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RAIL OPERATIONS

RGP5 FAUNA SURVEY: QUARRY 2

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 to expand BHPBIO's rail capacity through duplication of BHPBIO's Newman – Port Hedland railroad and other infrastructure is known as Rapid Growth Project 5 (RGP5). One component of the RGP5 is the construction of laydown areas, offices, and other infrastructure in Special Lease 3116/6298. This lease contains an inactive quarry named "Quarry 2" and the project area will be referred to as "Quarry 2 Lease" throughout.

The purpose of this study was to assess the vertebrate fauna assemblages and habitats of the area within and around the Quarry 2 Lease. The Quarry 2 Lease is located adjacent to chainage 72.5, approximately 65 km south of Port Hedland; it is immediately north of Tabba Siding on BHPBIO's rail line (Figure 1.1).

The study 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; Table S. 1.1).

The desktop survey indicated that 177 species of vertebrate fauna may occur within the Quarry 2 Lease, including 18 species of conservation significant fauna comprising nine rare fauna (four mammals, three birds and two reptiles) and nine Migratory bird species.

One reptile was observed during the reconnaissance survey on 7th May 2008 while evidence of the Northern Quoll (*Dasyurus hallucatus*) being present within the Quarry 2 Lease was found during the targeted Northern Quoll survey conducted on 15th July 2008. The Northern Quoll is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*. The Northern Quolls utilising the disused quarry should not be significantly impacted by the proposed new works in the Quarry 2 Lease which will be carried out away from this area. BHPBIO will manage any potential impacts under a Northern Quoll Management Plan that has been prepared for RGP5 (*ecologia*, 2008a).

The following management recommendations actions should be adopted by BHPBIO for its proposed works in the Quarry 2 Lease. (APPENDIX B).

1. Address recommendations of the RGP5 Northern Quoll Management Plan (*ecologia*, 2008a)
2. Minimise clearing of habitats thought to support rare fauna, such as the Northern Quoll, and clearly define clearing boundaries.
3. Areas cleared as part of construction should be rehabilitated as soon as practicable.
4. Utilise existing access tracks where possible to avoid habitat fragmentation.
5. Contractors should be made aware of potential conservation significant fauna locations.
6. Utilise BHPBIO weed management procedures.
7. 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.
8. Prevent the deliberate feeding of wild fauna, particularly feral predators.
9. Fire prevention strategies should be an integral component of CRAWs for construction contractors.
10. Ensure that fire extinguishers are available to work personnel and that they are trained in their use.

11. Avoid smoking near or parking vehicles over dry vegetation, particularly spinifex (*Triodia* spp.*)* or Buffel Grass (**Cenchrus ciliaris*).
12. Dust suppression measures, such as road watering and progressive rehabilitation of disturbed areas, should be used.
13. Noise suppression measures may be considered to reduce impact to native fauna, particularly Northern Quolls, when blasting.
14. 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 1.1– 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.	A separate Northern Quoll Management Plan has been prepared to manage any potential impacts to this species (*ecologia*, 2008a).
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, targeted survey was conducted to assess whether Northern Quolls are likely to use the Quarry 2 Lease (*ecologia*, 2008e).
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. A separate Northern Quoll Management Plan has been prepared to manage any potential impacts to this species (*ecologia*, 2008a).
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 2 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 the Quarry 2 Lease. 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 reconnaissance survey was conducted on the 7th May 2008 and covered the entire Quarry 2 Lease.

An additional survey investigating possible Northern Quoll presence at four inactive quarries adjacent to the Newman – Port Hedland rail line (Quarries 1 – 4) was conducted in July 2008 (*ecologia*, report in preparation). Results of this Quoll Targeted Survey pertinent to Quarry 2 have been included in this report and are also detailed in the RGP5 Northern Quoll Management Plan (*ecologia*, 2008a).

1.2 LOCATION

The Quarry 2 Lease area is shown in Figure 1.1, this entire area was surveyed during the *ecologia* reconnaissance survey. Also shown in Figure 1.1 is the area surveyed during the Quoll Targeted Survey.

The Quarry 2 Lease is located adjacent to chainage 72.5 on Special Lease 3116/6298, approximately 65 km south of Port Hedland; it is immediately north of Tabba Siding on BHPBIO's rail line (Figure 1.2).

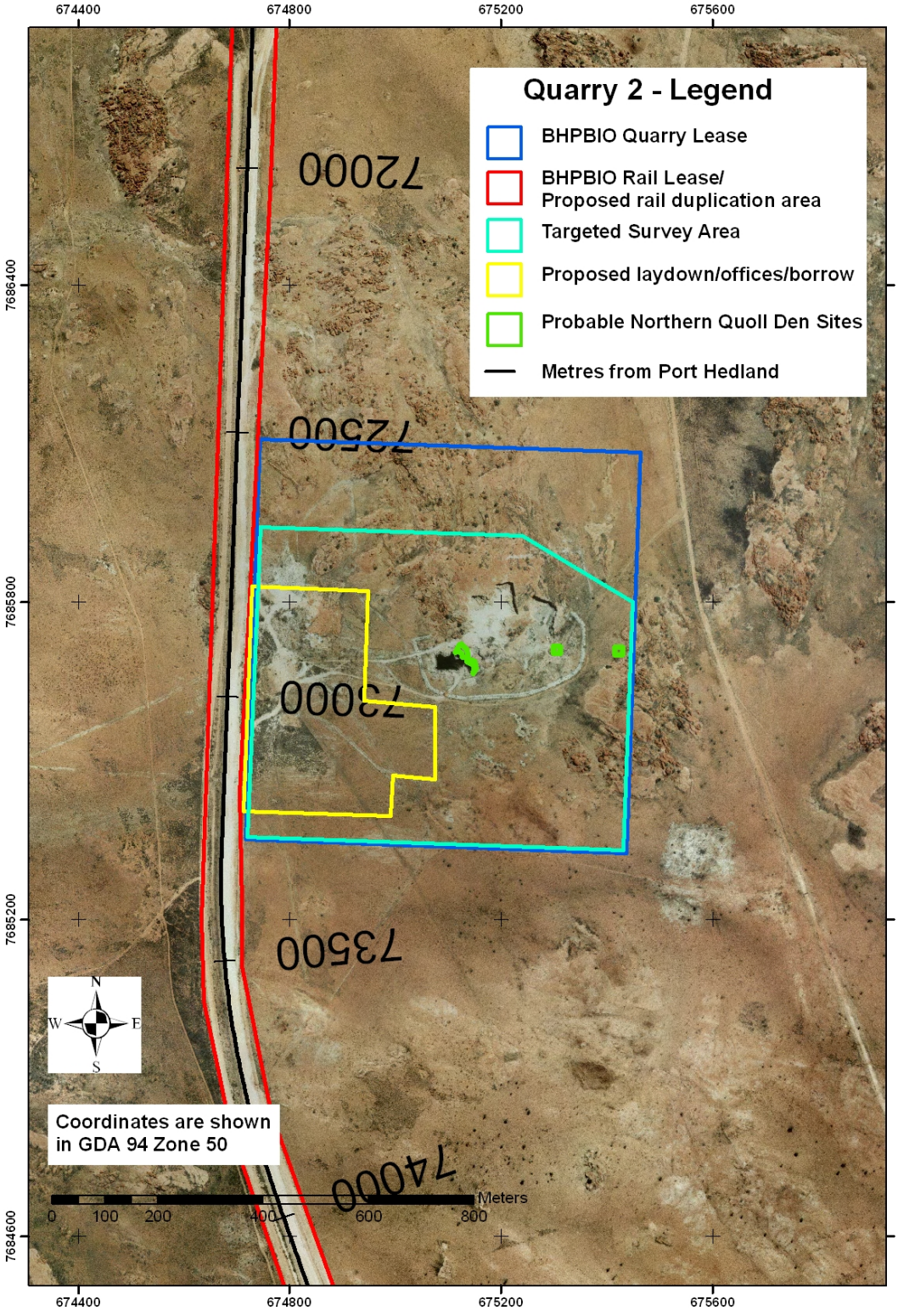

Figure 1.1 – The Quarry 2 lease area, showing the entire lease area surveyed in May 2008 and the Targeted Survey area of July 2008

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).

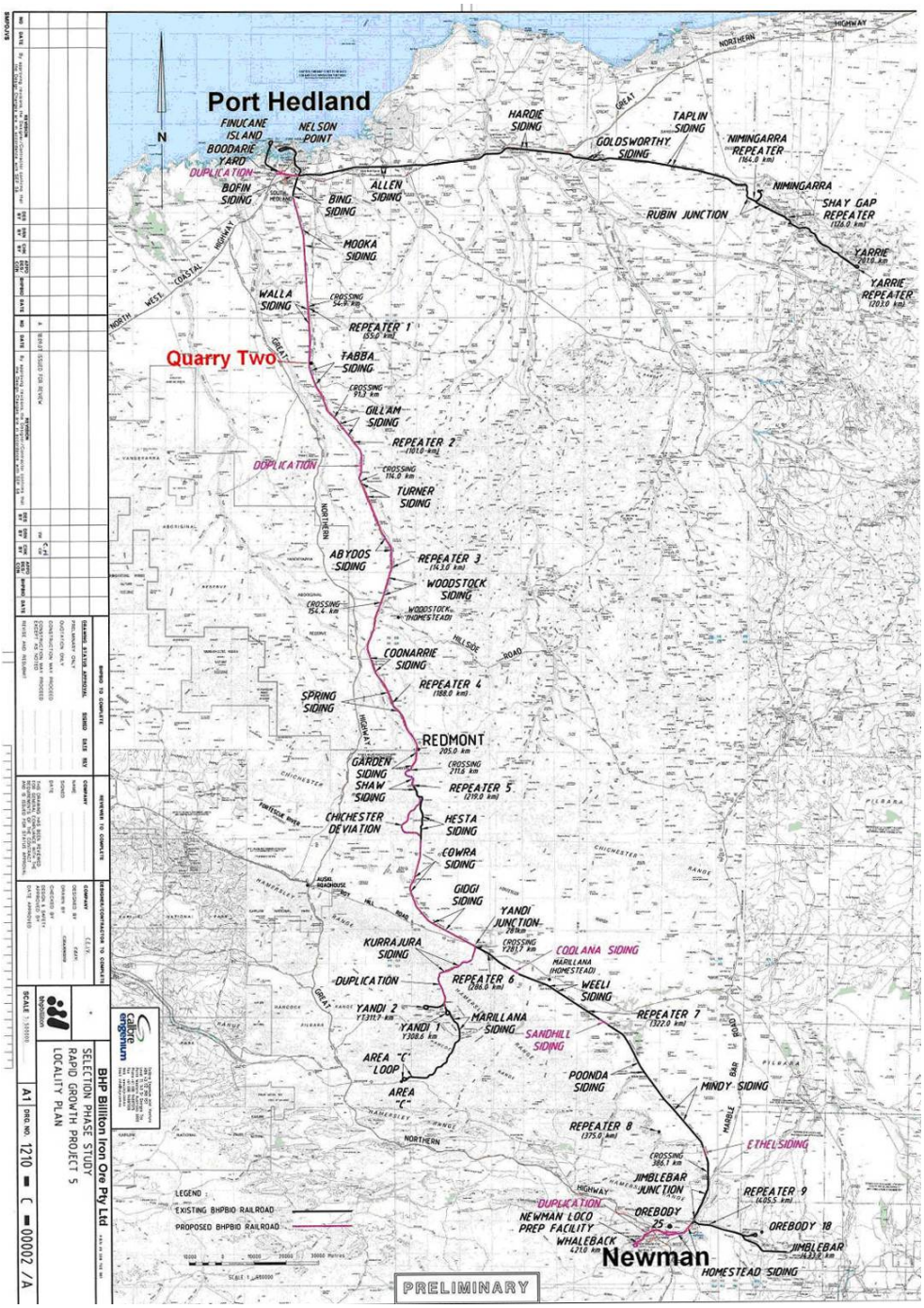

Figure 1.2 – Location of the Quarry 2 Lease

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 2 Lease 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

The nearest weather station with a long-term history is the weather station at Port Hedland, located 70 km NNW of Quarry 2. Weather data from this station was obtained from the Bureau of Meteorology (BOM, 2008). Climatic averages from 1948 through to 2008 are shown in Figure 2.1.

Most summer rain comes from scattered thunderstorms or cyclones which most commonly affect the coastal areas from December through March but can also take significant rainfall inland. A second peak in rainfall occurs in May as a result of rainfall caused by tropical cloud bands.

The normal inland maximum temperature range in summer is 37-42 °C while on the coast, such as at Port Hedland, the temperatures tend to be 2-3 °C cooler but usually more humid. Winter maximum temperatures are mild/warm with temperatures in the range 25-30 °C. Minimum temperatures range from 25 °C in midsummer to 12 °C in July near the coast and 8-12 °C inland. The lowest temperatures occur in the winter months of June, July and August.

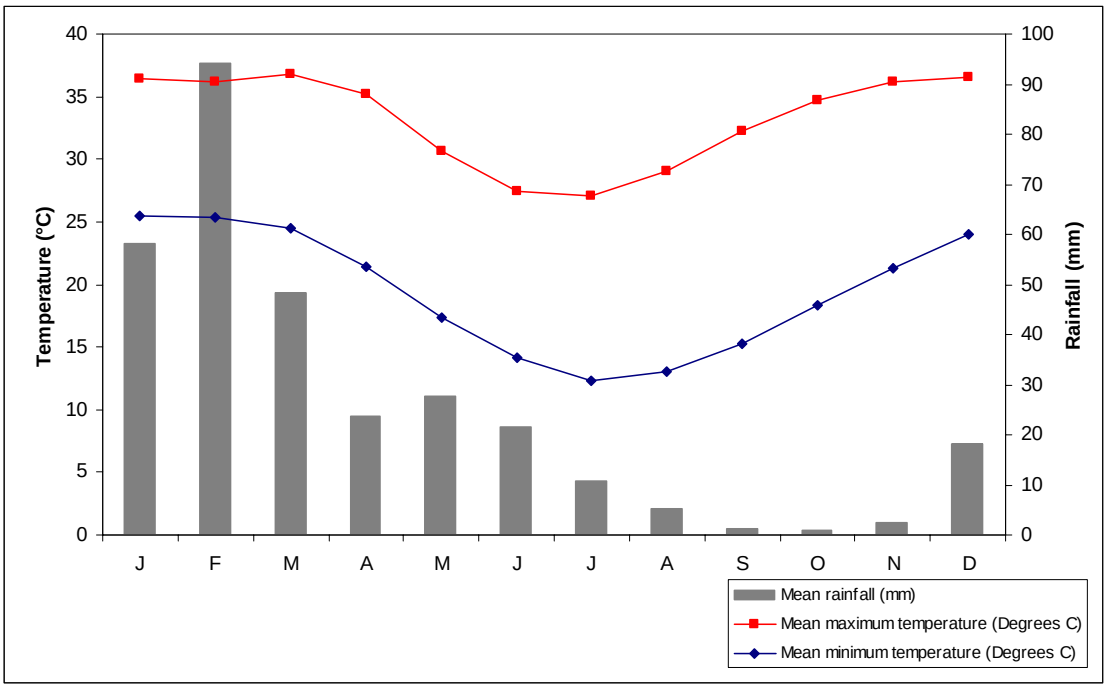

Figure 2.1 – Climate data from Port Hedland (Bureau of Meteorology Averages, 1948-2008)

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. Each land system is classified into a particular land type defined by the landforms and vegetation it contains.

The Quarry 2 Lease spans the border of two land systems; the Boolaloo and Macroy Land Systems (Figure 2.2). Table 2.1 provides a description of the land system types that lie within the Quarry 2 Lease from Van Vreeswyk *et al.* (2004). The Macroy land system is well represented regionally (in the Pilbara) and the maximum area of this land system that could be disturbed within the Quarry 2 Lease is small relative to the total area covered by this land system, as shown in the table. The total area of the Boolaloo land system in the Pilbara is less than other land systems; however, it is well represented locally (as shown in Figure 2.2). Were all of Quarry 2 Lease to be cleared, 0.03% of the Boolaloo land system is impacted (Table 2.1), but the amount of clearing proposed for the quarry is in fact significantly less (see Figure 5.1).

Table 2.1 – Land systems in the Quarry 2 Lease as described by Van Vreeswyk *et al*. (2004)

Land System	Habitat	Total area in WA (km^2)	Approx. area in the survey area (km^2)	Percentage of the total area occurring in survey area (%)
Boolaloo	Granite hills, domes and tor fields and sandy plains with shrubby spinifex grasslands	1,502	0.46	0.03
Macroy	Stony plains and occasional tor fields based on granite supporting hard and soft spinifex grasslands.	13,095	0.15	< 0.0012

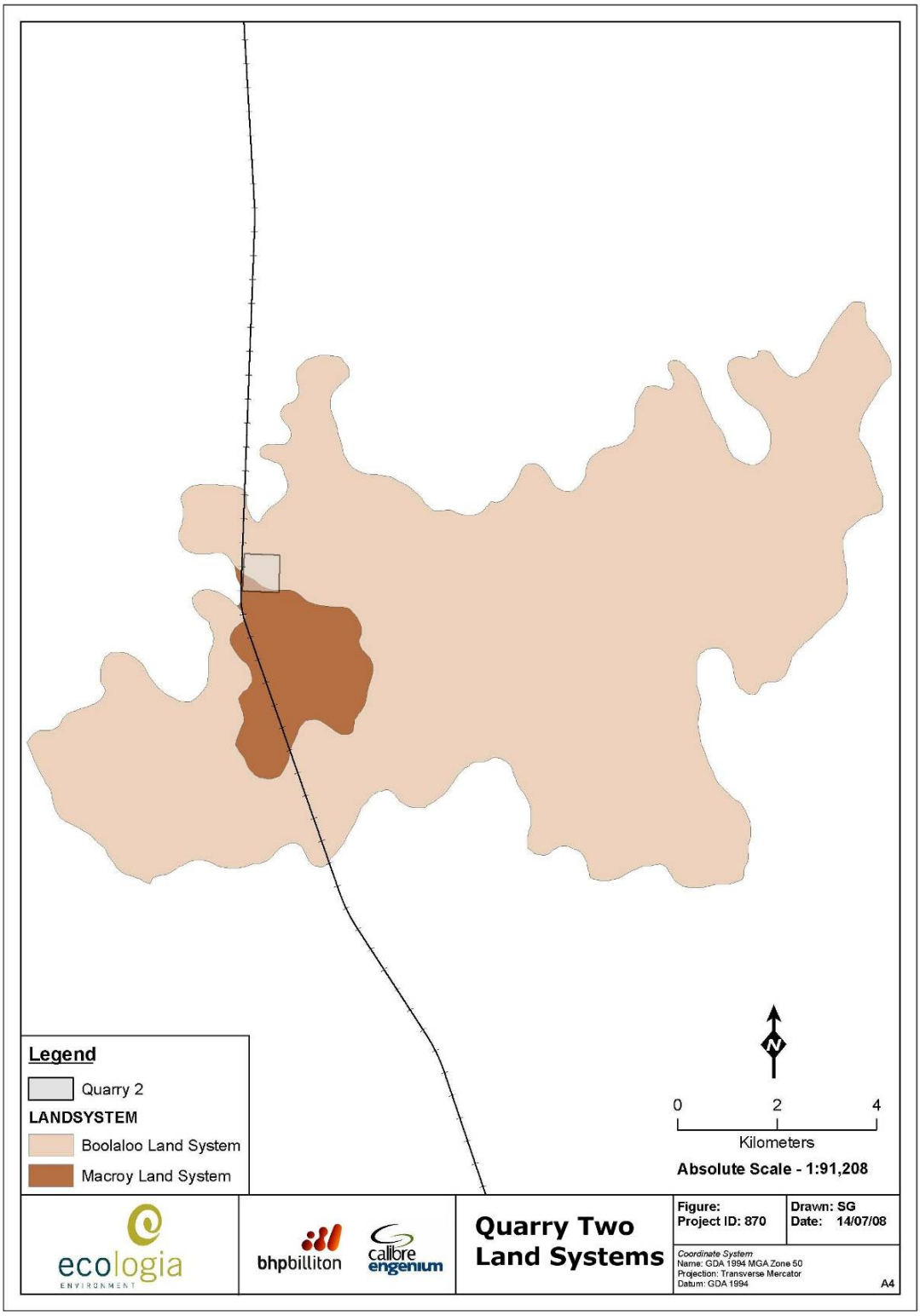

Figure 2.2 – Land systems in the Quarry 2 Lease as described by Van Vreeswyk *et al*. (2004)

2.3 BIOGEOGRAPHY

A biogeographic regionalisation of Australia has been developed collaboratively in which bioregions (broad-scale regionalisations) are formally recognised and mapped, called the Interim Biogeographic Regionalisation for Australia (IBRA), currently version 6.1 (Thackway and Cresswell, 1995). IBRA version 6.1 represents a landscape-based approach to classifying the land surface of Australia. Eighty-five biogeographic regions and 405 subregions have been delineated, each reflecting a unifying set of major environmental influences which shape the occurrence of flora and fauna and their interaction with the physical environment across Australia. Subregions are more localised and homogeneous geomorphological units in each bioregion, of which Western Australia has 53 (DEC, 2002).

The project area is located in the Pilbara biogeographic region of the Interim Biogeographic Regionalisation for Australia (IBRA). The Pilbara IBRA region is subdivided into the Hamersley, Fortescue Plains, Chichester and Roebourne Subregions (Figure 2.3); the Quarry 2 Lease is located in the Chichester subregion (PIL-1).

The Chichester subregion is characterised by undulating Archaean granite and basalt plains including significant areas of basaltic ranges (Kendrick *et al.,* 2001). The vegetation is dominated by:

- a shrub steppe of *Acacia inaequilatera* (Woody Kanji), over *Triodia wiseana* (spinifex / hummock grass) on the plains; and,
- a *Eucalyptus leucophloia* (Snappy gum) tree steppe on the ranges.

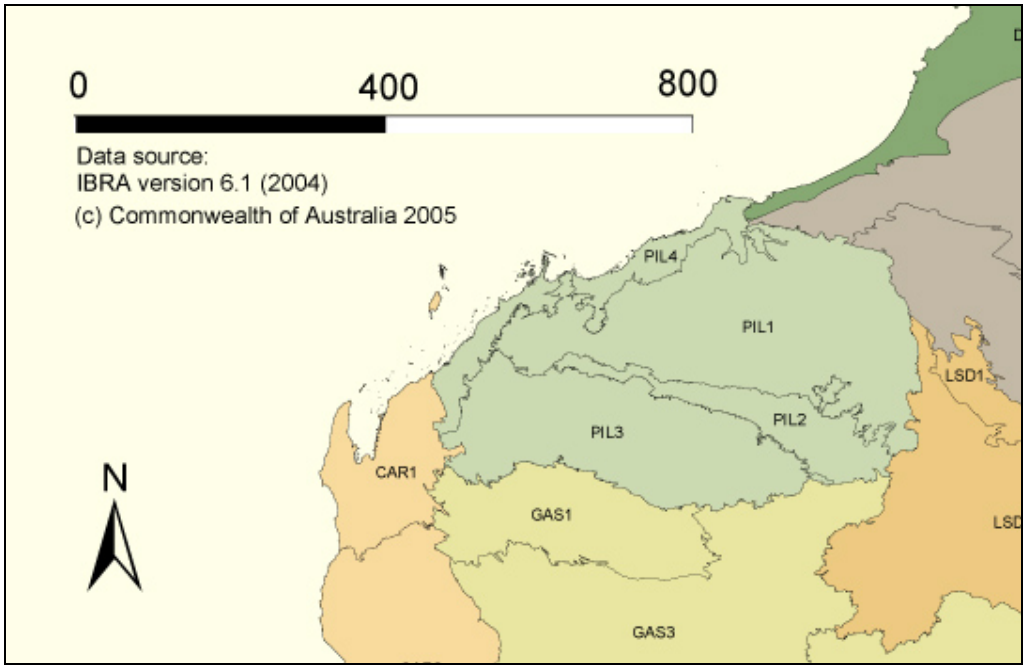

Figure 2.3 – Biogeographical subregions of north Western Australia

2.4 VEGETATION

The survey area is located in Beard's (1975) Fortescue Botanical District of the Pilbara. It occurs in the following vegetation unit mapped by Beard:

- a shrub steppe of *Acacia pyrifolia* (Kanji) and *Triodia pungens* (spinifex / hummock grass).

Vegetation units have been described and broadly mapped for other rail projects in the vicinity of the BHPBIO rail line (Biota, 2004). Two vegetation units close to the Quarry 2 Lease were described:

- *Acacia inaequilatera* and *A. ancistrocarpa* scattered tall shrubs, over *Triodia epactia* and *T. lanigera* hummock grassland on a sandy plain, and,
- *Acacia tumida* high shrubland to open scrub, over *Triodia epactia* hummock grassland on a granite outcrop.

3 SURVEY METHODS

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 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, in general, well studied. However, project area locality is not well known.	*ecologia* has conducted several recent Level 1 surveys within 30 km of the Quarry 2 Lease which were consulted when conducting the desk top survey (Repeater 1, Repeater 2, Walla to Turner). In addition, sites of a survey conducted along the FMG Rail corridor by Biota (2004) within 30 km of the Quarry 2 Lease were also consulted in the generation of potential species lists.
Landform special characteristics/ specific fauna/ specific context of the landform characteristics and their distribution and rarity in the region.	Landforms were a mixture of man-made and natural forms.	The project area consisted of a dominant low granite rise with emergent boulders, into which a quarry has been excavated. Nearby the quarry small areas of dumped rocks had also formed screes and one previously quarried area has resulted in a scree-lined pool with a small sandy shoreline. Much of the southern and western area of the lease was low acacia shrubland on sandy loam.
Lifeforms, life cycles, types of assemblages and seasonality (e.g. migration) of species likely to be present.	Conditions were warm and dry at the time of surveying	Amphibians were absent because of dry conditions and a diurnal survey, but may be present in the pool. Bird, mammal and reptile activity was good at time of surveying; however, because the survey of the Quarry 2 Lease was of short duration, few fauna were recorded.

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 of the project.	Data were available from a report on the fauna of the FMG rail corridor (Biota, 2004) located to the west of the Quarry 2 Lease. 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 a Level 1 survey between Turner and Walla sidings (*ecologia*, 2008b) including a survey at Repeater 1 (*ecologia*, 2008c), Repeater 2 (*ecologia*, 2008d) and Quoll Targeted Surveys at Quarries (2008e).
Number of different habitats or degree of similarity between habitats within a survey area.	Within the survey, a number of different habitats were observed.	A number of fauna habitats were encountered, shown in Table 3.2 and discussed in Section 4.2. The quarry itself provided a number of unique habitats. 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).	Relatively dry six months leading up to survey.	Relatively dry conditions and the absence of the usual cyclonic rainfall characterised the months preceding the survey. Rainfall at Port Hedland in the six months preceding the survey was well below average for almost all months except April, the month before the survey, in which 25 mm rainfall was received. Mean maximum daily temperatures at the time of the survey was approximately 31 °C.
Sensitivity of the environment to the proposed activities.	Further quarrying in this area may disturb man-made habitats suitable for Northern Quolls	The habitats created by the quarry are unique to this area of the Pilbara and appear to be utilised by significant species such as the Northern Quoll. These habitats may be sensitive to disruption.
Size, shape and location of the proposed activities. Scale and impact of the proposal.	The project area is approximately 0.55 km^2, adjacent to the existing BHPBIO rail line.	A small portion of the study area is proposed to be developed (Figure 5.1) and occurs on habitat that is well represented in surrounding areas and the region. The removal of borrow will change the landforms within the project area, but the scale of change is negligible in relation to the subregion and the land systems present.

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 the Environment, Water, Heritage and the Arts Protected Matters Database
- DEC's Threatened Fauna database
- *ecologia* (2008a) RGP5 Rail expansion project Northern Quoll Management Plan
- *ecologia* (2008b) RGP5 Fauna Survey: Walla Siding to Turner Siding Level 1 Fauna Survey
- *ecologia* (2008c) RGP5 Fauna Survey: Repeater 1 Level 1 Fauna Survey
- *ecologia* (2008d) RGP5 Fauna Survey: Repeater 2 Level 1 Fauna Survey
- *ecologia* (2008e) RGP5 Targeted Fauna Survey Quarries 1 -4. Report in Preparation for BHPBIO
- Biota (2004) Fauna habitats and fauna assemblage of the proposed FMG Stage A rail corridor

3.3 SURVEY TIMING

The reconnaissance survey was conducted in late autumn on 7th May 2008.

3.4 SITE LOCATIONS

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

Table 3.2 – Quarry 2 Lease fauna habitat descriptions and site photographs

Site vegetation description and fauna habitats	Photo
SANDY PLAIN	
Open *Acacia pyrifolia* high shrubs, with sparse patches of *Acacia tumida* var. *tumida*, over moderately dense mixed *Pterocaulon sphacelatum*, *Indigofera monophylla* and *Corchorus lasiocarpus* subsp. *lasiocarpus* low shrubs, over moderately dense *Triodia epactia* hummock grass and sparse mixed tussock grasses. Fauna habitats: sandy substrate for burrow formation, spinifex for shelter.	
Sparse *Acacia pyrifolia* high to medium shrubs, over scattered mixed low shrubs, over moderately dense *Triodia epactia* hummock grass. Fauna habitats: sandy substrate for burrow formation, spinifex for shelter, grasses suitable habitat for ground-dwelling birds.	
Sparse *Corymbia hamersleyana* low trees, over moderately dense *Acacia colei* var. *colei* medium to high shrubs, over moderately dense *Cajanus cinereus* medium shrubs, over open mixed *Indigofera monophylla*, *Pterocaulon sphacelatum* and *Pluchea tetranthera* very low shrubs, with open *Chrysopogon fallax*, **Cenchrus ciliaris* tussock and moderately dense *Triodia epactia* hummock grasses. Fauna habitats: small tree hollows, sand for burrowing, spinifex for shelter.	

Site vegetation description and fauna habitats	Photo
FERROUS / GRANITE LOW HILL CREST	
Isolated *Acacia inaequilatera* low trees over sparse *Senna glutinosa* subsp. *glutinosa* and *Senna glutinosa* subsp. *pruinosa* medium to high shrubs, over sparse *Tephrosia* sp. low shrubs, over moderately dense *Triodia epactia* hummock grasses. Fauna habitats: cracks/crevices suitable habitat for many species of reptiles including geckos, skinks, small dragons, and rock-dwelling pythons such as *Antaresia stimsoni*, and *A. perthensis*.	
GRANITE OUTCROP	
Sparse *Terminalia canescens* low trees, over open *Acacia tumida* high shrubs, over moderately dense parches of mixed low shrubs (including *Corchorus lasiocarpus* subsp. *lasiocarpus*, *Pterocaulon serrulatum*, *Tephrosia* sp.) and *Abutilon* sp.); sometimes over open mixed *Cyperus squarrosus* and *Fimbristylis dichotoma* sedges, with moderately dense mixed *Triodia epactia* hummock and tussock grasses, dominated by *Aristida holathera* var. *holathera*. Fauna habitats: cracks/crevices suitable habitat for many rock-dwelling animals.	
QUARRY	
Very disturbed rocky area of quarry. Sparse soft grasses but generally bare ground. Natural granite outcrop vegetation (as above) and fauna habitats behind disturbed area of quarry. Fauna habitats: jumbled rocky scree suitable for rock-dwelling inhabitants	

Site vegetation description and fauna habitats	Photo
Man-made water pool with shallow gradient suitable for waders. Jumbled rocks provide probable dens for Northern Quoll and refuge for pythons. Fauna habitats: jumbled rocky scree, soft sandy soil, semi-permanent waterbody.	

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 – Guides used for identification

Family	Guide
Mammals	Menkhorst and Knight (2001), Van Dyck and Strahan (2008)
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 are identified in this document (Section 7). The significance of the risks was 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 Stewart Ford, Simon Pynt and Thomas Rasmussen. A licence to take fauna for scientific purposes was granted by the DEC (licence no. SF006017).

4 RESULTS

4.1 FAUNA ASSEMBLAGES

A total of 177 vertebrate species potentially occur in the Quarry 2 Lease (Table 4.1). One species was recorded during the reconnaissance survey, the dragon *Amphibolurus longirostris*. A detailed listing of the fauna recorded in the Quarry 2 Lease and previously recorded in the surrounding areas is given in APPENDIX A.

Table 4.1 – Fauna recorded and potential number of species in the Quarry 2 Lease.

REFERENCE	MAMMALS	REPTILES	AMPHIBIANS	BIRDS
DEC Rare Fauna Database	1	0	0	0
WAM FaunaBase or Birdata	12(1)	23	3	95
Walla to Turner *(ecologia,* 2008b)	3	15	0	19
Repeater 1 *(ecologia,* 2008c)	0(1)	4	0	11
Repeater 2 *(ecologia,* 2008d)	0	3	0	0
Quarry 1 - 4 Targeted Fauna Survey (*ecologia*, 2008e)	1	0	0	4
FMG Rail (Biota, 2004)	11	36	4	35
***ecologia* Reconnaissance Survey - Quarry 2**	**0**	**1**	**0**	**0**
Potential number of species occurring	18(2)	51	5	101

Values in brackets indicate feral species numbers.

4.1.1 MAMMALS

Eighteen native mammals potentially occupy the Quarry 2 Lease (Table 4.1) and the Northern Quoll (*Dasyurus hallucatus*) has been recorded within the project area. While the species was not recorded during the reconnaissance (7th May 2008) survey, the Quoll Targeted Survey identified probable den sites with scats present and a Northern Quoll was seen (*ecologia*, 2008a). Furthermore, suitable den sites in the form of a natural granite rock piles were identified to the north and east of the quarry; extending beyond the quarry lease, however, these sites will not be disturbed during the new project works.

4.1.2 BIRDS

One hundred and four bird species potentially occupy the Quarry 2 Lease. No birds were recorded during the reconnaissance survey, however, four bird species were noted during the Quoll Targeted Survey, including Australasian Grebe in the water pool. The semi-permanent water pool and associated small sandy beach may attract Migratory waders, such as Black-winged Stilt and Common Sandpiper, on passage. Resident bird species are also expected to be attracted to this man-made feature.

4.1.3 REPTILES

Fifty-one reptile species potentially occur in the project area. One dragon (Agamidae) was recorded during the reconnaissance survey, the Long-nosed Water-dragon *Amphibolurus longirostris*. This species is typically seen on tree trunks or branches of vegetation lining gorges or watercourses and would is likely to be present because of the nearby waterbody.

A number of habitats suitable for reptiles were noted during the reconnaissance survey (see Table 3.2) including rocky outcrops, screes and spinifex on soft soil, and it is therefore likely that numerous other reptile species use the Quarry 2 Lease.

4.1.4 AMPHIBIANS

No amphibians were recorded during the reconnaissance survey, though potentially five species from two families occur in the area. Many of these species are burrowing species that emerge opportunistically following rainfall and can usually only be observed during floods.

4.1.5 INTRODUCED SPECIES

Two introduced mammals potentially use the project area (Table 4.1). Western Australian Museum records indicate that Domestic Cat (*Felis catus*) and European Cattle (*Bos taurus*) are likely to occur in the area. No feral fauna were seen during the reconnaissance survey.

4.2 FAUNA HABITATS

Major fauna habitats in the project area were surveyed and their potential for supporting species of conservation significance assessed. The following major fauna habitats were present in the Quarry 2 Lease:

1. The disturbed area of the quarry, comprising rocky scree, vertical rocky cliffs, a semi-permanent pool of water with an embankment of soft soil, supporting very little vegetation.
2. Rocky granitic hill with numerous, naturally formed rocks with sparse trees and sparse spinifex.
3. Sandy plain habitat with *Acacia* shrubs over moderately dense mixed shrub species and moderately dense spinifex. Occasional *Corymbia hamersleyana* low trees.
4. Ferrous/Granite low crest with isolated *Acacia inaequilatera* low trees over sparse senna shrubs and moderately dense Spinifex.
5. Granite outcrops with spare low trees, patches of Acacia shrubs and spare Spinifex.

4.3 SURVEY LIMITATIONS

Limitations and constraints of the current survey are summarised in Table 4.2 below.

Table 4.2 – 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).	Yes - moderate	Survey was short in time-frame and weather conditions in the months leading up to the survey were drier than average. No trapping was conducted which results in fewer records (but was beyond the scope of a Level 1 survey).
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	Most of the information gathered about this area came from previous surveys conducted by *ecologia* within 30 km of the Quarry 2 Lease and sites set up by Biota (2004) within 30 km of the Quarry 2 Lease. However, this part of the rail corridor has been relatively poorly surveyed compared to other areas of the Pilbara.
The proportion of the task achieved and further work which might be needed.	No constraint	The reconnaissance survey was complete. A follow-up survey, targeting Northern Quoll was also conducted in July 2008.
Timing/ weather/ season/ cycle.	No	The survey was conducted in early May following a record of below average rainfall at Port Hedland, however, rain fell in the month preceding the survey and surface water evident.
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 as discussed.
Efficacy of sampling methods (i.e. any groups not sampled by survey methods).	Yes – moderate	Birds and reptiles are generally more readily observed than other groups during a Level 1 survey.

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

Eighteen species of conservation significant fauna comprising nine rare fauna (four mammals, three birds and two reptiles) and nine Migratory bird species potentially use the Quarry 2 Lease. These were identified using database searches, the FMG rail surveys and surveys conducted in the area by *ecologia* (2008b, 2008c, and 2008d) and a habitat review of the project area. Table 5.4 lists the conservation significant species potentially occurring in the Quarry 2 Lease.

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							
Dasyurus hallucatus	Northern Quoll	EN	S1		Natural granites (tors) and creeklines, particularly where water is available	DEC, FMG and Hope Downs (Biota, 2004), present in the Quarry 2 Lease.	**HIGH** Occurs within the Quarry 2 lease
Macrotis lagotis	Bilby	VU	S1		Variable in arid zone – usually mulga shrublands and spinifex grasslands	None	**MEDIUM** Some potentially suitable habitat, DEC records from approx. 50 km to the south
Macroderma gigas	Ghost Bat			P4	Wide range of habitats including natural rockpiles in the local area	Several DEC records nearby	**MEDIUM** Likely to forage in rail lease, but no suitable roost habitat. Nearby DEC records.
Pseudomys chapmani	Western Pebble-mouse			P4	Stony slopes	DEC, FMG Rail (Biota, 2004), Walla to Turner Camp (*ecologia*, 2008b)	**LOW** Recorded from surrounding areas but no suitable habitat present.
Birds							
Ardeotis australis	Australian Bustard			P4	Open woodland and grassland	Birdata, DEC Rare Fauna Database	**HIGH** Likely to occur periodically within the lease.
Burhinus grallarius	Bush Stone-curlew			P4	Open woodland, often near beaches	Birdata, closest record is from Turner Camp (*ecologia*).	**MEDIUM** Possibly occurs in better wooded open acacia shrublands

		CONSERVATION SIGNIFICANCE					
Falco peregrinus	Peregrine Falcon		S4		Most terrestrial especially rocky areas	Birdata	**LOW** Suitable roost and nest sites absent
Reptiles							
Liasis olivaceus barroni	Pilbara Olive Python	VU	S1		Gorges and escarpments	None	**LOW** No suitable habitat in rail lease
Aspidites ramsayi	Woma			P1	Soft red sandy loams	DEC	**LOW** Most likely to occur north of Walla siding where there are several DEC records
Migratory Birds							
Merops ornatus	Rainbow Bee-eater	M			Open country, most veg. types, dunes, banks	Birdata, Repeater 1 *(ecologia,* 2008c), FMG Rail (Biota, 2004)	**HIGH** Likely to occur with rail lease; may breed in sandy areas
Actitis hypoleucos	Common Sandpiper	M			Banks, rocks, sandy beaches	None	**MEDIUM** Common migrant likely to be casual on passage
Ardea alba	Great Egret	M			Wetlands	None	**MEDIUM** May be present when surface water present
Apus pacificus	Fork-tailed Swift	M			Almost entirely aerial	Birdata	**MEDIUM** Aerial specialist likely to overfly lease occasionally
Himantopus himantopus	Black-winged Stilt	M			Shallow open fresh or brackish water	Birdata	**MEDIUM** Common migrant likely to be casual on passage

		CONSERVATION SIGNIFICANCE					
Tringa glareola	Wood Sandpiper	M			Mainly shallow fresh waters, occasionally brackish swamps	None	**MEDIUM** Migrant may be casual on passage
Tringa nebularia	Common Greenshank	M			Estuaries, inland lakes, open swamps	Birdata	**MEDIUM** Common migrant likely to be casual on passage
Ardea ibis	Cattle Egret	M			Short grasses (especially damp pastures) and wetlands	None	**LOW** No nearby records but may occur at times
Charadrius veredus	Oriental Plover	M			Sparsely vegetated plains. Beach and tidal flats, saltworks and sewage ponds.	Birdata	**LOW** Few records but could occur sporadically

5.3 CONSERVATION SIGNIFICANT FAUNA RECORDED DURING SURVEYING

5.3.1 MAMMALS

The only conservation significant species recorded in Quarry 2 Lease was Northern Quoll, recorded during the Quoll Targeted Survey (*ecologia*, 2008a, 2008e).

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

Northern Quolls are listed as 'Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and as a Schedule 1 species (i.e. fauna that is rare or likely to become extinct) under the Western Australian *Wildlife Conservation Act, 1950.*

Northern Quolls formerly occupied much of northern Australia from the Pilbara to southern Queensland. Their present distribution in Australia has contracted to several disjunct populations. In the Pilbara, Northern Quolls have undergone substantial declines since the mid 1980s and the species is now considered to be fragmented and mostly confined to the larger conservation reserves, as well as the Burrup Peninsula (DEWHA, 2005).

On the Abydos plain between Port Hedland and the Chichester Range, Northern Quolls have been located in natural granite outcrops (tors), major creeks (Biota, 2004; *ecologia*, 2008a) and in abandoned quarries (*ecologia*, 2008a). Their preferred natural den sites appear to be within the granite outcrops, which resemble large natural boulder piles, and possibly in hollow-bearing *Eucalyptus* sp. trees associated with larger creeklines.

While the Northern Quoll (*Dasyurus hallucatus*) was not recorded during the reconnaissance survey, they were, however, recorded during the Quoll Targeted Survey. The Quoll Targeted Survey identified two probable den sites (scats present), one in an artificial rockpile 100 m SE of the quarry and one on natural granite 230 m E of the quarry. Scats were found adjacent to the quarry access road near the semi-permanent water. A quoll was seen near the water body within the quarry. Habitat that may contain den sites (natural granite with rockpiles) was identified to the north and east of the quarry, extending beyond the quarry lease (*ecologia*, 2008a). Figure 5.1 displays the location of probable Northern Quoll habitat within the quarry lease in relation to the proposed activities in the Quarry 2 Lease.

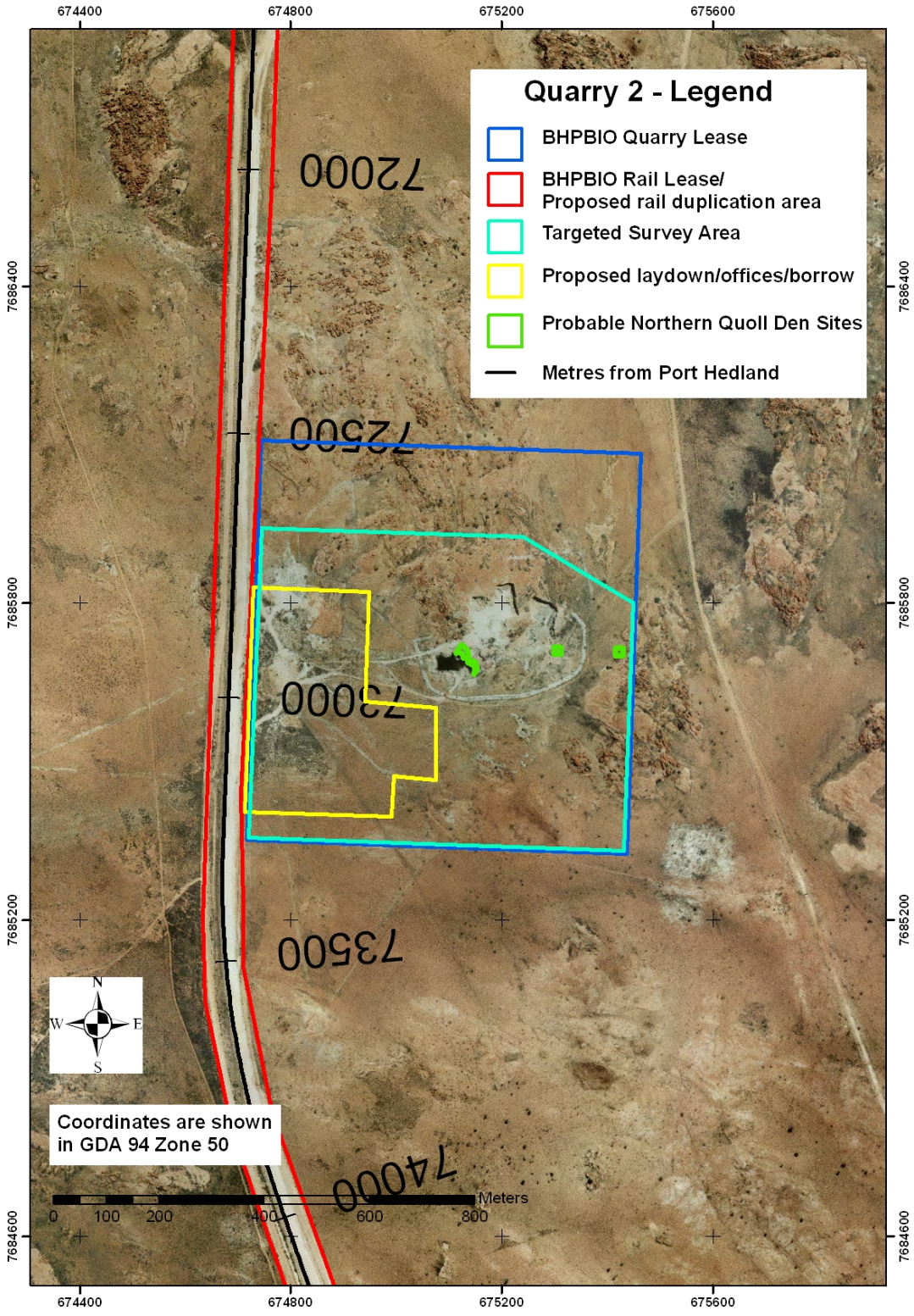

Figure 5.1 – Areas of proposed activities and probable locations of Northern Quolls in the Quarry 2 Lease

5.4 CONSERVATION SIGNIFICANT FAUNA DESCRIPTIONS

5.4.1 Migratory fauna

An EPBC search indicated that several birds listed as Migratory may use the area: Black-winged Stilt, Oriental Plover, Common Sandpiper, Wood Sandpiper, Common Greenshank, Oriental Pratincole, Rainbow Bee-eater, Great Egret, Cattle Egret, and Fork-tailed Swift. These are unlikely to be resident but may be attracted to the semi-permanent water available near the quarry where they may rest during migration. Therefore, the only Migratory birds likely to be present are Rainbow Bee-eaters (*Merops ornatus*).

Rainbow Bee-eaters are a common species in the Pilbara and are likely to be present at times. They nest from August to January in sandy embankments in which they dig tunnels (Johnstone and Storr, 1998). Fork-tailed Swifts are aerial and, although they may fly over, would not directly use the habitats present within the Quarry 2 Lease.

5.4.2 Nationally significant fauna – EPBC Act

Two mammal and one reptile 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

Macrotis lagotis is now the only extant species of this genus, with the second species (*Macrotis leucura*) recently becoming extinct. The species has not previously been recorded in the project area, and was not recorded during the reconnaissance survey of the current study; however, a search of the EPBC database search indicated that the species may occur in the Quarry 2 Lease. DEC records also indicate recent (1950 – 1999) observations 65 km to the south of the Quarry 2 Lease and it was recorded along the FMG rail corridor near cloudbreak.

The species is most commonly found in mulga shrublands and spinifex grasslands (Johnson, 2008). It once inhabited the arid and semiarid regions throughout most of the Australian mainland south of latitude 18 °S, however, its distribution has rapidly restricted in the last 100 years and it is now patchily distributed in arid regions including the Pilbara. 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.

The Bilby is considered to have a medium likelihood of occurrence in the Quarry 2 Lease given the presence of some suitable habitat and previous records within the region, however, none of the distinctive burrows of the species were observed within the project area and it is therefore unlikely to be resident at present.

5.4.2.3 Pilbara Olive Python *Liasis olivaceus barroni* – Vulnerable

The Pilbara population of this rock-inhabiting python is restricted to the gorges and escarpments of the Pilbara region of Western Australia (Wilson and Swan, 2008). The Quarry 2 Lease contains potentially suitable habitat in the form of the semi-permanent waterbody and associated rocky scree; however, given the absence of nearby gorges or escarpments from which animals could migrate (the nearest potentially suitably habitat appears to be 30 km to the east), migration of the species into the quarry area is unlikely to have happened. Pilbara Olive Python is, therefore, not thought to be present within the Quarry 2 Lease.

5.4.3 State significant fauna – WC Act

Two mammals, 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 Peregrine Falcon *Falco peregrinus* – Schedule 4

This 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.

Due to a lack of suitable roost and nest sites within the project area, this species is considered to have a low likelihood of occurrence. However, it could potentially utilise the area for foraging on a sporadic basis.

5.4.4 DEC Priority species

Two mammals, two bird and one reptile species are listed as DEC priority fauna, none of which were recorded during the reconnaissance survey.

5.4.4.1 Ghost Bat *Macroderma gigas* – Priority 4

The Ghost Bat, *Macroderma gigas*, is Australia's only strictly carnivorous bat (Richards *et al*., 2008). Similar to the Pilbara Leaf-nosed Bat, the Ghost Bat's distribution includes Northern Queensland and Kimberley regions with a separate population in the Pilbara. In arid areas, the species is found near rock outcrops where it roosts in caves and disused mines. It usually forages within 1-2 km of its roost site (Hutson *et al*., 2001). In the Pilbara, Ghost Bats typically roost in caves beneath bluffs of low, rounded hills composed of Marra Mamba geology and granite rockpiles. Genetic studies have shown that this species is extremely genetically subdivided and centralised upon regional maternity sites and therefore, each population should be managed as a separate entity as there is little genetic mixing (Worthington *et al*., 1994).

DEC records have placed the Ghost Bat within 1 km of the Quarry 2 Lease. An ANABAT recording was not made during the current reconnaissance survey. The Quarry 2 lease does not appear to contain suitable roost locations, however, there are significant boulder piles outside of the study lease to the northeast that may provide suitable roosting caverns for the species, resulting in the nearby DEC records. The species may forage within the project area on occasion.

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

The Western Pebble-mound Mouse inhabits gentler slopes of rocky ranges where the ground is covered by stony mulch and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs, typically *Senna*, *Acacia* and *Ptilotus* (Start, 2008). *Pseudomys chapmani* represents one of only three species of Australian rodent that builds a permanent, above-ground structure of stones on top of a subterranean burrow system (Dunlop and Pound, 1981). It lives colonially, in distinctive mounds of uniformly-sized

pebbles with occluded entrances, and up to 25 individuals have been found in a single mound (Start, 2008) although numbers ranging 4 -13 are more common (Anstee *et al*., 1997). Active mounds are characterised by volcano-like cones capped by craters that mark the occluded entrances to the burrows. Western Pebble-mound mice usually return to a home mound each day, but not all apparently active mounds harbour resident mice, as foraging mice from different home mounds may enter and tend vacant mounds within their foraging ranges (Start, 2008).

Formerly the mouse inhabited a much wider area but it appears to have suffered recent retractions in its range. Its decline in the Murchison and Gascoyne has been attributed predominantly to the introduction of exotic herbivores and the increase in numbers of foxes (Start, 2008). While the species still remains widespread in the Pilbara, suitable habitat is patchy. The species has been the focus of significant attention at Yandi, including monitoring and relocation surveys (*ecologia* 1995, 1996a, 1996b) because it was formerly classified as Priority 1 (taxa with few, poorly known populations on threatened lands) by the then Department of Conservation and Land Management. As more populations were discovered throughout the Pilbara, its conservation status was downgraded to Priority 4 (taxa in need of monitoring) by DEC.

A single old mound was recorded during the Walla Siding to Turner Camp Level 1 survey (*ecologia*, 2008b) and mounds were recorded within 30 km of the Quarry 2 Lease by Biota (2004). However, no mounds were observed during the survey and no suitable habitat was found, suggesting that the species is absent from the project area.

5.4.4.3 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). The species is likely to utilise the Quarry 2 Lease on occasion.

5.4.4.4 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, and the closest individuals were recorded during a recent survey at Turner River Camp approximately 54 km south of the Quarry 2 Lease (*ecologia*, 2008f), and Birdata shows a few records of the species in surrounding areas.

5.4.4.5 Woma *Aspidites ramsayi* – Priority 1

The Woma is a Priority 1 species, which means they are classified within “Taxa with few, poorly known populations on threatened lands.”

Womas can be found in woodlands, heaths and shrublands, sandplains and dune fields often with spinifex, in the sub-humid to arid interior. They are a nocturnal species, sheltering during the day in abandoned monitor and mammal burrows and in soil cracks (Wilson and Swan, 2008). They are rarely seen during the day, except in warm and heavily overcast weather. Womas prey on lizards, snakes, birds and small mammals (Ehmann and Watson, 2008).

Land clearing and predation by feral fauna has caused a decline in populations, particularly in south-west Western Australia (Wilson and Swan, 2008).

Several DEC records of Woma have been made north of Walla siding but there are no nearby records and it is considered unlikely to occur.

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.

- 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.
- Clearing of native vegetation may introduce invasive weed species, which can degrade fauna habitat.
- Human activity and associated food waste may attract feral fauna. Increases in feral fauna can have a negative impact on native diversity and ecological function due to increased predation and/or resource competition.
- Human activity, associated food wastes and increased infrastructure may create artificial habitat and attract Northern Quolls into work areas.
- The processes of vehicle movements, construction and clearing all increase the risk of accidental fire. Fires can cause direct fauna mortality as well as a short to long term loss of habitat.
- Vehicle movement can also cause mortality by striking fauna; of particular concern is mortality of Northern Quolls.
- Dust created during clearing and excavation may have a negative affect on native vegetation and fauna directly, reducing the value of fauna habitat.
- Noise made by machinery and blasting may have a negative affect on fauna in adjacent areas, including Northern Quolls.

Generally, the project is unlikely to have considerable impact on conservation significant fauna, for the following reasons:

- disturbance already present in the Project area due to existing infrastructure;
- proposed linear disturbance footprint;
- transitory nature of the bird species;
- habitat of the species being well represented outside the Project area;
- in many cases, the species have the capacity to disperse away from area of impact (exceptions are described in Section 6.1.1 – 6.1.6).

However, it should be noted that the Northern Quoll is likely to be an exception to this generalisation, as the unique man-made habitat available within the disused Quarry 2 is not widely available elsewhere. BHPBIO will manage any potential impacts under a Northern Quoll Management Plan that has been prepared for RGP5 (*ecologia*, 2008a).

6.1 IMPACTS ON FAUNA OF CONSERVATION SIGNIFICANCE

No conservation significant species were recorded within the project area during this survey, however, Northern Quolls were recorded two months later during the Quoll Targeted Survey. Five rare fauna and seven Migratory bird species were found to have High or Medium likelihood of occurrence within the Quarry 2 Lease. These are discussed below. Where species have similar ecological requirements, potential impacts are broadly similar and they have been grouped together.

6.1.1 Northern Quoll *Dasyurus hallucatus*

Northern Quolls present in the Quarry 2 Lease may be disturbed during construction and clearing. At present there are no plans to resume borrow operations in the areas of Quarry 2 where evidence of quolls has been found (see descriptions in Section 5.3.1.1 and Figure 5.1). 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 has been drafted by *ecologia* (2008a). 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, and separating work areas such as laydown yards to an area west of where quolls where evidence of quolls was found during the Quoll Targeted Survey (*ecologia*, 2008e). Further measures are outlined in the management plan document (*ecologia*, 2008a). Impacts to Northern Quoll should largely be mitigated by this and other procedures listed in the management plan.

6.1.2 Burrowing animals

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, however, they may face competition from resident individuals. An increase in feral predators as a result of human activity may result in increased predation on this species within the lease and in surrounding areas, potentially causing decline. The burrows of the species are characteristically large and rounded and, if active, bilby tracks should be evident.

6.1.3 Bats

It is unlikely that Ghost Bats roost in the quarry lease 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 roosting location.

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, sandy ground in which they dig angled tunnels (Johnstone and Storr, 1998). When nesting, 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 the Quarry 2 Lease 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 actions should be adopted by BHPBIO for its proposed works in the Quarry 2 Lease. (APPENDIX B). A management plan specifically addressing the potential impacts of the project on the Northern Quoll has been drafted as a separate document (*ecologia*, 2008a).

1. Address recommendations of the RGP5 Northern Quoll Management Plan (*ecologia*, 2008a)
2. Minimise clearing of habitats thought to support rare fauna, such as the Northern Quoll, and clearly define clearing boundaries.
3. Areas cleared as part of construction should be rehabilitated as soon as practicable.
4. Utilise existing access tracks where possible to avoid habitat fragmentation.
5. Contractors should be made aware of potential conservation significant fauna locations.
6. Utilise BHPBIO weed management procedures.
7. 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.
8. Prevent the deliberate feeding of wild fauna, particularly feral predators.
9. Fire prevention strategies should be an integral component of CRAWs for construction contractors.
10. Ensure that fire extinguishers are available to work personnel and that they are trained in their use.
11. Avoid smoking near or parking vehicles over dry vegetation, particularly spinifex (*Triodia* spp.*)* or Buffel Grass (**Cenchrus ciliaris*).
12. Dust suppression measures, such as road watering and progressive rehabilitation of disturbed areas, should be used.
13. Noise suppression measures may be considered to reduce impact to native fauna, particularly Northern Quolls, when blasting.
14. If rare fauna are observed on roads at night, consider a reduction in speed limits or avoidance of nocturnal works in that area.

8 REFERENCES

Anstee, S. D., Roberts, J. D., and O'Shea, J. E. (1997). Social Structure and Patterns of Movement of the Western Pebble-mound Mouse, *Pseudomys chapmani*, at Marandoo, Western Australia. *Wildlife Research*, 24**,** 295–305

Beard, J. S. (1975). Pilbara. Explanatory notes to Sheet 4, 1:1,000,000 Series Vegetation Survey of Western Australia. University of Western Australia Press, Perth.

Biota (2004). Fauna habitats and Fauna assemblage of the proposed FMG Stage A rail corridor. Unpublished report for FMG.

Blakers, M., Davies, S. and Reilly, P. N. (1984). *The Atlas of Australian Birds*. Melbourne University Press, Victoria.

Bureau of Meteorology (2008). Port Hedland climatic data. Accessed 08.07.08. URL: http://www.bom.gov.au/

Christidis, L. and Bowles, W. E. (2008). *Systematics and Taxonomy of Australian Birds*. CSIRO Publishing, Collingwood.

Churchill, S. (1998). *Australian Bats.* Reed New Holland, Sydney.

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

Department of Environment and Conservation (2002). *A Biodiversity Audit of Western Australia's 53 Subregions*. URL: http://www.dec.wa.gov.au/science-and-research/biological-surveys/a-biodiversity-audit-of-wa.html

Department of the Environment, Heritage, Water and the Arts (2005). Northern Quoll (*Dasyurus hallucatus*) Listing Advice. URL: http://www.environment.gov.au/biodiversity/threatened/species/dasyurus-hallucatus.html

Dunlop, J. N. and Pound, I. R. (1981). Observations on the pebble-mound mouse *Pseudomys chapmani* Kitchener, 1980. *Records of the Western Australian Museum*, 9, 1–15.

ecologia Environment (1995) Yandi Stage II Iron Ore Project: Biological Assessment Survey. Unpublished Report commissioned by BHP Iron Ore Pty Ltd.

ecologia Environment (2006a). Marillana Biological Survey. Unpublished report commissioned by BHP Iron Ore Pty. Ltd.

ecologia Environment (2006b) BHPBIO Yandi E3, E5, E6, W1, and W2 Conservation Significant Flora and Fauna Assessment. Unpublished report commissioned by BHP Iron Ore Pty. Ltd.

ecologia Environment (2008a). Rail expansion project Northern Quoll Management Plan. Unpublished report for BHPBIO.

ecologia Environment (2008b). RGP5 Level 1 Fauna Survey: Walla Siding to Turner River Camp. Level 1 Fauna Survey. Unpublished report for BHPBIO.

ecologia Environment (2008c). RGP5 Level 1 Fauna Survey: Repeater 1. Unpublished report for BHPBIO.

ecologia Environment (2008d). RGP5 Level 1 Fauna Survey: Repeater 2. Unpublished report for BHPBIO.

ecologia Environment (2008e). RGP5 Targeted Fauna Survey Quarries 1 -4. Report in Preparation for BHPBIO.

ecologia Environment (2008f). RGP5 Level 1 Fauna Survey. Turner River Camp. Unpublished report for BHPBIO.

Ehmann, H. and Watson, M. (2008). Woma Python *Aspidites ramsayi.* Fact Sheet. South Australian Arid Lands Natural Resources Management Board.

Environment Protection Authority (2002). *Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity* Protection. Perth, Western Australia.

Environmental Protection Authority (2004). *Guidance for the Assessment of Environmental Factors No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia.* Perth, Western Australia.

Frith, A. J. (1976). *Readers Digest Complete Birds of Australia*. Readers Digest, Sydney.

Hutson, A.M., Mickleburgh, S.P. and Racey, P.A. (compilers). (2001). Microchiropteran Bats: Global Status Survey and Action Plan. IUCN/SSC Chiroptera Specialist Group, IUCN, Gland, Switzerland and Cambridge, U.K. Chiroptera Specialist Group 1996. Macroderma gigas. In: IUCN 2007. 2007 IUCN Red List of Threatened Species. <www.iucnredlist.org>. Downloaded on 17 July 2008.

Johnson, K. A. (2008). Greater Bilby *Macrotis lagotis* In *Mammals of Australia 3rd Edition* (eds: Van Dyck, S and Strahan, R). Reed New Holland Publishers, Sydney.

Johnstone, R. E. and Storr, G. M. (1998). *Handbook of Western Australian Birds; Volume 1 – Non-passerines*. Western Australian Museum, Perth.

Kendrick, P. and McKenzie, N. (2001). Pilbara 1 (PIL1 – Chichester subregion) (DEC, Perth URL: http://www.naturebase.net/pdf/science/bio_audit/pilbara01_p547-558.pdf).

Magurran, A. (2004). *Measuring Biological Diversity*. Blackwell Publishing, Carlton.

Menkhorst, P. and Knight, F. (2001). *A Field Guide to the Mammals of Australia*. Oxford University Press, Melbourne.

National Health and Medical Research Council (2004). *Australian code of practice for the care and use of animals for scientific purposes* (Canberra, ACT).

Oakwood, M. (2008). Northern Quoll, *Dasyurus hallucatus* In *The Mammals of Australia 3rd Edition* (eds: Van Dyck, S and Strahan, R). Reed New Holland Publishers, Sydney.

Pizzey, G. (1983). *A Field Guide to the Birds of Australia.* Collins, Sydney.

Richards, G. C., Hand, S. and Armstrong, K. (2008). Ghost Bat, *Macroderma gigas* in *Mammals of Australia 3rd Edition* (eds: S Van Dyck and R Strahan), pp 449-450. Reed New Holland: Chatswood, Australia.

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

Start, A. N. (2008). Western Pebble-mouse *Pseudomys chapmani*, In *The Mammals of Australia 3rd Edition*, Van Dyck, S. and Strahan, R. (Eds.) Reed New Holland, Sydney.

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

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

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

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

Thackway, R. and Cresswell, I. D. (eds) (1995). An Interim Biogeographic Regionalisation for Australia: a Framework for Establishing the National System of Reserves*, Version 4.0.* Australian Nature Conservation Agency, Canberra.

Tyler, M. J., Smith, L. A. and Johnstone, R. E. (2000). *Frogs of Western Australia.* Western Australian Museum, Perth.

Van Dyck, S. and Strahan, R. (Eds) (2008). *The Mammals of Australia, 3rd Edition*. Reed New Holland: Chatswood, Australia.

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

Wilson, S. and Swan, G. (2008). *A Complete Guide to Reptiles of Australia 2nd Edition.* New Holland Publishers, Sydney.

Worthington, W. J., Moritz, C., Hall, L., and Toop, J. (1994). Extreme Population Structuring in the Threatened Ghost Bat, *Macroderma gigas*: Evidence from Mitochondrial DNA. *Proceedings of the Royal Society of London, Series B Biological Sciences*, 257(1349), 193-198.

APPENDIX A: FAUNA RECORDED AND REGIONAL FAUNA DATA

Mammals

Family & Species	Common Name	EPBC	WCA	DEC	WAM FaunaBase	DEC Rare Fauna Database	Walla to Turner (*ecologia*, 2008b)	Repeater 1 (*ecologia*, 2008c)	Repeater 2 (*ecologia*, 2008d)	FMG Rail (Biota, 2004)	Targeted NQ Survey (*ecologia*, 2008e)	Recon. Survey Quarry 2
DASYURIDAE												
Dasykaluta rosamondae	Kaluta				✓					✓		
Dasyurus hallucatus	Northern Quoll	EN	S1								✓	
Ningaui timealeyi	Pilbara Ningaui				✓					✓		
Planigale sp.	Common Planigale				✓					✓		
Pseudantechinus woolleyae	Woolley's Pseudantechinus									✓		
Sminthopsis macroura	Stripe-faced Dunnart				✓							
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart				✓					✓		
THYLACOMIDAE												
Macrotis lagotis	Greater Bilby	VU	S1									
EMBALLONURIDAE												
Taphozous georgianus	Common Sheath-tailed Bat				✓							
MEGADERMATIDAE												
Macroderma gigas	Ghost Bat			P4		✓						
VESPERTILIONIDAE												
Vespadelus finlaysoni	Finlayson's Cave Bat				✓		✓					
MOLOSSIDAE												
Mormopterus beccarii	Beccari's Free-tailed Bat						✓					
MURIDAE												
Notomys alexis	Spinifex Hopping-mouse				✓					✓		
Pseudomys chapmani	Western Pebble-mouse			P4			✓			✓		
Pseudomys delicatulus	Delicate Mouse				✓					✓		
Pseudomys desertor	Desert Mouse				✓					✓		

Family & Species	Common Name	EPBC	WCA	DEC	WAM FaunaBase	DEC Rare Fauna Database	Walla to Turner (*ecologia*, 2008b)	Repeater 1 (*ecologia*, 2008c)	Repeater 2 (*ecologia*, 2008d)	FMG Rail (Biota, 2004)	Targeted NQ Survey (*ecologia*, 2008e)	Recon. Survey Quarry 2
Pseudomys hermannsburgensis	Sandy Inland Mouse				✓					✓		
Zyzomys argurus	Common Rock Rat				✓					✓		
FELIDAE												
**Felis catus*	Cat				✓							
BOVIDAE												
**Bos taurus*	European Cattle							✓				

Notes: * FMG Rail (Biota, 2004) sites within 30 km of the Quarry 2 Lease

Birds

Family & Species	Common Name	EPBC	WCA	DEC	Birdata	Walla to Turner (*ecologia*, 2008b)	Repeater 1 (*ecologia*, 2008c)	Repeater 2 (*ecologia*, 2008d)	FMG Rail (Biota, 2004)	Targeted NQ Survey (*ecologia*, 2008e)	Recon. Survey Quarry 2
PHASIANIDAE											
Coturnix ypsilophora	Brown Quail				✓						
ANATIDAE											
Anas gracilis	Grey Teal				✓				✓		
Anas superciliosa	Pacific Black Duck				✓						
Aythya australis	Hardhead				✓						
Chenonetta jubata	Australian Wood Duck				✓						
Cygnus atratus	Black Swan					✓			✓		
Malacorhynchus membranaceus	Pink-eared Duck				✓				✓		
PODICIPEDIDAE											
Poliocephalus poliocephalus	Hoary-headed Grebe				✓				✓		
Tachybaptus novaehollandiae	Australasian Grebe				✓				✓	✓	
COLUMBIDAE											
Geopelia cuneata	Diamond Dove				✓	✓				✓	
Geophaps plumifera	Spinifex Pigeon				✓	✓					
Ocyphaps lophotes	Crested Pigeon				✓	✓				✓	
Phaps chalcoptera	Common Bronzewing				✓						
EUROSTOPODIDAE											
Eurostopodus argus	Spotted Nightjar				✓						
AEGOTHELIDAE											
Aegotheles cristatus	Australian Owlet-nightjar				✓				✓		
APODIDAE											
Apus pacificus	Fork-tailed Swift	M			✓						
ANHINGADAE											
Anhinga melanogaster	Darter				✓						
PHALACROCORIDAE											
Phalacrocorax melanoleucos	Little Pied Cormorant				✓	✓					
Phalacrocorax sulcirostris	Little Black Cormorant				✓						

Family & Species	Common Name	EPBC	WCA	DEC	Birdata	Walla to Turner (*ecologia*, 2008b)	Repeater 1 (*ecologia*, 2008c)	Repeater 2 (*ecologia*, 2008d)	FMG Rail (Biota, 2004)	Targeted NQ Survey (*ecologia*, 2008e)	Recon. Survey Quarry 2
ARDEIDAE											
Ardea alba	Great Egret	¶			✓						
Ardea ibis	Cattle Egret	¶									
Ardea pacifica	White-necked Heron				✓	✓			✓		
Egretta garzetta	Little Egret				✓						
Egretta novaehollandiae	White-faced Heron				✓						
THRESKIORNITHIDAE											
Threskiornis spinicollis	Straw-necked Ibis				✓	✓					
ACCIPITRIDAE											
Accipiter cirrhocephalus	Collared Sparrowhawk				✓						
Accipiter fasciatus	Brown Goshawk				✓						
Aquila audax	Wedge-tailed Eagle				✓				✓		
Circus assimilis	Spotted Harrier				✓				✓		
Elanus axillaris	Black-shouldered Kite				✓						
Haliastur sphenurus	Whistling Kite				✓						
Hieraaetus morphnoides	Little Eagle				✓						
Milvus migrans	Black Kite				✓						
FALCONIDAE											
Falco berigora	Brown Falcon				✓				✓		
Falco cenchroides	Nankeen Kestrel				✓				✓		
Falco longipennis	Australian Hobby				✓						
Falco peregrinus	Peregrine Falcon		S4		✓						
RALLIDAE											
Fulica atra	Eurasian Coot				✓						
OTIDAE											
Ardeotis australis	Australian Bustard			P4	✓						
BURHINIDAE											
Burhinus grallarius	Bush Stone-curlew			P4	✓						
RECURVIROSTRIDAE											
Himantopus himantopus	Black-winged Stilt	M			✓						

Family & Species	Common Name	EPBC	WCA	DEC	Birdata	Walla to Turner (*ecologia*, 2008b)	Repeater 1 (*ecologia*, 2008c)	Repeater 2 (*ecologia*, 2008d)	FMG Rail (Biota, 2004)	Targeted NQ Survey (*ecologia*, 2008e)	Recon. Survey Quarry 2
CHARADRIIDAE											
Charadrius veredus	Oriental Plover	M			✓						
Elseyornis melanops	Black-fronted Dotterel				✓	✓					
Erythrogonys cinctus	Red-kneed Dotterel				✓						
SCOLOPACIDAE											
Actitis hypoleucos	Common Sandpiper	M									
Tringa glareola	Wood Sandpiper	M									
Tringa nebularia	Common Greenshank	M			✓						
TURNICIDAE											
Turnix velox	Little Button-quail				✓				✓		
CACATUIDAE											
Cacatua sanguinea	Little Corella				✓	✓			✓		
Eolophus roseicapillus	Galah				✓		✓		✓		
Nymphicus hollandicus	Cockatiel				✓	✓			✓		
PSITTACIDAE											
Barnardius zonarius	Australian Ringneck				✓		✓				
Melopsittacus undulatus	Budgerigar				✓	✓			✓		
CUCULIDAE											
Chalcites basalis	Horsfield's Bronze-Cuckoo				✓						
Cacomantis pallidus	Pallid Cuckoo				✓				✓		
TYTONIDAE											
Tyto alba	Barn Owl				✓						
HALCYONIDAE											
Todirhamphus pyrrhopygius	Red-backed Kingfisher				✓		✓				
MEROPIDAE											
Merops ornatus	Rainbow Bee-eater	M			✓		✓		✓		
PTILONORHYNCHIDAE											
Chlamydera guttata	Western Bowerbird				✓				✓		
MALURIDAE											
Amytornis striatus	Striated Grasswren				✓						

Family & Species	Common Name	EPBC	WCA	DEC	Birdata	Walla to Turner (*ecologia*, 2008b)	Repeater 1 (*ecologia*, 2008c)	Repeater 2 (*ecologia*, 2008d)	FMG Rail (Biota, 2004)	Targeted NQ Survey (*ecologia*, 2008e)	Recon. Survey Quarry 2
Malurus lamberti	Variegated Fairy-wren				✓						
Malurus leucopterus	White-winged Fairy-wren				✓				✓		
ACANTHIZIDAE											
Gerygone fusca	Western Gerygone				✓						
Smicrornis brevirostris	Weebill				✓						
PARDALOTIDAE											
Pardalotus rubricatus	Red-browed Pardalote				✓						
MELIPHAGIDAE											
Acanthagenys rufogularis	Spiny-cheeked Honeyeater				✓						
Certhionyx variegatus	Pied Honeyeater				✓						
Sugomel niger	Black Honeyeater					✓	✓		✓		
Ephthianura tricolor	Crimson Chat				✓						
Lichenostomus keartlandi	Grey-headed Honeyeater				✓				✓		
Lichenostomus penicillatus	White-plumed Honeyeater				✓	✓	✓		✓		
Lichenostomus virescens	Singing Honeyeater				✓	✓			✓	✓	
Lichmera indistincta	Brown Honeyeater				✓	✓	✓		✓		
Manorina flavigula	Yellow-throated Miner				✓	✓					
Melithreptus gularis	Black-chinned Honeyeater				✓						
POMATOSTOMIDAE											
Pomatostomus temporalis	Grey-crowned Babbler				✓						
CAMPEPHAGIDAE											
Coracina maxima	Ground Cuckoo-shrike				✓						
Coracina novaehollandiae	Black-faced Cuckoo-shrike				✓		✓		✓		
Lalage sueurii	White-winged Triller				✓						
PACHYCEPHALIDAE											
Colluricincla harmonica	Grey Shrike-thrush				✓						
Oreoica gutturalis	Crested Bellbird				✓						
Pachycephala rufiventris	Rufous Whistler				✓						
ARTAMIDAE											
Artamus cinereus	Black-faced Woodswallow				✓				✓		

Family & Species	Common Name	EPBC	WCA	DEC	Birdata	Walla to Turner (*ecologia*, 2008b)	Repeater 1 (*ecologia*, 2008c)	Repeater 2 (*ecologia*, 2008d)	FMG Rail (Biota, 2004)	Targeted NQ Survey (*ecologia*, 2008e)	Recon. Survey Quarry 2
Artamus minor	Little Woodswallow				✓				✓		
Cracticus nigrogularis	Pied Butcherbird				✓				✓		
Cracticus tibicen	Australian Magpie				✓						
Cracticus torquatus	Grey Butcherbird				✓						
RHIPIDURIDAE											
Rhipidura leucophrys	Willie Wagtail				✓	✓	✓		✓		
CORVIDAE											
Corvus bennetti	Little Crow								✓		
Corvus orru	Torresian Crow				✓				✓		
MONARCHIDAE											
Grallina cyanoleuca	Magpie-lark				✓		✓		✓		
PETROCIDAE											
Melanodryas cucullata	Hooded Robin				✓						
ALAUDIDAE											
Mirafra javanica	Singing Bushlark				✓						
MEGALURIDAE											
Cinclorhamphus mathewsi	Rufous Songlark				✓						
Eremiornis carteri	Spinifexbird				✓						
HIRUNDINIDAE											
Hirundo ariel	Fairy Martin				✓						
Hirundo nigricans	Tree Martin				✓						
NECTARINIDAE											
Dicaeum hirundinaceum	Mistletoebird				✓				✓		
ESTRILDIDAE											
Emblema pictum	Painted Finch				✓	✓	✓		✓		
Taeniopygia guttata	Zebra Finch				✓	✓					
MOTACILLIDAE											
Anthus novaeseelandiae	Australian Pipit				✓						

Notes: * FMG Rail (Biota, 2004) sites within 30 km of the Quarry 2 Lease

Amphibians & Reptiles

Family & Species	Common Name	EPBC	WCA	DEC	WAM FaunaBase	Walla to Turner (*ecologia*, 2008b)	Repeater 1 (*ecologia*, 2008c)	Repeater 2 (*ecologia*, 2008d)	FMG Rail (Biota, 2004)	Recon. Survey Quarry 2
AMPHIBIA										
HYLIDAE										
Cyclorana maini	Main's Frog								✓	
Litoria rubella	Desert Tree Frog								✓	
MYOBATRACHIDAE										
Limnodynastes spenceri	Spencer's Frog				✓					
Notaden nichollsi	Desert Spadefoot				✓				✓	
Uperoleia russelli	Russell's Toadlet				✓				✓	
REPTILIA										
AGAMIDAE										
Amphibolurus longirostris	Long-nosed Dragon					✓			✓	✓
Ctenophorus caudicinctus	Ring-tailed Dragon					✓	✓	✓	✓	
Ctenophorus isolepis	Military Dragon					✓	✓		✓	
Ctenophorus nuchalis	Central Netted Dragon								✓	
Diporiphora valens	A dragon								✓	
Pogona minor	Dwarf Bearded Dragon								✓	
BOIDAE										
Antaresia perthensis	Pygmy Python				✓					
Aspidites ramsayi	Woma			P1						
Liasis olivaceus barroni	Pilbara Olive Python	VU	S1							
CHELUIDAE										
Chelodina steindachneri									✓	
ELAPIDAE										
Acanthophis wellsi	Pilbara Death Adder								✓	

Family & Species	Common Name	EPBC	WCA	DEC	WAM FaunaBase	Walla to Turner (*ecologia*, 2008b)	Repeater 1 (*ecologia*, 2008c)	Repeater 2 (*ecologia*, 2008d)	FMG Rail (Biota, 2004)	Recon. Survey Quarry 2
Demansia psammophis cupreiceps	Yellow-faced Whipsnake				✓					
Suta punctata	Little Spotted Snake								✓	
Vermicella snelli	A Snake								✓	
GEKKONIDAE										
Diplodactylus conspicillatus	Fat-tailed Gecko								✓	
Gehyra punctata	A Dtella					✓	✓			
Gehyra variegata	A Dtella				✓	✓				
Heteronotia binoei	Bynoe's Gecko								✓	
Lucasium stenodactylum	Sand-plain Gecko								✓	
Nephrurus levis	Smooth Knob-tailed Gecko								✓	
Strophurus elderi	Jewelled Gecko				✓				✓	
PYGOPODIDAE										
Delma haroldi	A legless lizard				✓				✓	
Delma pax	A legless lizard				✓	✓			✓	
Delma tincta	A legless lizard								✓	
Pygopus nigriceps	Western Hooded Scaly-foot								✓	
SCINIDAE										
Carlia munda	A skink					✓			✓	
Carlia triacantha	Rainbow Skink				✓				✓	
Cryptoblepharus plagiocephalus	A Fence Skink					✓				
Ctenotus duricola	A skink				✓				✓	
Ctenotus grandis titan	A skink				✓				✓	
Ctenotus helenae	A skink								✓	
Ctenotus pantherinus	Leopard Skink					✓		✓	✓	
Ctenotus saxatilis	Rock Ctenotus				✓	✓	✓	✓	✓	

Family & Species	Common Name	EPBC	WCA	DEC	WAM FaunaBase	Walla to Turner (*ecologia*, 2008b)	Repeater 1 (*ecologia*, 2008c)	Repeater 2 (*ecologia*, 2008d)	FMG Rail (Biota, 2004)	Recon. Survey Quarry 2
Cyclodomorphus melanops	Spinifex Slender Blue-tongue								✓	
Egernia depressa	Pygmy Spiny-tailed Skink				✓					
Eremiascincus richardsonii	Broad-banded Sand-swimmer				✓					
Lerista bipes	A skink				✓				✓	
Lerista muelleri	A skink				✓				✓	
Menetia greyii	Common Dwarf Skink								✓	
Morethia ruficauda exquisita	A skink				✓				✓	
Notoscincus ornatus	A skink				✓				✓	
Proablepharus reginae	A skink				✓	✓				
TYPHLOPIDAE										
Ramphotyphlops ammodytes	A blind-snake				✓				✓	
Ramphotyphlops grypus	A blind-snake				✓				✓	
VARANIDAE										
Varanus acanthurus	Ridge-tailed Monitor				✓	✓				
Varanus brevicauda	Short-tailed Pygmy Monitor				✓				✓	
Varanus eremius	Pygmy Desert Monitor				✓				✓	
Varanus giganteus	Perentie					✓				
Varanus panoptes	Yellow-spotted Monitor					✓				
Varanus pilbarensis	Pilbara Rock Monitor				✓					
Varanus tristis	Black-headed Monitor					✓				

Notes: * FMG Rail (Biota, 2004) sites within 30 km of the Quarry 2 Lease

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. Restrict clearing to previously disturbed areas where possible.	4	2	8	Med
Vegetation Clearing	Removal of fauna habitat	Loss of biodiversity and adverse impact to ecological function	4	2	8	Med	Clearing should be restricted to that which is necessary. Avoid clearing in sensitive or highly diverse environments such as creeklines and drainage channels or vegetation in good condition where possible.	3	2	6	Med
Vegetation Clearing	Removal of fauna habitat and / or nesting, denning areas	Loss of conservation significant fauna	2	4	8	Med	Maintain 50 m between probable northern quoll den sites as per management plan (BHPBIO, 2008). Clearing is restricted to areas away from den sites. Bilby burrows should be avoided if found.	1	4	4	Low
Vegetation Clearing	Inadequate weed hygiene management	Spread of weeds after clearing resulting in degradation of fauna habitat.	3	3	9	Med	Implement BHPBIO weed management procedures for contractors.	1	3	3	Low
Human presence	Inadequate waste management	Increase in feral fauna resulting in competition for resources and/or increased predation on native fauna	3	4	12	High	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
Human presence	Inadequate waste management and provision of artificial habitat	Increased proximity of Northern Quolls to infrastructure and vehicles	3	4	12	High	Procedures as above. Also consider isolation of artificial habitat (e.g. under buildings) using wire mesh.	1	4	4	Low
Vehicle movements, construction and clearing	Accidental fire	Destruction of fauna habitat and populations	2	4	8	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	1	1	Low

Process/Activity	Event	Impact	Likelihood	Consequence	Risk Level	Significance	Controls	Likelihood	Consequence	Risk Level	Significance
Clearing, construction and ongoing activities	Dust emissions	Damage to vegetation resulting in displacement of Northern Quolls	3	4	12	High	BHPBIO dust suppression methods should be utilised.	2	2	4	Low
Clearing, blasting, construction and ongoing activities	Noise pollution	Disturbance and displacement of local Northern Quolls	3	4	12	Med	Potential impact of blasting and ongoing activities on Northern Quolls is unknown. Avoid blasting in lease if possible. Reduce frequency and/or intensity of blasts.	2	4	8	Med
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 (i.e. Northern Quoll)	2	4	8	Med	Reduced speed limits and signage should be considered. Personnel to be made aware of risk to Northern Quoll through BHPBIO induction procedures. Deaths should be reported as per BHPBIO regulations.	1	4	4	Low

Table B-1 – Risk assessment consequence and likelihood scores

		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.					