty-two native mammals potentially occupy the Quarry 1 project area (Table 4.1). Only the Northern Quoll (*Dasyurus hallucatus*) was recorded during this survey. This species was initially identified during the April survey by the presence of scats. In May, two males and two females were captured in Elliott traps after one night of trapping.

4.1.2 BIRDS

One hundred and forty bird species potentially occupy the Quarry 1 area. Ten species were recorded during this survey including four species of waterbird: Black-winged Stilt (family: Recurvirostridae), Black-fronted Dotterel (Charadriidae), White-faced Heron (Ardeidae) and Pacific Black Duck (Anatidae). These species would inhabit the quarry opportunistically due to the presence of free-standing water. Fairy martins, also recorded during the survey, are aerial predators, likely to be attracted to the abundance of flying insects surrounding the waterbody.

4.1.3 REPTILES

Seventy-nine reptile species potentially occur in the project area, nine of which, from five families were seen on this survey. These consisted of three dragons (Agamidae), two skinks (Scincidae), two monitors (Varanidae), Stimson's Python (*Antaresia stimsoni*, Boidae), and the Rock Dtella (*Gehyra punctata*, Gekkonidae). The most frequently observed species were the Military Dragon (*Ctenophorus isolepis*), the Rock Ctenotus (*Ctenotus saxatilis*) and the Long-nosed Dragon (*Amphibolurus longirostris*) which were recorded 28, 11 and nine times respectively.

4.1.4 AMPHIBIANS

No amphibians were recorded during this survey, though potentially eight species from two families occur in the area. Records for all eight species exist in the WAM Faunabase near Quarry 1; six were recorded near the project area during the FMG rail surveys compiled by Biota (2004).

4.1.5 INTRODUCED SPECIES

Seven introduced mammals from seven families potentially use the project area (Table 4.1): the House Mouse (**Mus musculus*), Dingo (**Canis lupus dingo*), Red Fox (**Vulpes vulpes*), Cat (**Felis catus*), Donkey (**Equus asinus*), Camel (**Camelus dromedarius*) and European Cattle (**Bos taurus*). No feral fauna were seen during the survey; however, based on the abundance of previous records it is likely that some of the above species would use the project area.

4.2 FAUNA HABITATS

All major fauna habitats in the project area were surveyed and their potential for supporting species of conservation significance assessed. Six major fauna habitats were present in the Quarry 1 area:

- The disturbed area of the quarry, comprising rocky scree, vertical rocky cliffs, an ephemeral pool and an embankment of soft soil, supporting very little vegetation;
- Other open, revegetated or disturbed areas with little vegetation cover and significant weed penetration (e.g. **Cenchrus ciliaris*);
- Rocky granitic hill with numerous, naturally formed rocks and sparse spinifex;
- Dense to moderately dense *Acacia bivenosa* / *A. stellaticeps* low shrubs over spinifex on sandy alluvium;
- Open, spinifex dominated sandplain with or without quartz rocks at surface, with scattered *Acacia* spp. low shrubs and scattered *Corymbia* spp. low trees; and
- Drainage channels supporting taller *Acacia* spp. and others shrubs, scattered *Corymbia* spp. low trees, weeds and grasses on soft sandy or eroded ground.

Few trees were noted within the study area and those that were present were often young and low. No termite mounds were observed.

4.3 SURVEY LIMITATIONS

Limitations and constraints of the current survey are summarised in Table 4.1 below.

Table 4.1 – Survey limitations and constraints

CONSTRAINT	RELEVANT (yes/no)	COMMENT
Competency/ experience of the consultant carrying out the survey.	No constraint	Qualified, experienced and competent personnel performed the survey.
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No constraint	Reptiles and birds were the major faunal groups sampled. Amphibians were not found in the water at the base of the quarry. Mammal scats were found and a subsequent survey confirmed that Northern Quoll were present; no other native mammals were observed.
Proportion of fauna identified, recorded and/ or collected.	No constraint	All fauna observed were identified in the field.
Sources of information (previously available information as distinct from new data).	Yes – moderate	This part of the rail corridor has been poorly surveyed relative to other areas of the Pilbara, although part of a previous survey (Biota 2004) was relevant.
The proportion of the task achieved and further work which might be needed.	No constraint	The survey is complete.
Timing/ weather/ season/ cycle.	No constraint	The survey was conducted in early April after a non-cyclonic rainfall period – surface water was evident at other sites along the rail corridor. Bird, reptile and mammal activity was high.
Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention).	No constraint	There were no disturbances.
Intensity (in retrospect was the intensity adequate).	No constraint	The intensity of the survey was adequate and achieved the aims of a Level 1 survey.
Completeness (e.g. was relevant area fully surveyed).	No constraint	The area was fully surveyed with all relevant habitats included.
Resources (e.g. degree of expertise available in animal identification to taxon level).	No constraint	All species were identified to species level in the field.
Remoteness and/ or access problems.	No constraint	Access was not a problem.
Availability of contextual (e.g. biogeographic) information on the region.	Yes – moderate	The Pilbara bioregion has been well studied; however, the local area has received little study.
Efficacy of sampling methods (i.e. any groups not sampled by survey methods).	Yes – moderate	Birds and reptiles were readily observed and are better represented than mammals or amphibians. The sampling level and intensity were suitable for a Level 1 survey, however.

5 CONSERVATION SIGNIFICANT FAUNA

5.1 STATUTORY FRAMEWORK

Fauna species that have been formally recognised as rare, threatened with extinction, or as having high conservation value are protected by law under Commonwealth and State legislation. At the national level, fauna are protected under the EPBC Act. Within WA, rare fauna are listed under the WC Act. International Agreements include the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA).

Schedule 1 of the Commonwealth EPBC Act contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Extinct, Extinct in the wild and Conservation Dependent. Definitions of categories relevant to fauna occurring or potentially occurring in the project area are provided in Table 5.1.

Table 5.1 – Definitions of relevant categories under the EPBC Act

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

Classification of rare and endangered fauna under the WC Act recognises four distinct schedules, as listed in Table 5.2. In addition, the DEC maintains a Priority fauna list which includes those removed from the WC Act and other species known from only a few populations or in need of monitoring. Five Priority codes are recognised, as detailed in Table 5.3.

Table 5.2 – Definition of Schedules under the WC Act

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

Table 5.3 – Definition of DEC Priority Codes

PRIORITY	DEFINITION
Priority One (P1)	Taxa with few, poorly known populations on threatened lands. Taxa which are known from few specimens or sight records from one or a few localities, on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority Two (P2)	Taxa with few, poorly known populations on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities, on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority Three (P3)	Taxa with several, poorly known populations, some on conservation lands. Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority Four (P4)	Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands.
Priority Five (P5)	Taxa in need of monitoring Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

5.2 CONSERVATION SIGNIFICANT FAUNA POTENTIALLY OCCURRING IN THE STUDY AREA

Twenty-two species of conservation significant fauna comprising 16 rare fauna (nine mammals, five birds and two reptiles) and six Migratory bird species potentially use the Quarry 1 area. These were identified using database searches, the FMG rail surveys and a habitat review of the project area. Table 5.4 lists the conservation significant species potentially occurring in the in the Quarry 1 area.

Table 5.4 – Conservation significant fauna potentially occurring in study area.

EPBC - *Environment Protection and Biodiversity Conservation Act 1999*; WCA - *Wildlife Conservation Act 1950* Specially Protected Fauna Notice 2008; DEC - DEC Priority fauna

SPECIES	COMMON NAME	CONSERVATION SIGNIFICANCE			HABITAT	PREVIOUS RECORDS	LIKELIHOOD OF OCCURRENCE
		EPBC	WCA	DEC			
Mammals							
Dasycercus blythi	Brush-Tailed Mulgara			P4	Spinifex grassland	WAM Faunabase	MEDIUM – suitable habitat and recorded nearby
Dasyurus hallucatus	Northern Quoll	EN	S1		Rocky areas, also eucalypt forest and woodland.	This survey, WAM	HIGH – species recorded in area
Lagorchestes conspicillatus	Spectacled Hare-wallaby			P3	Large hummock spinifex grassland	Not recorded nearby	LOW – not recorded nearby and lack of suitable habitat
Leggadina lakedownensis	Northern Short-tailed Mouse			P4	Wide range of habitats, all on seasonally inundated red or white sandy-clay soils	Not recorded nearby	MEDIUM – no nearby records but species recorded along rail corridor to south
Macroderma gigas	Ghost Bat			P4	Wide range of habitats including natural rockpiles in the local area	DEC database	MEDIUM – suitable habitat for foraging and potentially roosting and recorded nearby
Macrotis lagotis	Greater Bilby	VU	S1		Wide variety in arid zone	WAM Faunabase	MEDIUM – suitable habitat exists and records nearby, but species is uncommon
Mormopterus loriae cobourgiana	Western Little Free-tailed Bat			P1	Mangrove stands, particularly mature Grey Mangroves	DEC database	LOW – several records within 20 km but no suitable habitat
Pseudomys chapmani	Western Pebble-mouse			P4	Stony slopes	DEC database and historical records from nearby at Turner River Camp	LOW – recorded nearby, but lack of suitable habitat
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	VU	S1		Roosts in hot, humid caves	Not recorded nearby	LOW – no records nearby

SPECIES	COMMON NAME	CONSERVATION SIGNIFICANCE			HABITAT	PREVIOUS RECORDS	LIKELIHOOD OF OCCURRENCE
		EPBC	WCA	DEC			
Birds							
Ardeotis australis	Australian Bustard			P4	Open woodland and grassland	Birdata, DEC, *ecologia* (2008b),	MEDIUM – suitable habitat present and recorded nearby
Burhinus grallarius	Bush Stone-curlew			P4	Open woodland, often near beaches	Birdata, Turner Camp	MEDIUM – suitable habitat present and recorded nearby
Falco hypoleucos	Grey Falcon			P4	Woodland and scrubland in arid zone	Birdata	LOW – suitable foraging habitat present and recorded nearby, but rare
Falco peregrinus	Peregrine Falcon		S4		Most terrestrial especially rocky areas	Not recorded nearby	LOW – suitable foraging habitat present, but not recorded nearby.
Neochmia ruficauda subclarescens	Star Finch			P4	Sedgelands associated with permanent water	Birdata, DEC database	LOW – no suitable habitat
Reptiles							
Aspidites ramsayi	Woma			P1	Soft red sandy loams	WAM Faunabase, nearby DEC records	MEDIUM – suitable habitat present and recorded nearby
Liasis olivaceus barroni	Pilbara Olive Python		S1		Gorges and escarpments	No records nearby	LOW – no records nearby
Migratory Bird Species							
Actitis hypoleucos	Common Sandpiper	M			Banks, rocks, sandy beaches	Hope Downs Survey	MEDIUM – likely to visit ephemeral water in quarry
Apus pacificus	Fork-tailed Swift	M			Almost entirely aerial	Birdata	MEDIUM – likely to overfly area at times
Ardea alba	Great Egret	M			Wetlands	Birdata, Hope Downs Survey	LOW – unlikely to be attracted to quarry water
Glareola maldivarum	Oriental Pratincole	M			Open plains, bare ground around swamps	None	LOW – lack of suitable habitat and no records nearby
Merops ornatus	Rainbow Bee-eater	M			Open country, most veg. types, dunes, banks	Birdata, Hope Downs Survey	MEDIUM – suitable habitat and recorded nearby
Tringa nebularia	Common Greenshank	M			Estuaries, inland lakes, open swamps	Birdata	MEDIUM – likely to visit ephemeral water in quarry

5.3 CONSERVATION SIGNIFICANT FAUNA RECORDED DURING SURVEYING

5.3.1 MAMMALS

5.3.1.1 Northern Quoll *Dasyurus hallucatus* – EPBC Endangered, WC Act Schedule 1

A single species of conservation significance, the Northern Quoll, was found at Quarry 1. Scats belonging to the species were found throughout the rocky scree habitat of the quarry during reconnaissance in April. Two males and two females were subsequently trapped at Quarry 1 in a single night during May.

This solitary, carnivorous, arboreal and terrestrial marsupial formerly occurred across northern Australia from the Pilbara region to south-eastern Queensland. In Western Australia, it appears to be restricted to areas of the Hamersley range northwards towards the coastline and north Kimberley. Reasons for its population decline may be mortality by introduced animals such as dogs, foxes, cats and cane toads or competition with such species (Braithwaite and Begg 1995) but they are also killed by snakes, owls and kites (Oakwood 2008).

The species has been recorded from several sites associated with the FMG rail corridor biological investigations (Biota 2004) and is now confirmed from two sites along the existing BHPBIO corridor (Quarry 1 and Quarry 3). *D. hallucatus* tend to occur in rocky habitat near water (a suitable looking dry quarry, Quarry 2, showed no sign of Northern Quoll activity); however, scats were also recorded on granite rockpiles (tors) along the existing rail corridor.

A management plan for the species is currently being drafted for submission to DEC.

5.3.2 BIRDS

No bird species of conservation significance were recorded in the project area during this survey.

5.3.2.1 EPBC Migratory Species

No species listed as migratory under the EPBC act were recorded in the project area during this survey.

5.3.3 REPTILES

No reptiles of conservation significance were recorded in the project area during this survey.

5.4 CONSERVATION SIGNIFICANT FAUNA DESCRIPTIONS

5.4.1 Migratory fauna

The likelihood that migratory species utilise the habitats at Quarry 1 is difficult to determine. However, they utilise small, sometimes ephemeral areas such as the water body at the base of the Quarry. They are likely to be seasonal and most would be occasional.

Potential species are Common Sandpiper and Common Greenshank. Rainbow Bee-eaters are likely to be present at times, and nest from August to January in sandy embankments in which they dig tunnels (Johnstone and Storr, 1998). When nesting the birds are vulnerable to clearing; adult birds may abandon their chicks if disturbed and chicks may be killed directly by machinery during clearing. Fork-tailed Swifts are aerial and, although they may fly over, would not directly use the habitats present within the project area.

5.4.2 Nationally significant fauna

Three mammal species protected under the commonwealth EPBC Act potentially occur in the project area.

5.4.2.1 Northern Quoll *Dasyurus hallucatus* – Endangered

See Section 5.3.1.1

5.4.2.2 Greater Bilby *Macrotis lagotis* – Vulnerable

This distinctive bandicoot occurs singly or in scattered colonies, inhabiting a range of habitats such as clayey and stony downs soils and sands with spinifex and massive red earths with *Acacia* shrubland and hummock grassland (Menkhorst and Knight 2001). At present, the Bilby is distributed in the northern arid parts of Western Australia (Johnson 2008). Changes in fire regime, grazing by rabbits and livestock and predation by foxes and feral cats are thought to be the main factors contributing to the species' decline.

There are scattered records of the species in suitable habitat surrounding Quarry 1 suggesting that it may be possible for the species to occupy the project area, though no evidence was recorded during reconnaissance.

5.4.2.3 Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* – Vulnerable

The Orange Leaf-nosed Bat is found in the Pilbara, Kimberley, Northern Territory and north-western Queensland, and the Pilbara form discussed here is considered Vulnerable. This species is very selective when it comes to roost caverns and is dependent on caves and mines that are hot and humid for survival during the dry season. They are more influenced by the availability of suitable roost caves than habitat types (Churchill, 1998).

Although there are no records of the species occurring in the area or nearby, Quarry 1 is within the current range of the Pilbara Leaf-nosed Bat and according to the DEH database there is suitable habitat for the species in the surrounding area. However, as there are no suitable caves within the project area itself, it is highly unlikely that the species roosts there.

5.4.3 State significant fauna

Three mammal, one bird and one reptile species scheduled under the WC Act have potential to occur in the project area. They are discussed below.

5.4.3.1 Northern Quoll *Dasyurus hallucatus* – Schedule 1

See Section 5.3.1.1

5.4.3.2 Greater Bilby *Macrotis lagotis* – Schedule 1

See Section 5.4.2.2

5.4.3.3 Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* – Schedule 1

See Section 5.4.2.3

5.4.3.4 Peregrine Falcon *Falco peregrinus* – Schedule 4

This nomadic and sedentary falcon is widespread in many parts of Australia and some of its continental islands, but absent from most deserts and the Nullarbor Plain (Simpson and Day 2004). It feeds almost entirely on birds, especially parrots and pigeons. It nests on flat ledges formed by cliffs, granite outcrops and quarries and in hollow trees, usually along watercourses or near water (Simpson and Day 2004). The status of this species is considered to be generally uncommon and potentially declining in settled regions but still well-established in remoter regions (Pizzey 1983). Blakers *et al*. (1984) consider that Australia is one of the strongholds of the species, since it has declined in many other parts of the world.

The Peregrine Falcon has been recorded in the vicinity of Quarry 1 and it is possible that the species may utilise the area when hunting on occasion.

5.4.3.5 Pilbara Olive Python *Liasis olivaceus barroni* – Schedule 1

This terrestrial and rock inhabiting python is restricted to the gorges and escarpments in the Pilbara region of Western Australia (Wilson and Swan 2008). Quarry 1 contains typically suitable habitat; however, given the absence of nearby gorges or escarpments, migration of the species into the quarry area is unlikely.

5.4.4 DEC Priority species

Six mammal, four bird and one reptile species are listed as DEC priority fauna, none of which were recorded during reconnaissance.

5.4.4.1 Brush-tailed Mulgara *Dasycercus blythi* – Priority 4

Until very recently the Brush-tailed Mulgara and the Crest-tailed Mulgara (*Dasyurus cristicauda*) were considered a single species. Current literature states that *D. blythi*, not *D. cristicauda,* occur in Western Australia (Woolley 2008). As such, records of D. cristicauda from the FMG rail survey, DEC and DEH database were regarded as *D. blythi*. *D. blythi* occurs across much of the arid interior of Western Australia where it excavates single-entranced burrows in spinifex grassland usually on the flats between low dunes (Woolley 2008). The species has recently been recorded from the areas surrounding Quarry 1 as

shown by WA Museum records, though no suitable habitat or evidence of the species was recorded during this study.

5.4.4.2 Spectacled Hare-wallaby *Lagorchestes conspicillatus leichardti* – Priority 3

This medium-sized, solitary wallaby is found across Northern Australia and in the Pilbara region. It inhabits grasslands and escapes the heat of the day by burrowing into large spinifex hummocks. The species is in decline in the Pilbara due to a combination of fox predation and increased burning which destroys the large spinifex hummocks that it requires (Burbidge and Johnson 2008). In recent times Spectacled Hare-wallabies have been recorded to the south of Quarry 1, as WAM and DEC records show. However, the lack of large spinifex clumps in the study area makes it unlikely that this species is present at Quarry 1.

5.4.4.3 Northern Short-tailed Mouse *Leggadina lakedownensis* – Priority 4

This Short-tailed Mouse occupies a wide-variety of habitats across northern Australia, including spinifex and tussock grasslands, samphire and sedgelands in the arid zone as well as tropical *Eucalyptus* and *Melaleuca* woodlands and stony ranges. Although they can potentially occupy a wide variety of vegetation types, most of their habitats are on seasonally inundated red or white loams (Moro and Kutt 2008). The species has been recorded further south along the rail corridor by *ecologia* and recent DEC and WAM records show that the species is present in the surrounding area. It is therefore possible that Northern Short-tailed Mice are present in the project area.

5.4.4.4 Ghost Bat *Macroderma gigas* – Priority 4

This medium-sized, carnivorous chiropteran occurs in the north of the continent from the Pilbara to Queensland. Its distribution seems to be determined by the availability of suitable roosting sites which include caves, bluffs of low rounded hills and granite rock piles (Richards and Hand 1995). The species preys on large insects, spiders and termites, frogs and lizards as well as small birds and mammals (including other bats).

Although the project area does not contain suitable roost sites, Ghost Bats have been recorded in the surrounding areas within 20 km, suggesting that it occupies natural roost sites such as granite tors of the surrounding plain. It is therefore possible that Ghost Bats could forage in the area on occasion, although no bats (a potential prey source) were recorded at the Quarry using ANABAT equipment. The species is unlikely to utilise the Quarry as a roost.

5.4.4.5 Western Little Free-tailed Bat – *Mormopterus loriae cobourgiana* Priority 1

In Western Australia, *M. loriae cobourgiana* has only been recorded in mangrove swamps with large mature Grey Mangroves (*Avicennia marina*), from Lake McLeod to Point Torment (Milne *et al.* 2008). No such habitat is present in or near the project area. DEC records of the species are restricted to areas north of Quarry 1 and are likely to be associated with the mangrove habitat near Port Hedland. This species was not recorded by the ANABAT bat detector during the survey.

5.4.4.6 Western Pebble-mouse *Pseudomys chapmani* – Priority 4

The Western Pebble-mouse (*Pseudomys chapmani*) was described in 1980 and recognised as the builder of pebble-mounds in the Pilbara and adjacent regions of Western Australia. It inhabits hummock grassland areas of *Triodia*, *Cassia*, *Acacia* and *Ptilotus* on skeletal soils containing an abundance of small pebbles (Start and Kitchener 1995). These conditions are most common on spurs and the lower slopes of ridges. The mice use the pebbles to

construct mounds. Most records of Western Pebble-mice and their mounds are from further south along the rail corridor in stony habitat. This, and the lack of suitable habitat in the project area, makes it unlikely that the species is present.

5.4.4.7 Australian Bustard *Ardeotis australis* – Priority 4

The Australian Bustard is a large, turkey-like species, well known for the elaborate mating display of the males. It is distributed across parts of New Guinea and most of Australia, favouring open or lightly wooded grassland, chenopod flats, low heathland and farming country. It is a nomadic species and its abundance varies both locally and seasonally, largely according to the presence of grasshoppers to which it is attracted (Johnstone and Storr 1998). Although no bustard tracks were observed at Quarry 1, the highly nomadic nature of this species, coupled with previous records in the surrounding area, suggests that the species may occasionally be present.

5.4.4.8 Bush Stone-curlew *Burhinus grallarius* – Priority 4

The Bush Stone-curlew is distributed across northern, eastern and western Australia as well as some offshore islands. It is usually found in lightly wooded country with thickets or long grass providing daytime shelter. In Western Australia, it is common north of the northern limit (80 mile beach) of the introduced Red Fox (**Vulpes vulpes*), and rarer to locally extinct south of the limit. Bush Stone-curlews are ground dwelling and non-migratory and are unlikely to move from their established home ranges. As such they are quite susceptible to local disturbances (Frith 1976; Johnstone and Storr 1998). There are no DEC or WAM records for the species in the surrounding area, but three individuals were recorded during a recent survey at Turner River Camp approximately 100 km south of Quarry 1 (*ecologia* 2008b), and Birdata shows a few records of the species in surrounding areas.

5.4.4.9 Grey Falcon *Falco hypoleucos* – Priority 4

The Grey Falcon is a medium-sized, compact, pale falcon with a heavy, thick-set, deep-chested appearance (Johnstone and Storr 1998). The species is sparsely distributed in the northern half of WA, restricted to shrubland, grassland and wooded watercourses. It is also occasionally found in open woodlands near the coast and often occurs near wetlands, where surface water attracts prey. This species preys primarily on birds, especially parrots and pigeons, using high-speed chases and stoops. Reptiles and mammals are also taken (Johnstone and Storr 1998).

There are no records for this species in and around the Quarry 1 area and it unlikely to occur.

5.4.4.10 Star Finch *Neochmia ruficauda subclarescens* – Priority 4

Star finches are found in disjunct populations in the Pilbara region and in parts of the Kimberly region of Western Australia. This species mainly occurs in long grass or rushes around lagoons or permanent water or in irrigated crops and pastures. The species is declining due to clearing of feeding and breeding habitat (Johnstone and Storr 2004).

Quarry 1 contains ephemeral water but none of the standing reed or rush vegetation preferred by Star Finches, which are therefore not expected to occur there.

5.4.4.11 Woma *Aspidites ramsayi* – Priority 1

Woma pythons inhabit woodlands, heaths and shrublands of the subhumid to arid interior (Wilson and Swan 2008) and there are nearby DEC records of the species to the north and

south. Suitable habitat and nearby records suggest that it is potentially present within the study area.

6 IMPACT ASSESSMENT

Though the existing habitat is the result of quarrying activity associated with the construction of the existing BHPBIO rail, fauna have since colonised the area, including the Northern Quoll. The risk assessment tabulated in APPENDIX B identifies the following threatening processes.

- The clearing of native vegetation results in an unavoidable loss of biodiversity, particularly when a particular habitat type is scarce.
- Vegetation clearing and the associated removal of fauna habitat will result in the loss of local vertebrate communities, a reduction in biodiversity and a loss of ecological function, as well as displacement of local fauna into surrounding areas where they are likely to face competition from established individuals. When a particular habitat type is scarce these negative effects are enhanced. Clearing can also cause direct mortality to fossorial fauna and fauna which when disturbed instinctively hide in burrows or under vegetation. Young animals may be particularly susceptible.
- Human activity (e.g. food waste) and habitat fragmentation may result in an increase in feral fauna which may have a negative impact on native diversity and ecological function due to increased predation and/or resource competition.
- Accidental fire arising from clearing and construction could cause direct fauna mortality as well as a short to long term loss of habitat.
- Vehicle strikes may cause fauna mortality.
- Dust created during clearing and excavation may have a negative affect on native vegetation, reducing its value as fauna habitat.
- Noise made by machinery may have a negative affect on fauna in adjacent areas.

6.1 IMPACTS ON FAUNA SPECIES OF CONSERVATION SIGNIFICANCE

One conservation significant species was recorded in the project area and a further 21 potentially occur (Table 5.4). An individual species could possibly be affected by the development if it is likely to be directly or indirectly killed in the clearing or construction process. This can occur if the species is territorial or phylopatric and unlikely to leave its home range in the event of disturbance. On the other hand, if a species is able to evade disturbance, its survival would depend on the availability of suitable habitat nearby. Young mammals and birds still under parental care are most at risk from clearing.

Where species have similar life histories, potential impacts are broadly similar and they have been discussed together.

6.1.1 Northern Quoll *Dasyurus hallucatus*

Northern Quolls present at Quarry 1 may be disturbed during construction and clearing. At present there are no plans to resume borrow operations at the Quarry. Additional impacts associated with a loss of foraging area in the vicinity of the quarry may be expected. A Northern Quoll management plan for RGP5 is currently being produced by *ecologia*. As part of the management planning process, BHPBIO is considering a 50 m buffer area around the existing quarry in which no activity will take place. Further measures will be outlined in the

management plan document. Impacts to Northern Quoll should largely be mitigated by this and other procedures listed in the management plan.

Prior to clearing areas away from the quarry, a survey for additional den sites in the impact footprint is planned.

6.1.2 Burrowing animals

Brush-tailed Mulgara, Northern Short-tailed Mouse and Greater Bilby spend the day in burrows under spinifex mounds and in vegetation, which they may be unlikely to vacate if disturbed. As a result, it is possible that clearing could result in direct mortality as well as loss of habitat. Similar habitats are available in the areas adjacent to the project area and individuals that are able to escape should be able to relocate nearby. Once there they may face competition from resident individuals, however. An increase in feral predators as a result of human activity may result in increased predation of these species within the lease and in surrounding areas, potentially causing one or more of the species to decline.

Woma Pythons are nocturnal, terrestrial snakes which shelter in hollow logs, animal burrows or thick herbage during the day (Cogger 2000). Diurnal clearing activities may therefore impact on this species as, similar to burrowing mammals, it may remain sheltered in its burrow in response clearing.

6.1.3 Bats

It is unlikely that Ghost Bats or Western Little Free-tailed Bat roost in the quarry but Ghost Bats may forage in the area. Activities associated with the project should have minimal effect on bats which currently do not appear to utilise the Quarry as a food source.

6.1.4 Ground breeding birds

Australian Bustard and Bush Stone-curlew may be present within the lease. Adults are able to avoid direct impact during clearing and operations, but eggs or young birds that are still dependent on the adults are not. Australian Bustards lay eggs from March to September, while Bush Stone-curlews lay July to January (Johnstone and Storr 1998) so that young of one or both of these species may be present at most times of the year.

Rainbow Bee-eaters are likely to be present occasionally, and nest from August to January in sandy embankments or on flat ground in which they dig angled tunnels (Johnstone and Storr, 1998). When nesting, birds are vulnerable to clearing because nests are essentially burrows; adult birds may abandon their chicks if disturbed and chicks may be killed directly by machinery during clearing and construction. This species could be impacted by the activities at Quarry 1 if it chooses to construct breeding chambers in the areas to be cleared, which it may do if the waterbody at the base of the quarry supports a greater abundance of insect prey than the surrounding open sandplains.

7 MANAGEMENT RECOMMENDATIONS

The following management recommendations have arisen as a result of the risk analysis conducted (APPENDIX B). A management plan specifically addressing the potential impacts of the project on the Northern Quoll is currently being drafted as a separate document.

1. Minimise clearing of habitats thought to support rare fauna such as the Northern Quoll.
2. Areas cleared as part of construction should be rehabilitated as soon as practicable once they are no longer required.
3. Utilise existing access tracks where possible to avoid further habitat fragmentation.
4. Contractors should be made aware that Western Pebble-mound Mouse mounds, Brush-tailed Mulgara, Greater Bilby and Rainbow Bee-eater burrows may be present and that these should be avoided if found.
5. Utilise BHPBIO weed management procedures.
6. Isolate and remove all waste, particularly food waste, from the work area on a regular basis. Maintain food waste in sealed containers when on site.
7. Prevent the deliberate feeding of wild fauna, particularly feral predators.
8. Fire prevention strategies should be an integral component of CRAWs for construction contractors.
9. Ensure that fire extinguishers are available to work personnel and that they are trained in their use.
10. Avoid smoking near or parking vehicles over dry vegetation, particularly spinifex (*Triodia* spp.*)* or Buffel Grass (**Cenchrus ciliaris*).
11. Dust suppression measures such as road watering and progressive rehabilitation of disturbed areas should be used (as per BHPBIO EMS).
12. Noise suppression measures may be considered to reduce impact to native fauna (as per BHPBIO EMS).
13. If rare fauna are observed on roads at night, consider a reduction in speed limits or avoidance of nocturnal works in that area.

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APPENDIX A: FAUNA RECORDED AND REGIONAL FAUNA DATA

Mammals

Family and Species	Common Name	EPBC	WCA	DEC	WAM Faunabase	DEC	DEH	FMG rail, Biota, 2004)	Van Dyck and Strahan, 2008	Repeater 1	Bing to Walla	Quarry 1
TACHYGLOSSIDAE												
Tachyglossus aculeatus	Echidna								✓			
DASYURIDAE												
Dasycercus blythi	Brush-Tailed Mulgara			P4	✓		✓		✓			
Dasykaluta rosamondae	Little Red Kaluta				✓			✓	✓			
Dasyurus hallucatus	Northern Quoll	EN	S1		✓		✓					✓
Ningaui timealeyi	Pilbara Ningaui				✓			✓	✓			
Planigale sp.	Common Planigale							✓				
Pseudantechinus roryi	Rory's Pseudantechinus				✓			✓	✓			
Sminthopsis macroura	Stripe-faced Dunnart							✓	✓			
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart				✓			✓	✓			
THYLACOMIDAE												
Macrotis lagotis	Bilby	VU	S1		✓							
MACROPODIDAE												
Lagorchestes conspicillatus leichardti	Spectacled Hare-wallaby			P3					✓			
Macropus robustus erubescens	Euro				✓				✓			
Macropus rufus	Red Kangaroo				✓				✓			
EMBALLONURIDAE												

Family and Species	Common Name	EPBC	WCA	DEC	WAM Faunabase	DEC	DEH	FMG rail, Biota, 2004)	Van Dyck and Strahan, 2008	Repeater 1	Bing to Walla	Quarry 1
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat								✓			
Taphozous georgianus	Common Sheath-tailed Bat				✓				✓			
MEGADERMATIDAE												
Macroderma gigas	Ghost Bat			P4		✓			✓			
HIPPOSIDERIDAE												
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	S1				✓		✓			
VESPERTILIONIDAE												
Chalinolobus gouldii	Gould's Wattled Bat								✓			
Chalinolobus morio	Chocolate Wattled Bat								✓			
Nyctophilus geoffroyi	Lesser Long-eared Bat				✓				✓			
Scotorepens greyii	Little Broad-nosed Bat								✓			
Vespadelus finlaysoni	Finlayson's Cave Bat				✓				✓			
MOLOSSIDAE												
Chaerephon jobensis	Northern Free-tailed Bat				✓				✓			
Mormopterus beccarii	Beccari's Free-tailed Bat								✓			
Mormopterus loriae cobourgiana	Western Little Free-tailed Bat			P1		✓			✓			
Tadarida australis	White-striped Free-tailed Bat								✓			
MURIDAE												
**Mus musculus*	House Mouse				✓				✓			
Leggadina lakedownensis	Northern Short-tailed Mouse			P4					✓			
Notomys alexis	Spinifex Hopping-mouse				✓			✓	✓			
Pseudomys chapmani	Western Pebble-mouse			P4		✓			✓			

Family and Species	Common Name	EPBC	WCA	DEC	WAM Faunabase	DEC	DEH	FMG rail, Biota, 2004)	Van Dyck and Strahan, 2008	Repeater 1	Bing to Walla	Quarry 1
Pseudomys desertor	Desert Mouse				✓			✓	✓			
Pseudomys hermannsburgensis	Sandy Inland Mouse				✓			✓	✓			
Zyzomys argurus	Common Rock Rat				✓			✓	✓			
CANIDAE												
**Canis lupus dingo*	Dingo								✓		✓	
**Vulpes vulpes*	Red Fox								✓			
FELIDAE												
**Felis catus*	Cat								✓			
EQUIDAE												
**Equus asinus*	Donkey								✓			
CAMELIDAE												
**Camelus dromedarius*	Camel								✓			
BOVIDAE												
**Bos taurus*	European Cattle								✓	✓	✓	

Birds

Family and Species	Common Name	EPBC	WCA	DEC	Birdata	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Simpson and Day, 2004	Repeater 1	Bing to Walla	Quarry 1
CASUARIDAE													
Dromaius novaehollandiae	Emu				✓				✓	✓			
PHASIANIDAE													
Coturnix pectoralis	Stubble Quail					✓				✓			
Coturnix ypsilophora	Brown Quail				✓					✓			
ANATIDAE													
Anas gracilis	Grey Teal				✓				✓	✓		✓	
Anas superciliosa	Pacific Black Duck				✓				✓	✓		✓	✓
Aythya australis	Hardhead				✓								
Dendrocygna eytoni	Plumed Whistling-duck				✓					✓			
PODICIPEDIDAE													
Podiceps cristatus	Great Crested Grebe				✓					✓			
Poliocephalus poliocephalus	Hoary-headed Grebe				✓					✓			
Tachybaptus novaehollandiae	Australasian Grebe				✓				✓	✓			
COLUMBIDAE													
**Columba livia*	Rock Pigeon				✓								
Geopelia cuneata	Diamond Dove				✓				✓	✓		✓	
Geopelia striata	Peaceful Dove				✓					✓		✓	
Geophaps plumifera	Spinifex Pigeon				✓	✓			✓	✓		✓	
Ocyphaps lophotes	Crested Pigeon				✓					✓		✓	

Family and Species	Common Name	EPBC	WCA	DEC	Birdata	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Simpson and Day, 2004	Repeater 1	Bing to Walla	Quarry 1
Phaps chalcoptera	Common Bronzewing								✓	✓			
PODARGIDAE													
Podargus strigoides	Tawny Frogmouth				✓					✓			
EUROSTOPODIDAE													
Eurostopodus argus	Spotted Nightjar				✓				✓	✓		✓	
AEGOTHELIDAE													
Aegotheles cristatus	Australian Owlet-nightjar				✓				✓	✓			
APODIDAE													
Apus pacificus	Fork-tailed Swift	M			✓			✓					
PHALACROCORIDAE													
Phalacrocorax carbo	Great Cormorant				✓					✓			
Phalacrocorax melanoleucos	Little Pied Cormorant				✓				✓	✓		✓	
Phalacrocorax sulcirostris	Little Black Cormorant				✓				✓	✓			
Phalacrocorax varius	Pied Cormorant				✓					✓			
CICONIIDAE													
Ephippiorhynchus asiaticus	Black-necked Stork				✓					✓			
ARDEIDAE													
Ardea alba	Great Egret	M			✓			✓	✓	✓			
Ardea ibis	Cattle Egret	M			✓			✓		✓			
Ardea intermedia	Intermediate Egret				✓								
Ardea pacifica	White-necked Heron				✓				✓	✓			

Family and Species	Common Name	EPBC	WCA	DEC	Birdata	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Simpson and Day, 2004	Repeater 1	Bing to Walla	Quarry 1
Egretta garzetta	Little Egret				✓					✓			
Egretta novaehollandiae	White-faced Heron				✓				✓	✓		✓	✓
Nycticorax caledonicus	Nankeen Night Heron				✓	✓			✓	✓			
THRESKIORNITHIDAE													
Platalea flavipes	Yellow-billed Spoonbill				✓					✓			
Plegadis falcinellus	Glossy Ibis				✓					✓			
Threskiornis molucca	Australian White Ibis				✓					✓			
Threskiornis spinicollis	Straw-necked Ibis				✓					✓			
ACCIPITRIDAE													
Accipiter cirrhocephalus	Collared Sparrowhawk				✓					✓			
Accipiter fasciatus	Brown Goshawk				✓				✓	✓			
Aquila audax	Wedge-tailed Eagle				✓				✓	✓		✓	
Circus approximans	Swamp Harrier				✓								
Circus assimilis	Spotted Harrier				✓				✓	✓		✓	
Elanus axillaris	Black-shouldered Kite				✓					✓			
Haliastur sphenurus	Whistling Kite				✓					✓		✓	✓
Hieraaetus morphnoides	Little Eagle				✓					✓		✓	
Lophoictinia isura	Square-tailed Kite				✓					✓			

Family and Species	Common Name	EPBC	WCA	DEC	Birdata	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Simpson and Day, 2004	Repeater 1	Bing to Walla	Quarry 1
FALCONIDAE													
Falco berigora	Brown Falcon				✓				✓	✓		✓	
Falco cenchroides	Nankeen Kestrel				✓				✓	✓		✓	
Falco hypoleucos	Grey Falcon			P4	✓					✓			
Falco longipennis	Australian Hobby				✓					✓			
Falco peregrinus	Peregrine Falcon		S4							✓			
RALLIDAE													
Fulica atra	Eurasian Coot				✓					✓			
Porzana tabuensis	Spotless Crake									✓			
Tribonyx ventralis	Black-tailed Native-hen				✓					✓			
OTIDAE													
Ardeotis australis	Australian Bustard			P4	✓		✓		✓	✓			
BURHINIDAE													
Burhinus grallarius	Bush Stone-curlew			P4	✓					✓			
RECURVIROSTRIDAE													
Himantopus himantopus	Black-winged Stilt				✓					✓			✓
ROSTRATULIDAE													
Rostratula australis	Australian Painted Snipe	VU, M	S1					✓					
CHARADRIIDAE													
Charadrius australis	Inland Dotterel									✓			
Charadrius ruficapillus	Red-capped Plover				✓								

Family and Species	Common Name	EPBC	WCA	DEC	Birdata	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Simpson and Day, 2004	Repeater 1	Bing to Walla	Quarry 1
Charadrius veredus	Oriental Plover	M			✓			✓		✓			
Elseyornis melanops	Black-fronted Dotterel				✓				✓	✓		✓	
Erythrogonys cinctus	Red-kneed Dotterel				✓					✓			
Vanellus miles	Masked Lapwing				✓								
Vanellus tricolor	Banded Lapwing				✓								
SCOLOPACIDAE													
Actitis hypoleucos	Common Sandpiper	M			✓				✓	✓			
Numenius minutus	Little Curlew	M			✓			✓		✓			
Tringa glareola	Wood Sandpiper	M			✓					✓			
Tringa nebularia	Common Greenshank	M			✓					✓			
Tringa stagnatilis	Marsh Sandpiper	M			✓	✓		✓		✓			
TURNICIDAE													
Turnix velox	Little Button-quail				✓				✓	✓		✓	
GLAREOLIDAE													
Glareola maldivarum	Oriental Pratincole	M			✓			✓		✓			
CACATUIDAE													
Cacatua sanguinea	Little Corella				✓				✓	✓		✓	
Eolophus roseicapillus	Galah				✓	✓			✓	✓	✓	✓	
Nymphicus hollandicus	Cockatiel				✓				✓	✓		✓	
PSITTACIDAE													
Barnardius zonarius	Australian Ringneck				✓					✓	✓		

Family and Species	Common Name	EPBC	WCA	DEC	Birdata	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Simpson and Day, 2004	Repeater 1	Bing to Walla	Quarry 1
Melopsittacus undulatus	Budgerigar				✓				✓			✓	
Pezoporus occidentalis	Night Parrot	CR	S1							✓			
CUCULIDAE													
Centropus phasianinus	Pheasant Coucal				✓	✓				✓			
Chalcites basalis	Horsfield's Bronze-Cuckoo				✓					✓			
Chalcites osculans	Black-eared Cuckoo									✓			
Cacomantis pallidus	Pallid Cuckoo				✓				✓	✓			
STRIGIDAE													
Ninox connivens	Barking Owl				✓					✓			
Ninox novaeseelandiae	Southern Boobook				✓					✓			
TYTONIDAE													
Tyto alba	Barn Owl				✓	✓				✓			
HALCYONIDAE													
Dacelo leachii	Blue-winged Kookaburra				✓					✓		✓	
Todirhamphus pyrrhopygius	Red-backed Kingfisher				✓				✓	✓	✓		
Todirhamphus sanctus	Sacred Kingfisher				✓				✓	✓		✓	
MEROPIDAE													
Merops ornatus	Rainbow Bee-eater	M			✓			✓	✓	✓		✓	
CLIMATERIDAE													
Climacteris melanura	Black-tailed Treecreeper				✓	✓				✓			
PTILONORHYNCHIDAE													

Family and Species	Common Name	EPBC	WCA	DEC	Birdata	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Simpson and Day, 2004	Repeater 1	Bing to Walla	Quarry 1
Chlamydera guttata	Western Bowerbird				✓				✓	✓		✓	
MALURIDAE													
Amytornis striatus	Striated Grasswren									✓			
Malurus lamberti	Variegated Fairy-wren				✓	✓				✓			
Malurus leucopterus	White-winged Fairy-wren				✓	✓			✓	✓		✓	✓
Stipiturus ruficeps	Rufous-crowned Emu-wren									✓			
ACANTHIZIDAE													
Gerygone fusca	Western Gerygone									✓			
Smicrornis brevirostris	Weebill									✓			
PARDALOTIDAE													
Pardalotus rubricatus	Red-browed Pardalote				✓					✓			
Pardalotus striatus	Striated Pardalote				✓					✓			
MELIPHAGIDAE													
Acanthagenys rufogularis	Spiny-cheeked Honeyeater									✓			
Sugomel niger	Black Honeyeater								✓	✓	✓	✓	
Ephthianura aurifrons	Orange Chat				✓					✓			
Ephthianura tricolor	Crimson Chat				✓					✓			
Lichenostomus keartlandi	Grey-headed Honeyeater				✓				✓	✓			
Lichenostomus penicillatus	White-plumed Honeyeater				✓	✓			✓	✓	✓	✓	
Lichenostomus virescens	Singing Honeyeater				✓				✓	✓		✓	
Lichmera indistincta	Brown Honeyeater				✓				✓		✓	✓	

Family and Species	Common Name	EPBC	WCA	DEC	Birdata	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Simpson and Day, 2004	Repeater 1	Bing to Walla	Quarry 1
Manorina flavigula	Yellow-throated Miner				✓					✓			
Melithreptus gularis	Black-chinned Honeyeater				✓					✓			
NEOSITTIDAE													
Daphoenositta chrysoptera	Varied Sittella									✓			
POMATOSTOMIDAE													
Pomatostomus temporalis	Grey-crowned Babbler				✓				✓	✓			
CAMPEPHAGIDAE													
Coracina novaehollandiae	Black-faced Cuckoo-shrike				✓				✓	✓	✓	✓	
Lalage sueurii	White-winged Triller				✓					✓			
PACHYCEPHALIDAE													
Colluricincla harmonica	Grey Shrike-thrush				✓					✓			
Oreoica gutturalis	Crested Bellbird				✓					✓			✓
Pachycephala rufiventris	Rufous Whistler				✓				✓	✓			
ARTAMIDAE													
Artamus cinereus melanops	Black-faced Woodswallow				✓				✓			✓	✓
Artamus leucorhynchus	White-breasted Woodswallow				✓	✓				✓			
Artamus minor	Little Woodswallow								✓				
Artamus personatus	Masked Woodswallow				✓					✓			
Cracticus nigrogularis	Pied Butcherbird				✓				✓	✓			✓
Cracticus tibicen	Australian Magpie				✓					✓			
Cracticus torquatus	Grey Butcherbird									✓			

Family and Species	Common Name	EPBC	WCA	DEC	Birdata	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Simpson and Day, 2004	Repeater 1	Bing to Walla	Quarry 1
RHIPIDURIDAE													
Rhipidura albiscapa	Grey Fantail				✓					✓			
Rhipidura leucophrys	Willie Wagtail				✓				✓	✓	✓	✓	✓
CORVIDAE													
Corvus bennetti	Little Crow				✓				✓	✓			
Corvus orru	Torresian Crow				✓				✓	✓		✓	
MONARCHIDAE													
Grallina cyanoleuca	Magpie-lark				✓				✓	✓	✓	✓	
ALAUDIDAE													
Mirafra javanica	Horsfield's Bushlark									✓		✓	
ACROCEPHALIDAE													
Acrocephalus australis	Australian Reed-Warbler				✓					✓			
MEGALURIDAE													
Cinclorhamphus mathewsi	Rufous Songlark				✓	✓				✓			
Eremiornis carteri	Spinifexbird				✓					✓		✓	
HIRUNDINIDAE													
Cheramoeca leucosternus	White-backed Swallow				✓					✓			
Hirundo ariel	Fairy Martin				✓					✓		✓	✓
Hirundo neoxena	Welcome Swallow				✓					✓			
Hirundo nigricans	Tree Martin				✓				✓	✓		✓	

Family and Species	Common Name	EPBC	WCA	DEC	Birdata	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Simpson and Day, 2004	Repeater 1	Bing to Walla	Quarry 1
NECTARINIDAE													
Dicaeum hirundinaceum	Mistletoebird				✓				✓	✓			
ESTRILDIDAE													
Emblema pictum	Painted Finch				✓				✓	✓	✓	✓	
Neochmia ruficauda subclarescens	Star Finch			P4	✓		✓			✓			
Taeniopygia guttata	Zebra Finch				✓					✓		✓	
MOTACILLIDAE													
Anthus novaeseelandiae	Australian Pipit				✓				✓	✓		✓	

Reptiles

Family and Species	Common Name	EPBC	WCA	DEC	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Field Guides	Repeater 1	Bing to Walla	Quarry 1
AGAMIDAE												
Amphibolurus gilberti	Gilbert's Dragon								✓			
Amphibolurus longirostris	Long-nosed Dragon				✓				✓		✓	✓
Ctenophorus caudicinctus	Ring-tailed Dragon				✓			✓	✓	✓	✓	✓
Ctenophorus isolepis	Military Dragon				✓			✓	✓	✓	✓	✓
Ctenophorus nuchalis	Central Netted Dragon				✓			✓	✓		✓	
Diporiphora valens	A dragon							✓				
Diporiphora winneckei	Canegrass Dragon				✓				✓			
Pogona minor	Dwarf Bearded Dragon				✓			✓	✓			
BOIDAE												
Antaresia perthensis	Pygmy Python				✓			✓	✓			
Antaresia stimsoni	Stimson's Python				✓				✓		✓	✓
Aspidites melanocephalus	Black-headed Python				✓				✓			
Aspidites ramsayi	Woma			P1	✓	✓						
Liasis olivaceus barroni	Pilbara Olive Python		S1				✓		✓			
CHELUIDAE												
Chelodina steindachneri	Flat-shelled Turtle							✓				
ELAPIDAE												
Acanthophis pyrrhus	Desert Death Adder				✓				✓			
Acanthophis wellsi	Pilbara Death Adder								✓			
Brachyurophis approximans	NW Shovel-nosed Snake							✓	✓			

Family and Species	Common Name	EPBC	WCA	DEC	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Field Guides	Repeater 1	Bing to Walla	Quarry 1
Demansia psammophis cupreiceps	Yellow-faced Whipsnake				✓			✓	✓			
Demansia reticulata	Desert Whipsnake				✓							
Demansia rufescens	Rufous Whipsnake				✓							
Furina ornata	Moon Snake				✓				✓			
Pseudechis australis	Mulga Snake				✓				✓			
Pseudonaja modesta	Ringed Brown Snake				✓							
Pseudonaja nuchalis	Gwardar				✓				✓			
Simoselaps anomalus	Desert Banded Snake				✓			✓	✓			
Suta fasciata	Rosen's Snake								✓			
Suta punctata	Little Spotted Snake				✓			✓	✓			
Vermicella snelli	Pilbara Bandy-bandy								✓			
GEKKONIDAE												
Diplodactylus conspicillatus	Fat-tailed Gecko				✓			✓	✓			
Gehyra punctata	A Dtella				✓				✓	✓	✓	✓
Gehyra pilbara	A Dtella								✓			
Gehyra purpurascens	A Dtella				✓							
Gehyra variegata	A Dtella				✓			✓	✓			
Heteronotia binoei	Bynoe's Gecko				✓			✓	✓			
Heteronotia spelea	Desert Cave Gecko								✓			
Lucasium stenodactylum	Sand-plain Gecko				✓			✓	✓			
Nephrurus levis pilbarensis	Smooth Knob-tailed Gecko				✓			✓	✓			
Nephrurus wheeleri	Banded Knob-tailed Gecko								✓			

Family and Species	Common Name	EPBC	WCA	DEC	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Field Guides	Repeater 1	Bing to Walla	Quarry 1
Oedura marmorata	Marbled Velvet Gecko								✓			
Rhynchoedura ornata	Beaked Gecko				✓				✓			
Strophurus ciliaris	Northern Spiny-tailed Gecko				✓			✓	✓			
Strophurus elderi	Jewelled Gecko				✓			✓	✓			
PYGOPODIDAE												
Delma butleri	A legless lizard				✓				✓			
Delma haroldi	A legless lizard				✓			✓	✓			
Delma pax	A legless lizard				✓			✓				
Delma tincta	A legless lizard				✓			✓	✓			
Lialis burtonis	Burton's Snake Lizard				✓			✓	✓			
Pygopus nigriceps	Western Hooded Scaly-foot				✓			✓	✓			
SCINIDAE												
Carlia munda	A skink							✓	✓			
Carlia triacantha	Rainbow Skink				✓			✓	✓			
Cryptoblepharus carnabyi	A Fence Skink				✓				✓			
Cryptoblepharus ustulatus (plagiocephalus)	A Fence Skink				✓				✓			
Ctenotus duricola	A skink				✓			✓				
Ctenotus grandis	A skink				✓			✓				
Ctenotus helenae	A skink				✓			✓	✓			
Ctenotus pantherinus	Leopard Skink				✓			✓	✓		✓	✓
Ctenotus piankai	A skink				✓				✓			
Ctenotus rufescens	A skink				✓			✓				

Family and Species	Common Name	EPBC	WCA	DEC	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Field Guides	Repeater 1	Bing to Walla	Quarry 1
Ctenotus saxatilis	Rock Ctenotus				✓			✓	✓	✓	✓	✓
Cyclodomorphus melanops	Spinifex Slender Blue-tongue								✓			
Egernia depressa	Pygmy Spiny-tailed Skink				✓			✓	✓			
Egernia formosa	A skink								✓			
Eremiascincus richardsonii	Broad-banded Sand-swimmer				✓			✓	✓			
Lerista bipes	A skink				✓			✓	✓			
Lerista muelleri	A skink				✓			✓	✓			
Menetia greyii	Common Dwarf Skink				✓			✓	✓			
Morethia ruficauda	A skink										✓	
Notoscincus ornatus	A skink				✓			✓	✓			
Proablepharus reginae	A skink				✓			✓	✓			
Tiliqua multifasciata	Centralian Blue-tongue				✓				✓			
TYPHLOPIDAE												
Ramphotyphlops ammodytes	A blind-snake				✓			✓	✓			
Ramphotyphlops grypus	A blind-snake							✓	✓			

Family and Species	Common Name	EPBC	WCA	DEC	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Field Guides	Repeater 1	Bing to Walla	Quarry 1
VARANIDAE												
Varanus acanthurus	Ridge-tailed Monitor				✓			✓	✓			
Varanus brevicauda	Short-tailed Pygmy Monitor				✓			✓	✓			
Varanus eremius	Pygmy Desert Monitor				✓			✓	✓			✓
Varanus giganteus	Perentie								✓		✓	
Varanus gouldii	Gould's Goanna				✓			✓	✓			✓
Varanus panoptes	Yellow-spotted Monitor											
Varanus tristis	Black-headed Monitor								✓			

Amphibians

Family and Species	Common Name	EPBC	WCA	DEC	WAM Faunabase	DEC	DEH	FMG rail (Biota, 2004)	Field Guides	Repeater 1	Bing to Walla	Quarry 1
HYLIDAE												
Cyclorana australis	Giant Frog				✓			✓	✓			
Cyclorana maini	Main's Frog				✓			✓	✓			
Litoria rubella	Desert Tree Frog				✓			✓	✓		✓	
MYOBATRACHIDAE												
Limnodynastes spenceri	Spencer's Frog				✓			✓				
Neobatrachus aquilonius	Northern Burrowing Frog				✓							
Notaden nichollsi	Desert Spadefoot				✓			✓	✓			
Uperoleia glandulosa	Glandular Toadlet				✓							
Uperoleia russelli	Russell's Toadlet				✓			✓	✓			

APPENDIX B: RISK ASSESSMENT

Process/Activity	Event	Impact	Likelihood	Consequence	Risk Level	Significance	Controls	Likelihood	Consequence	Risk Level	Significance
Vegetation Clearing	Removal of fauna habitat	Loss of local vertebrate fauna communities	5	2	10	Med	Clearing should be restricted to that which is necessary. Clearing boundaries should be defined in the field.	5	2	10	Med
Vegetation Clearing	Removal of fauna habitat	Loss of biodiversity	4	3	12	High	Clearing should be restricted to that which is necessary. Use existing access tracks where possible. Avoid clearing in sensitive or highly diverse environments such as creeklines and drainage channels or vegetation in good condition where possible.	2	3	6	Med
Vegetation Clearing	Removal of fauna habitat	Adverse impact to ecological function	4	2	8	Med	As above.	3	2	6	Med
Vegetation Clearing	Habitat fragmentation	Reduction in habitat quality through edge effects and patchiness	4	1	4	Low	Utilise existing access tracks where possible – do not create additional tracks unnecessarily.	2	1	2	Low
Vegetation Clearing	Removal of fauna habitat	Loss of Conservation Significant Fauna	3	4	12	High	Avoid clearing habitat known to support threatened species, such as large spinifex mounds. Avoid disturbance near existing Pebble-mouse mounds. Utilise existing access tracks where possible. Identify and avoid nesting Rainbow Bee-eater colonies. Identify and avoid Greater Bilby burrows if found.	2	4	8	Med

Process/Activity	Event	Impact	Likelihood	Consequence	Risk Level	Significance	Controls	Likelihood	Consequence	Risk Level	Significance
Inadequate weed hygiene management	Spread of weeds after clearing	Degradation of fauna habitat.	3	3	9	High	Implement BHPBIO weed management procedures.	1	3	3	Low
Inadequate waste management	Increase in feral fauna	Increase in feral fauna resulting in competition for resources and/or increased predation on native fauna	2	3	6	Med	Implement BHPBIO waste disposal procedures. Remove waste regularly from site. Maintain food waste in sealed containers when on site. Do not feed wild animals such as dogs and foxes.	1	3	3	Low
Habitat fragmentation	Increase in feral fauna	Increase in feral fauna resulting in competition for resources and/or increased predation on native fauna	2	4	8	Med	Clearing should be restricted to that which is necessary. Utilise existing access tracks where possible – do not create additional tracks unnecessarily.	1	4	4	Low
Fire	Accidental fire as a result of human activity	Destruction of fauna habitat and populations	2	4	6	Med	Site-specific fire prevention strategy may be considered as part of CRAW process. All vehicles should be fitted with fire extinguishers and personnel trained in their use. Avoid smoking near dry vegetation or parking vehicles above it.	1	4	3	Low
Dust	Dust emissions from clearing, construction and ongoing activities	Damage to vegetation resulting in loss of fauna habitat	3	3	9	High	BHPBIO dust suppression methods should be utilised.	2	3	6	Med
Clearing construction and ongoing activities	Noise pollution	Noise has the potential to disturb fauna causing a decline in populations	2	3	6	Med	BHPBIO noise controls should be implemented	1	3	3	Low
Vehicle movements, construction and clearing	Vehicle strike	Fauna mortality	3	1	3	Low	Enforce speed limits and avoid driving during dusk and dawn. Personnel to be made aware of risk to fauna through BHPBIO induction procedures.	2	1	2	Low
Vehicle movements, construction and clearing	Vehicle strike	Mortality of conservation significant fauna	2	4	8	Med	Lower speed limits may be appropriate. Personnel to be made aware of risk to fauna as per BHPBIO induction procedures. If rare fauna observed, consider avoiding nocturnal work in the area if possible.	1	4	4	Low

		LIKELIHOOD				
		5	4	3	2	1
		ALMOST CERTAIN	LIKELY	POSSIBLE	UNLIKELY	RARE
		Is expected to occur in most circumstance	Will probably occur in most circumstance	Could occur	Could occur but not expected	Occurs in exceptional circumstances
CONSEQUENCES	5 - CATASTROPHIC Significant impact to fauna species of conservation significance or regional biodiversity	25	20	15	10	5
	4 - MAJOR Impact to fauna species of conservation significance in project area.	20	16	12	8	4
	3 - MODERATE Loss of fauna biodiversity in project area.	15	12	9	6	3
	2 - MINOR Short term or localised impact to fauna biodiversity.	10	8	6	4	2
	1 - INSIGNIFICANT No impact to fauna of conservation significance or biodiversity.	5	4	3	2	1

11-25	High risk, site/issue specific management programmes required, advice/approval from regulators required.
6 – 10	Medium risk, specific management and procedures must be specified.
1 – 5	Low risk, managed by routine procedures.