

## **APPENDIX D**

### **FAUNA ASSESSMENT**



---

## **Snapper Mineral Sands Project Environmental Assessment**

APPENDIX D  
SNAPPER MINERAL SANDS PROJECT  
FAUNA ASSESSMENT



PREPARED BY  
WESTERN RESEARCH INSTITUTE AND  
RESOURCE STRATEGIES

FEBRUARY 2007  
Project No. BMX-3-09/2.7  
Document No. Appendix D-K

## TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
EXECUTIVE SUMMARY	ES-1
D1 INTRODUCTION	D-1
D1.1 SURVEY AND ASSESSMENT OBJECTIVES	D-1
D1.2 PLANNING REGION	D-1
D1.3 BIOGEOGRAPHIC AND ZOOGEOGRAPHIC REGIONAL SETTING	D-2
D1.3.1 Murray Darling Depression Bioregion	D-2
D1.3.2 Zoogeographic Region	D-2
D1.4 PREVIOUS VERTEBRATE FAUNA SURVEYS	D-3
D1.4.1 Biodiversity Survey of the Lower Murray Darling	D-3
D1.4.2 Fauna Survey of the Ginkgo Mine and Surrounds	D-3
D1.4.3 Western Region Biodiversity Conservation Project	D-4
D1.4.4 A Survey for Threatened Fauna in South-western NSW	D-4
D1.4.5 Threatened Species and Populations	D-5
D1.5 DESCRIPTION OF THE STUDY AREA	D-5
D1.5.1 Climate	D-5
D1.5.2 Geology and Soils	D-5
D1.5.3 Hydrology and Topography	D-5
D1.5.4 Landuse	D-9
D1.5.5 Vegetation Types	D-9
D2 SURVEY METHODS	D-10
D2.1 SURVEY TIMING AND CONDITIONS	D-10
D2.2 FAUNA SAMPLE SITES	D-10
D2.3 FAUNA SURVEY TECHNIQUES	D-11
D2.4 RELATIVE ABUNDANCE	D-15
D3 SURVEY RESULTS AND DISCUSSION	D-16
D3.1 MAJOR FAUNA HABITAT TYPES	D-16
D3.2 FAUNA SPECIES DIVERSITY AND ABUNDANCE	D-18
D3.2.1 Amphibians	D-19
D3.2.2 Reptiles	D-20
D3.2.3 Birds	D-20
D3.2.4 Mammals	D-21
D3.2.5 Introduced Vertebrate Fauna	D-21
D3.3 THREATENED FAUNA SPECIES	D-22
D4 EVALUATION OF POTENTIAL IMPACTS	D-23
D4.1 HABITAT REMOVAL/MODIFICATION	D-23
D4.2 CREATION OF BARRIERS TO FAUNA MOVEMENT	D-23
D4.3 INTRODUCED FLORA SPECIES	D-23
D4.4 INTRODUCED ANIMAL SPECIES	D-24
D4.5 FAUNA AND NOISE	D-24
D4.6 FAUNA AND ARTIFICIAL LIGHTING	D-24
D4.7 VEHICULAR TRAFFIC MOVEMENTS	D-24
D4.8 BUSHFIRE RISK	D-24
D4.9 INFECTION OF FROGS BY AMPHIBIAN CHYTRID	D-25
D4.10 THREATENED FAUNA SPECIES	D-25
D4.10.1 Painted Burrowing Frog ( <i>Neobatrachus pictus</i> )	D-26
D4.10.2 Jewelled Gecko ( <i>Diplodactylus elderi</i> )	D-30
D4.10.3 Crowned Gecko ( <i>Diplodactylus stenodactylus</i> )	D-32

## TABLE OF CONTENTS (continued)

D4.10.4	Marble-faced Delma ( <i>Delma australis</i> )	D-34
D4.10.5	Wedgesnout Ctenotus ( <i>Ctenotus brooksi</i> )	D-36
D4.10.6	Slender Mallee Blue-tongue Lizard ( <i>Cyclodomorphus melanops elongatus</i> )	D-39
D4.10.7	Western Blue-tongued Lizard ( <i>Tiliqua occipitalis</i> )	D-41
D4.10.8	Malleefowl ( <i>Leipoa ocellata</i> )	D-43
D4.10.9	Grey Falcon ( <i>Falco hypoleucos</i> )	D-45
D4.10.10	Square-tailed Kite ( <i>Lophoictinia isura</i> )	D-48
D4.10.11	Black-breasted Buzzard ( <i>Hamirostra melanosternon</i> )	D-50
D4.10.12	Bush Stone-curlew ( <i>Burhinus grallarius</i> )	D-52
D4.10.13	Shy Heathwren ( <i>Calamanthus cautus</i> )	D-54
D4.10.14	Chestnut Quail-thrush ( <i>Cinclosoma castanotus</i> )	D-56
D4.10.15	Striated Fieldwren ( <i>Calamanthus fuliginosus</i> )	D-59
D4.10.16	Major Mitchell's Cockatoo ( <i>Cacatua leadbeateri</i> )	D-61
D4.10.17	Hooded Robin (south-eastern form) ( <i>Melanodryas cucullata cucullata</i> )	D-63
D4.10.18	Grey-crowned Babbler (eastern subsp.) ( <i>Pomatostomus temporalis temporalis</i> )	D-66
D4.10.19	Black-eared Miner ( <i>Manorina melanotis</i> )	D-68
D4.10.20	Redthroat ( <i>Pyrrholaemus brunneus</i> )	D-71
D4.10.21	Eastern Long-eared Bat (south-eastern form) ( <i>Nyctophilus timoriensis</i> )	D-73
D4.10.22	Little Pied Bat ( <i>Chalinolobus picatus</i> )	D-75
D4.10.23	Inland Forest Bat ( <i>Vespadelus baverstocki</i> )	D-77
D4.10.24	Yellow-bellied Sheath-tail-bat ( <i>Saccolaimus flaviventris</i> )	D-80
D4.11	SEPP 44 – KOALA HABITAT PROTECTION	D-82
D5	IMPACT AVOIDANCE AND MITIGATION MEASURES	D-83
D6	KEY THRESHOLDS	D-85
D7	SUMMARY AND CONCLUSION	D-86
D8	REFERENCES	D-87
D9	ACKNOWLEDGEMENTS	D-94

## LIST OF TABLES

Table D-1	Threatened Fauna Species Recorded in the Wider Region
Table D-2	Temperatures, Total Rainfall, Sun and Moon Information for the Survey Period
Table D-3	Fauna Survey Sites
Table D-4	Comparison of Vertebrate Species Located with Other Relevant Datasets
Table D-5	Total Vertebrate Species Distributed within Sampling Areas
Table D-6	Distribution of Vertebrate Species Across Survey Sites S1-S6
Table D-7	Threatened Fauna Species Located During the Survey
Table D-8	Threatened Fauna Species with Habitat Components Known or Considered Likely to Occur within the Study Area

**TABLE OF CONTENTS (continued)**

**LIST OF FIGURES**

Figure D-1	Regional Location
Figure D-2	Snapper Mine General Arrangement Year 1
Figure D-3	Snapper Mine General Arrangement Year 14
Figure D-4	Extent of the Murray Darling Depression Bioregion in NSW
Figure D-5	Department of Natural Resources Mapped Vegetation Communities
Figure D-6	Location of Fauna Sample Sites
Figure D-7	Location of Grid Squares Used to Locate Opportunistic Sightings
Figure D-8	Threatened Fauna Recorded During the Survey

**LIST OF PLATES**

Plate D-1	Habitat Type 1 – Mixed Woodland
Plate D-2	Habitat Type 2 – Open Grassland/Shrubland with Scattered Trees
Plate D-3	Habitat Type 3 – Mallee Shrubland

**LIST OF ATTACHMENTS**

Attachment DA	Survey Effort March 2006
Attachment DB	Vertebrate Fauna Species within the Study Area and the Surrounds
Attachment DC	Species Relative Abundance March 2006

## EXECUTIVE SUMMARY

### **Objectives**

This vertebrate fauna survey and impact assessment was conducted as part of the Environmental Assessment (EA) for the Snapper Mineral Sands Project (the Snapper Mine).

The Snapper Mine is located approximately 70 kilometres (km) north of Wentworth and 40 km west of Pooncarie, New South Wales (NSW). It is 10 km south-west of the existing Ginkgo Mineral Sands Project (the Ginkgo Mine).

Western Research Institute conducted the terrestrial vertebrate fauna survey in the study area between the 7 and 15 March 2006. The objectives of the fauna survey and assessment were to:

- Conduct a terrestrial vertebrate fauna survey in the study area utilising recognised fauna survey techniques.
- Assess terrestrial vertebrate fauna species diversity (native and introduced) and their relative abundance.
- Identify and describe the range of habitats utilised by terrestrial vertebrate fauna.
- Conduct targeted surveys for threatened fauna species (excluding fish) considered possible occurrences within the study area or surrounds (including those listed in the Schedules of the NSW *Threatened Species Conservation Act, 1995* [TSC Act] and the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* [EPBC Act]) and map the location of any threatened species identified.
- Compare the vertebrate diversity of the study area with those identified in nearby or regional faunal survey projects.
- Describe the vertebrate fauna present or likely to be present within the Snapper Mine area, which comprises the Snapper Mine Mining Lease Application (MLA) area and the electricity transmission line (ETL) and highway access road (HAR) extensions.
- Identify the potential impacts of the Snapper Mine on fauna including threatened fauna species.
- Conduct detailed evaluations to determine whether the Snapper Mine is likely to have a significant effect on any threatened fauna species.
- Provide mitigating measures likely to address the potential impacts of the Snapper Mine on vertebrate fauna including on threatened fauna species.

### **Findings**

The vertebrate fauna species diversity in both the Murray Darling Depression (MDD) Bioregion and the surrounding study area have been well described, as have the species of conservation concern. The results of the survey were comparable to other similar fauna surveys in the region. A number of threatened fauna species have the potential to utilise habitat within the study area. Five threatened species were recorded during the survey, namely the Western Blue-tongued Lizard (*Tiliqua occipitalis*), Major Mitchell's Cockatoo (*Cacatua leadbeateri*), Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*), Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*) and Little Pied Bat (*Chalinolobus pictatus*).

All habitat types in the study area have been adversely impacted mainly due to past pastoral land management practices. Both the functionality and health of the range of habitat types in the area have been impaired and consequently are likely to be sub-optimal for both vegetation and fauna. Under current pastoral land management practices the conservation and production values appear to be slowly further degrading. Although ecological resilience appears to have been adversely impacted, it does not yet seem to have moved through an irreversible ecological threshold. Hence, self repair under appropriate management conditions appears to be still possible, albeit likely to be very slow under the given climatic conditions.

### **Conclusions**

In summary the following conclusions were made:

- It is likely that the vertebrate fauna values of the region are likely to be maintained and possibly improved, considering the Snapper Mine's proposed measures to avoid, mitigate and/or offset potential impacts.
- The Snapper Mine is unlikely to reduce the long-term viability of any local population of vertebrate fauna species.
- The Snapper Mine is unlikely to lead to the extinction of any vertebrate species or population or place any at risk of extinction.
- The Snapper Mine is unlikely to adversely affect critical habitat as no critical habitats are known to occur within the vicinity of the Snapper Mine area.
- The Snapper Mine is unlikely to adversely affect areas of high conservation value.
- Habitat that is likely to be adversely affected by the Snapper Mine is not considered likely, if removed, to impact adversely the long-term viability of any vertebrate species, population or ecological community.
- Adverse impacts from the Snapper Mine on vertebrate fauna are likely to continue to diminish throughout the life of the mine. At the time of mining lease relinquishment, the DPI-MR would ensure that relevant relinquishment requirements (e.g. demonstration of a stable final landform which is generally consistent with the surrounding landscape) have been fulfilled. It should be noted that appropriate impact mitigation measures would be implemented from the commencement of the Snapper Mine.
- Given the above, from a regional perspective, adverse impacts from the Snapper Mine on vertebrate fauna are unlikely to be permanent or irreversible.

## D1 INTRODUCTION

This vertebrate fauna survey and impact assessment was conducted as part of the Environmental Assessment (EA) for the Snapper Mineral Sands Project (the Snapper Mine). Western Research Institute was commissioned to conduct the survey work.

The Snapper Mine is located approximately 70 kilometres (km) north of Wentworth and 40 km west of Pooncarie, New South Wales (NSW). It is 10 km south-west of the existing Ginkgo Mineral Sands Project (the Ginkgo Mine) (Figure D-1).

The Snapper Mine general arrangement is shown on Figures D-2 and D-3. A detailed description of the Snapper Mine is provided in Section 2 of the EA.

### D1.1 SURVEY AND ASSESSMENT OBJECTIVES

The objectives of the vertebrate fauna survey and assessment were to:

- Conduct a terrestrial vertebrate fauna survey in the study area utilising recognised fauna survey techniques.
- Assess terrestrial vertebrate fauna species diversity (native and introduced) and their relative abundance.
- Identify and describe the range of habitats utilised by terrestrial vertebrate fauna.
- Conduct targeted surveys for threatened fauna species (excluding fish) considered possible occurrences within the study area or surrounds (including those listed in the Schedules of the NSW *Threatened Species Conservation Act, 1995* [TSC Act] and the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* [EPBC Act]) and map the location of any threatened species identified.
- Compare the vertebrate diversity of the study area with those identified in nearby or regional fauna survey projects.
- Describe the fauna present or likely to be present within the Snapper Mine area, which comprises the Snapper Mine Mining Lease Application (MLA) area and the electricity transmission line (ETL) and highway access road (HAR) extensions.
- Conduct detailed evaluations to determine whether the Snapper Mine is likely to have a significant effect on any threatened fauna species.
- Identify the potential impacts of the Snapper Mine on fauna including threatened fauna species.
- Provide measures to address the potential impacts of the Snapper Mine on fauna including threatened fauna species.

The study area incorporates the MLA area, associated infrastructure areas and the immediate surrounds.

### D1.2 PLANNING REGION

The Snapper Mine is also located within two regional areas, *viz.* the Southern Mallee Region (SMR) (Mazzer *et al.*, 1998) and the Lower Murray–Darling Region (Val *et al.*, 2001). The SMR includes south-western NSW from Balranald to north of Pooncarie, to the Victorian Border. In contrast, the lower Murray–Darling Region is bounded by the Murray River in the south and Broken Hill and Ivanhoe to the north. It extends from the South Australian border to Balranald in the east.

## D1.3 BIOGEOGRAPHIC AND ZOOGEOGRAPHIC REGIONAL SETTING

### D1.3.1 Murray Darling Depression Bioregion

Thackway and Cresswell (1995) describe a bioregion as a *complex land area composed of a cluster of interacting ecosystems that are repeated in similar form throughout*. Bioregional descriptions seek to describe the dominant landscape scale attributes of climate, lithology, geology, landform and vegetation. The Interim Biogeographic Regionalisation for Australia (IBRA) bioregion classifications by Thackway and Cresswell (1995; 2000) (and available in DEH, 2006a) are similar to those previously proposed by Morgan and Terrey (1992).

Bioregions provide a way of viewing landscape and biotic patterns in ecological terms, since they represent major structural geologies and climatic differences, particularly where geomorphology is the major driver of soil and vegetation (Morgan, 2001; Smart, 2002). Thackway and Cresswell (1995) argue that bioregions provide a relatively homogenous landscape with their associated biota, as well as linking ecosystems with relatively strong linkages compared with those found between bioregions. As such, the boundaries of bioregions and sub-regions (where rainfall may over-ride geomorphology to some extent) (Smart, 2002):

- *“Provide a fundamental framework within which finer scale assessments of biodiversity distribution, condition, priorities and monitoring should take place.*
- *Provide a basis for communicating this information and these finer priorities at a State, national and international level in a standard format.”*

The survey area lies within the Murray Darling Depression (MDD) Bioregion that occupies the south-west corner of NSW as well as extending south-westwards into Victoria and South Australia (Figure D-4). The NSW section of the bioregion is bounded in the north by the Broken Hill Complex Bioregion with the Cobar Penepain to the north-east and the Riverina Bioregion to the east (Sahukar *et al.*, 2003). The Bioregion also borders the Darling Riverina Plains to the north-west and contains outlying remnants of the Darling River and tributaries.

The MDD Bioregion lies entirely within the Western Division of NSW and contains few town centres (Sahukar *et al.*, 2003). The MDD Bioregion includes the Murray, Murrumbidgee, Lachlan, Darling, Barwon and Yanda Rivers and Peacock Creek catchments.

### D1.3.2 Zoogeographic Region

The study area and surrounds are also located within the Eyrean zoogeographic region. The Eyrean zoogeographic region (arid and semi arid zones) is a coarse but more useful predictor of faunal assemblages than is the MDD Bioregion or the region commonly known as the Western Plains (Anderson, 1961). While IBRA bioregions have helped to rationalise our understanding of landscape patterns, fauna species tend to respond more to vegetation structure (i.e. grassland, woodland and forest) rather than to particular vegetation communities *per se*.

## **D1.4 PREVIOUS VERTEBRATE FAUNA SURVEYS**

A number of vertebrate fauna surveys have been carried out in recent years in the wider region and general locality of the Snapper Mine area. These vertebrate fauna surveys are outlined in the following sections.

### **D1.4.1 Biodiversity Survey of the Lower Murray Darling**

The NSW Department of Land and Water Conservation (now NSW Department of Natural Resources [DNR]) conducted a biodiversity survey of the Lower Murray Darling between September 1998 and March 2000 (Val *et al.*, 2001). A total of 114 sites were surveyed with the majority of sites located within the MDD Bioregion.

A total of 250 native terrestrial vertebrate fauna species were recorded by Val *et al.* (2001) including eight amphibians, 63 reptiles, 164 birds and 24 native mammals (including 12 bats).

Val *et al.* (2001) also reviewed historical survey effort in the bioregion including Krefft's (1866) detailed herpetofauna and mammal fauna surveys as described by Wakefield (1966).

### **D1.4.2 Fauna Survey of the Ginkgo Mine and Surrounds**

Mount King Ecological Surveys (MKES) (2001) carried out two extensive fauna surveys associated with the development of the Ginkgo Mine, the first in spring November 2000 during warm wet conditions and the second in May 2001 under cooler autumn conditions.

These surveys were undertaken within the Ginkgo Mine Mining Lease (ML) area as well as along the infrastructure areas (including, the HAR, ETL and potable water pipeline) and within the general area at locations within approximately 50 km surrounding the Ginkgo Mine ML.

These surveys are particularly applicable to the study area as the Ginkgo Mine ML and infrastructure areas are proximal to it (Figure D-1) with similar landform and fauna habitat.

Detailed fauna surveys were conducted at nine sites and additional habitat assessment and faunal searches were conducted at a further 28 sites. Survey methods included targeted surveys for threatened fauna species.

A total of four amphibians, 27 reptiles, 136 birds and 21 mammals (including 11 bat species, five native non-bat species and six introduced species) were recorded by MKES (2001).

Seventeen threatened fauna species were recorded by MKES (2001) at locations within the Ginkgo Mine ML, along the infrastructure areas and within the general area at locations within approximately 50 km surrounding the Ginkgo Mine ML area.

The threatened fauna species which were recorded are as follows:

- Painted Burrowing Frog (*Neobatrachus pictus*);
- Jewelled Gecko (*Diplodactylus elderi*);
- Crowned Gecko (*Diplodactylus stenodactylus*);
- Wedgesnout Ctenotus (*Ctenotus brooksi*);
- Western Blue-tongued Lizard (*Tiliqua occipitalis*);
- Freckled Duck (*Stictonetta naevosa*);
- Blue-billed Duck (*Oxyura australis*);
- Grey Falcon (*Falco hypoleucos*);
- Square-tailed Kite (*Lophoictinia isura*);
- Major Mitchell's Cockatoo (*Cacatua leadbeateri*);
- Regent Parrot (eastern subsp.) (*Polytelis anthopeplus monarchoides*);
- Barking Owl (*Ninox connivens*);
- Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*);
- Grey Crowned Babbler (*Pomatostomus temporalis temporalis*);
- Little Pied Bat (*Chalinolobus picatus*);
- Inland Forest Bat (*Vespadelus baverstocki*); and
- Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*).

#### **D1.4.3 Western Region Biodiversity Conservation Project**

Mazzer *et al.* (1998) targeted vertebrate fauna of the SMR of NSW between spring 1994 and autumn 1996 as part of the Western Region Biodiversity Conservation Project. Over 400 vertebrate species were located in seven different communities of animals. These included four amphibians, 51 reptiles, 153 birds, 25 mammals and 10 introduced species.

#### **D1.4.4 A Survey for Threatened Fauna in South-western NSW**

Webster *et al.* (2003) targeted 24 threatened fauna at 40 survey sites in south-western NSW between October 1994 and March 1995.

The closest study site to the Snapper Mine was at Pooncarie (Figure D-1). No threatened species were recorded at this study site by Webster *et al.* (2003).

#### **D1.4.5 Threatened Species and Populations**

The vertebrate fauna species diversity in both the MDD Bioregion and the surrounding study area have been well described, as have the species of conservation concern. Table D-1 provides a list of threatened fauna species which are known or considered likely to occur within the wider region. The list was compiled based on the following:

- database searches for the NSW Department of Environment and Conservation (DEC) (2006a) Atlas of NSW Wildlife for the Popiltah, Cuthero, Pooncarie, Bunnerungee, Para and Arumpo 1:100,000 map sheets;
- results of the fauna survey conducted for the Ginkgo Mine by MKES (2001);
- Birds Australia (2006) database records using a search area of approximately 400 square kilometres (km<sup>2</sup>) surrounding the Snapper Mine area; and
- Australian Museum database (Australian Museum, 2006) using a search area of approximately 400 km<sup>2</sup> surrounding the Snapper Mine area.

No threatened fauna species records occur within the study area from the databases above. No threatened fauna populations listed under the Schedules of the TSC Act or EPBC Act occur within the MDD Bioregion.

#### **D1.5 DESCRIPTION OF THE STUDY AREA**

A description of the existing environment of the study area is provided below.

##### **D1.5.1 Climate**

The area is dominated by a hot semi-arid climate. The mean annual temperature across the bioregion is 16-19°C; the mean annual rainfall between 210-408 millimetres (mm); the minimum average monthly rainfall varies between 12-29 mm and the maximum average monthly rainfall varies between 22-40 mm.

##### **D1.5.2 Geology and Soils**

The MDD Bioregion is a shallow crustal depression filled with marine and terrestrial sediments formed over the last 50-60 million (M) years, as tertiary and quaternary sediments. Sandy surface sediments have been reworked into dunes and sandplains, the latter found at the Snapper Mine area. Mallee is found only on sandy soils, whereas other components of the sandplain have heavier soils with brown gradational or texture contrast profiles (Sahukar *et al.*, 2003).

##### **D1.5.3 Hydrology and Topography**

Elevations range from approximately relative level (RL) 60 metres (m) Australian Height Datum (AHD) in the south-eastern and north-western MLA area to approximately RL 80 m AHD in the centre of the MLA area. There are no defined drainage lines within the study area. However two dams are located within the MLA area, which are associated with the Snapper deposit exploration programme.

**Table D-1  
Threatened Fauna Species Recorded in the Wider Region**

Scientific Name	Common Name	Conservation Status <sup>1</sup>		DEC Atlas of NSW Wildlife <sup>2</sup>	MKES <sup>3</sup>	Birds Australia <sup>4</sup>	Likelihood of Occurrence in the Study Area	Comment
		TSC Act	EPBC Act					
<b>Amphibians</b>								
<i>Neobatrachus pictus</i>	Painted Burrowing Frog	E	-	-	•	-	Moderate	Potential habitat is available in the study area. Located by Mount King Ecological Surveys (MKES) (2001) during the Ginkgo Mine fauna survey.
<b>Reptiles</b>								
<i>Diplodactylus elderi</i>	Jewelled Gecko	V	-	•	•	-	Moderate	Potential habitat is available in the study area. Located by MKES (2001) during the Ginkgo Mine fauna survey.
<i>Diplodactylus stenodactylus</i>	Crowned Gecko	V	-	-	•	-	Moderate	Potential habitat is available in the study area. Located by MKES (2001) during the Ginkgo Mine fauna survey.
<i>Delma australis</i>	Marble-faced Delma	E	-	•	-	-	Moderate	Potential habitat is available in the study area.
<i>Ctenotus brooksi</i>	Wedgesnout Ctenotus	V	-	-	•	-	Moderate	Potential habitat is available in the study area. This species may have been located by MKES (2001) during the Ginkgo Mine fauna survey.
<i>Cyclodomorphus melanops elongatus</i>	Slender Mallee Blue-tongued Lizard	E	-	•	-	-	Moderate	Potential habitat is available in the study area, although it is at the edge of this species range.
<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard	V	-	•	•	-	Moderate	Potential habitat is available in the study area. Located by MKES (2001) during the Ginkgo Mine fauna survey.
<b>Birds</b>								
<i>Leipoa ocellata</i>	Malleefowl	E	-	•	-	-	Moderate	Limited potential habitat is available in the study area.
<i>Stictonetta naevosa</i>	Freckled Duck	V	-	•	•	-	Unlikely	Limited habitat available. Located by MKES (2001) during the Ginkgo Mine fauna survey proximal to the Darling River.
<i>Oxyura australis</i>	Blue-billed Duck	V	-	•	•	-	Unlikely	Limited habitat available. Located by MKES (2001) during the Ginkgo Mine fauna survey proximal to the Darling River.
<i>Falco hypoleucos</i>	Grey Falcon	V	-	•	•	-	Moderate	Foraging habitat available. Located by MKES (2001) during the Ginkgo Mine fauna survey.
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	•	•	-	Moderate	Foraging and nesting habitat available. Located by MKES (2001) during the Ginkgo Mine fauna survey.

**Table D-1 (Continued)**  
**Threatened Fauna Species Recorded in the Wider Region**

Scientific Name	Common Name	Conservation Status <sup>1</sup>		DEC Atlas of NSW Wildlife <sup>2</sup>	MKES <sup>3</sup>	Birds Australia <sup>4</sup>	Likelihood of Occurrence in the Study Area	Comment
		TSC Act	EPBC Act					
<b>Birds (Cont.)</b>								
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard	V	-	•	-	•	Unlikely	This species prefers riverine habitat, limited foraging habitat.
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	•	-	-	Moderate	Limited habitat.
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	V	-	•	•	•	High	Potential habitat is available in the study area. Located by MKES (2001) during the Ginkgo Mine fauna survey.
<i>Calyptorhynchus banksii</i>	Red-tailed Black-cockatoo	V	E	-	-	•	Unlikely	Edge of range, limited habitat.
<i>Polytelis anthoepus monarchoides</i>	Regent Parrot (eastern subsp.)	E	V	•	•	-	Unlikely	Limited habitat available. Located by MKES (2001) during the Ginkgo Mine fauna survey proximal to the Darling River.
<i>Ninox connivens</i>	Barking Owl	V	-	•	•	-	Unlikely	Limited habitat available. Located by MKES (2001) during the Ginkgo Mine fauna survey proximal to the Darling River.
<i>Calamanthus cautus</i>	Shy Heathwren	V	-	•	-	-	Moderate	Potential habitat is available in the study area.
<i>Pyrrholaemus brunneus</i>	Redthroat	V	-	•	-	•	Moderate	Potential habitat is available in the study area.
<i>Manorina flavigula melanotis</i>	Black-eared Miner	E	E	•	-	-	Moderate	Edge of range, limited habitat.
<i>Certhionyx variegatus</i>	Pied Honeyeater	V	-	•	-	-	Unlikely	Edge of range, limited habitat.
<i>Melanodryas cucullata</i>	Hooded Robin	V	-	•	•	•	High	Potential habitat is available in the study area. Located by MKES (2001) during the Ginkgo Mine fauna survey.
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	V	-	-	•	-	High	Potential habitat is available in the study area. Located by MKES (2001) during the Ginkgo Mine fauna survey.
<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush	V	-	•	-	-	Moderate	Limited habitat.
<i>Pachycephala rufogularis</i>	Red-lored Whistler	E	V	•	-	-	Unlikely	Limited habitat available, edge of range.
<i>Pachycephala inornata</i>	Gilbert's Whistler	V	-	•	-	-	Unlikely	Limited habitat available, edge of range.

**Table D-1 (Continued)**  
**Threatened Fauna Species Recorded in the Wider Region**

Scientific Name	Common Name	Conservation Status <sup>1</sup>		DEC Atlas of NSW Wildlife <sup>2</sup>	MKES <sup>3</sup>	Birds Australia <sup>4</sup>	Likelihood of Occurrence in the Study Area	Comment
		TSC Act	EPBC Act					
<b>Mammals</b>								
<i>Ningui yvonneae</i>	Southern Ningui	V	-	•	-	-	Unlikely	Limited habitat due to historic landuse in the area.
<i>Myrmecobius fasciatus</i>	Numbat	PE	V	•	-	-	Unlikely	Limited habitat due to historic landuse in the area.
<i>Chaeropus ecaudatus</i>	Pig-footed Bandicoot	PE	-	•	-	-	Unlikely	Limited habitat due to historic landuse in the area.
<i>Lasiorhinus latifrons</i>	Southern Hairy-nosed Wombat	E	-	•	-	-	Unlikely	Limited habitat due to historic landuse in the area.
<i>Cercartetus concinnus</i>	Western Pygmy-possum	E	-	•	-	-	Unlikely	Limited habitat due to historic landuse in the area.
<i>Bettongia lesueur</i>	Burrowing Bettong	PE	-	•	-	-	Unlikely	Limited habitat due to historic landuse in the area.
<i>Lagorchestes leporides</i>	Eastern Hare-wallaby	PE	Ext	•	-	-	Unlikely	Limited habitat due to historic landuse in the area.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	-	•	-	Moderate	Potential habitat is available in the study area.
<i>Nyctophilus timoriensis</i>	Eastern Long-eared Bat (south-eastern form)	V	V	•	-	-	Moderate	Edge of range, foraging and roosting habitat available.
<i>Chalinolobus picatus</i>	Little Pied Bat	V	-	•	•	-	High	Foraging and roosting habitat available.
<i>Vespadelus baverstocki</i>	Inland Forest Bat	V	-	•	•	-	Moderate	Potential habitat is available in the study area.
<i>Leporillus conditor</i>	Greater Stick-nest Rat	PE	V	•	-	-	Unlikely	Limited habitat due to historic landuse in the area.
<i>Notomys mitchellii</i>	Mitchell's Hopping-mouse	PE	-	•	-	-	Unlikely	Limited habitat due to historic landuse in the area.

<sup>1</sup> **Conservation Status**  
 NSW TSC Act  
 Commonwealth EPBC Act  
 V Vulnerable  
 E Endangered  
 PE Presumed Extinct  
 Ext Extinct

<sup>2</sup> DEC (2006a)

<sup>3</sup> MKES (2001)

<sup>4</sup> Birds Australia (2006)

#### **D1.5.4 Landuse**

The MLA and associated infrastructure areas are located within existing pastoral leases. The study area has been heavily overgrazed resulting in a very impacted understorey, the lower parts of trees often being trimmed to grazing height, low to non-existent tree and shrub recruitment, loss of soil carbon and significant loss of ground litter and the cryptogamic crust.

#### **D1.5.5 Vegetation Types**

The vegetation within the study area is dominated by Black Oak over Bluebush. The height and density of the Black Oak is variable as is the abundance of other associated species including Wilga, Rosewood and Warrior Bush. At the north-western end of the MLA area, the Black Oak is generally smaller, mixed with Rosewood (many senescent) and gives way to pure Bluebush with occasional small clumps of Black Oak or Mallee. Other vegetation in the Study area includes Mallee over Bluebush, Mallee over Spinifex and Black Box with Rosewood surrounding the small grassy depression.

Vegetation communities in the region have been mapped by the DNR (2005) through the Lower Murray Darling Catchment Management Authority (CMA). The vegetation communities mapped in the locality are shown on Figure D-5.

## D2 SURVEY METHODS

The survey methods outlined in this section targeted amphibians, reptiles, birds and mammals.

### D2.1 SURVEY TIMING AND CONDITIONS

The terrestrial vertebrate fauna survey was conducted in the study area from 7 to 15 March 2006.

Weather conditions experienced during the survey were mainly warm to hot, dry days and mild to moderate nights. Temperatures and rainfall recorded at the Snapper Mine area are provided in Table D-2. Maximum temperatures ranged from 28.4 to 43.3°C and minimum temperatures from 13.2 to 23.0°C during the survey period. The only rain recorded (1.2 mm) fell on the 13 March 2006.

Sunrise and sunset data together with moonrise and moonset and moon phases are also recorded in Table D-2.

**Table D-2**  
**Temperatures, Total Rainfall, Sun and Moon Information for the Survey Period**

Date	Temperature (°C) <sup>1</sup>		Rainfall (mm) <sup>1</sup>	Sun		Moon		
	Maximum	Minimum		Sunrise (24 Hour Time)	Sunset (24 Hour Time)	Rise (24 Hour Time)	Set (24 Hour Time)	Phase
7/3/06	32.3	15.4	Nil	0725	2002	1515	-	1 <sup>st</sup> Quarter
8/3/06	28.4	13.2	Nil	0725	2001	1612	0043	Waxing
9/3/06	33.3	17.9	Nil	0726	1959	1701	0138	Half
10/3/06	37.9	16.9	Nil	0727	1958	1743	0237	Waxing
11/3/06	38.2	19.7	Nil	0728	1957	1818	0337	¾
12/3/06	40.5	22.4	Nil	0729	1956	1848	0437	Waxing
13/3/06	43.3	23.0	1.2 mm	0729	1954	1914	0535	Waxing
14/3/06	29.0	15.0	Nil	0730	1953	1938	0632	Full
15/03/06	29.7	16.9	Nil	0731	1951	2001	0727	Full

<sup>1</sup> Ginkgo Mine site meteorology data.

### D2.2 FAUNA SAMPLE SITES

Six survey sites (i.e. Sites S1 to S6) were established in the study area to survey for amphibians, reptiles, birds and mammals (Table D-3). The location of the survey sites are shown on Figure D-6. Detailed surveys were carried out at each of these six sites.

In addition to the survey sites, other targeted searches and observations for vertebrate fauna were conducted throughout the study area at 10 locations, identified as TA–TJ (Figure D-6). Opportunistic sightings were recorded throughout the MLA area as they occurred and were located as occurring in locations 1-39, each of these being an area of one km<sup>2</sup> (Figure D-7).

**Table D-3  
Fauna Survey Sites**

Site Number	Site Details	Habitat Type
Site S1	GPS: 54 608378 6300900 Bearing of site: 0° – 200 m, 90° – 100 m Altitude: 64 m	Mallee Shrubland
Site S2	GPS: 54 607553 6299083 Bearing of site: 280° – 200 m, 190° – 100 m Altitude: 71 m	Mixed Woodland
Site S3	GPS: 54 605347 6302766 Bearing of site: 320° – 200 m, 230° – 100 m Altitude: 69 m	Mixed Woodland
Site S4	GPS: 54 604701 6302865 Bearing of site: 0° – 200 m, 90° – 100 m Altitude: 66 m	Mixed Woodland
Site S5	GPS: 54 603759 6302028 Bearing of site: 270° – 200 m, 0° – 100 m Altitude: 65 m	Mallee Shrubland
Site S6	GPS: 54 603415 6302462 Bearing of site: 330° – 200 m, 60° – 100 m Altitude: 68 m	Open Grassland with Scattered Trees

### D2.3 FAUNA SURVEY TECHNIQUES

The survey techniques utilised were based on guidelines by the DEC (2004) and Bell and Hoye (2002) and are described below. The survey effort implemented at each survey site is described in Attachment DA.

Where necessary, species identifications were checked using the following references: Strahan (2004); Pizzey and Knight (1997); Cogger (2000); Menkorst and Knight (2001); Barret *et al.* (2003); Swan *et al.* (2004). Playback calls were selections from Stewart (1992; 1994; 1997; 1998; 1999a; 1999b and 1999c). Tracks and traces were identified where practicable using Triggs (2004).

Sampling at Sites S1-S6 was conducted within a 'typical' survey quadrat of 100 x 200 m (i.e. 2 hectares [ha]) marked out with survey tape. As indicated below, opportunistic observations were conducted for vertebrate fauna throughout the MLA area. The survey effort is summarised in Attachment DA.

#### ***Elliott Type A on Ground***

Elliott A traps (8 x 10 x 33 centimetres [cm]) were baited with a mixture of peanut butter and rolled oats, provided with a handful of nesting material to keep captured animals warm, and partially covered with a plastic bag to keep animals dry (in the event of rain). Twenty-five traps were placed in suitable locations at Sites S1-S6 at approximately 20 m intervals along the boundary of the rectangular sampling plots and the location marked with flagging tape. Traps were left out at each location for four nights, providing 100 trap nights per site. Traps were checked early each morning, any captured animal identified, assessed and released, disturbance and false trap closures noted and the traps reset as appropriate.

***Elliott Type B on Ground***

Elliott B traps (16 x 16 x 46 cm) were baited and covered in the same way as the Elliott A traps. Fifteen traps were placed in suitable locations at Sites S1-S6 at approximately 20 m intervals along the boundary of the rectangular sampling plots and the location marked with flagging tape, usually within 5 to 10 m of the type A Elliott traps. Traps were left out at each location for four nights, providing 60 trap nights per site. Traps were checked early each morning, any captured animal identified, assessed and released, disturbance and false trap closures noted and the traps reset as appropriate.

***Elliott Type A as Tree Traps***

Ten Elliott A traps were placed in suitable trees at Sites S1-S6 on a bracket 2 to 3 m above ground level, at random suitable tree locations following the diagonal within each site and the location marked with flagging tape. The tree traps were baited and covered in the same way as the other Elliott traps.

The tree traps were left out at each location for four nights providing 40 trap nights per site. Traps were checked early each morning, any captured animal identified, assessed and released, disturbance and false trap closures noted and the traps re-set as appropriate.

***Ground Hair Tubes (Small and Large)***

Twenty-five hair tubes (12/13 large x 100 mm in diameter plus 12/13 small 40 mm in diameter) were baited with either a mixture of peanut butter and rolled oats (12/13 tubes of each size) or tinned cat food (fish flavour, 12/13 tubes of each size). The bait was contained between two screens of nylon fly mesh in the centre of the tube, unable to be easily accessed by an investigating animal. Double-sided sticky tape was attached to the insides of both openings of the hair tube. The tape was positioned so that hairs from an investigating animal would likely be entrapped.

The hair tubes were placed in suitable locations at Sites S1-S6 at approximately 20 m intervals along the boundary of the rectangular sampling plots and the location marked with flagging tape. Traps were left out at each survey site for six nights providing 150 trap nights per site. Tubes were checked for the presence of hair samples, and if present, the tape was removed and placed between sheets of waxed paper for later analysis. Hair samples were identified by Dr Barbara Triggs (an expert in mammalian hair identification).

***Tree Hair Tubes (Small and Large)***

Five large hair tubes (100 mm in diameter) and five small hair tubes (40 mm in diameter) were baited with either a mixture of peanut butter and rolled oats (three large tubes and two small tubes) or tinned cat food (fish flavour, two large tubes and three small tubes). The bait was contained in a central location, unable to be easily accessed by an investigating animal. Double-sided sticky tape was attached to the insides of both openings of the hair tube and positioned that hairs from an investigating animal would likely be entrapped.

Traps were left out at each location for six nights providing 60 trap nights per survey site. Tubes were checked for the presence of hair samples and, if present, the tape was removed and placed between sheets of waxed paper for later analysis. Hair samples were identified by Dr Barbara Triggs.

### ***Pitfall Traps***

Six pitfall traps were located within the sampling plot at Sites S1-S6. Each trap consisted of a cylindrical plastic bucket or polyvinyl chloride (PVC) plumbing tube with a detachable lid for use when the trap needed to be closed. The dimensions of the bucket were 600 mm high and diameter 400 mm, and the PVC tube 250 mm x 600 mm. The bucket/tube was fitted into a hole in the ground so that the upper rim was slightly lower than the surrounding ground surface. Either (1) A shade cloth fence 300 mm tall and 10 m in length was placed tightly at right angles to the ground, held in place by 10 mm diameter metal stakes and centred over the bucket, so that the fence was a snug fit to the ground (Sites S3-S6), or (2) a continuous 50 m fence was used (Sites S1 and S2). Litter and small rocks or wood pieces were placed in each trap with a small amount of water to protect trapped animals from excessive heat and desiccation. Prior to setting up the fence, the ground over which the fence was to be positioned was raked free of litter. Pitfall traps were active for eight nights at Sites S1, S2 and S3, a total of 48 trap nights per site. Pitfall traps were active for seven nights at Sites S4, S5 and S6, a total of 42 trap nights per site. In total there were 270 pit trap nights expended. The traps were checked each morning and afternoon for trapped animals, which if present were identified, described and then released in the general vicinity of capture.

### ***Bat Surveys***

#### *Harp Traps*

Two harp traps were set for two nights at suitable locations at Sites S1, S4, S5 and besides the dam near Site S2. In total there were four harp trap nights per site.

#### *Anabat Detectors*

Two Anabat detectors were set at each of six sites for two nights, totalling 12 detector nights. The detectors were placed in appropriate locations at Sites S1, S3-S6 and beside the dam near Site S2. Recorded calls were analysed by Dr Greg Richards.

### ***Spotlighting***

The primary targets of this activity were arboreal and ground dwelling larger mammals, nocturnal birds, nocturnal amphibians and reptiles. Spotlighting activities involved: spotlighting on foot: one person by 60 minute walking sessions at around 1 kilometre per hour (km/hour), on two separate evenings, were conducted at Sites S1-S6; and spotlighting from a vehicle along available tracks on two nights, totalling 6 spotlight hours. The speed of the vehicle was kept to around 5 km/hour.

### ***Herpetological Searches***

Systematic searches were conducted for reptiles and amphibians at Sites S1-S6. Sixty minute daytime searches were conducted on two separate days at each site targeting reptiles and amphibians. Bark was prised from trees, ground litter was raked, logs were turned over and cavities examined, fallen branches were moved, where present rocks were turned and slow walking was used in an attempt to flush out any reptiles or amphibians present.

### ***Bird Surveys***

Two one-hour area surveys were conducted on two separate days at Sites S1-S6, at least one early in the morning and one in the late afternoon. Birds were recognised by sightings, calls and flight patterns. The observer walked slowly up and down along each long axis transects until the sampling plot was covered.

### ***Call Playback***

Standard call playback procedures were used for a range of bird and mammal species.

#### ***Birds and Mammals***

Species targeted were the Barking Owl, Bush Stone-curlew and the Spotted Nightjar. Nocturnal call playbacks were conducted on two occasions at Sites S1-S6. Each session commenced with a short listening period, followed by spotlighting of the surrounding vegetation. The calls of target species were played for three to five minutes separated by 30 seconds of listening. Following the completion of all species calls, a further spotlight scan was made of the surrounding vegetation. Additional spotlight scans were made at the end of each nocturnal bird call playback to identify any individuals perched in the surrounding vegetation. Calls of species that feed on other call playback species were played last. If a prey species responded to call playback, the calls of its potential predator were not played during that session of call playback. Some additional locations were added to ensure a full coverage of the area was achieved.

### ***Opportunistic Observations***

Any sightings of fauna were recorded whilst travelling throughout the study area. To maximise such sightings the routes to various locations were varied as much as possible. Opportunistic sightings were recorded in relation to grid squares 1-39 (Figure D-7).

### ***Additional Transects***

The transects (TA-TJ) (Figure D-6) were designed to cover some of the additional habitat variation within the MLA area as well as targeting species located in the likely location of the ETL and other infrastructure components. General searching was carried out along these transects on at least two occasions early to mid-morning, recording all birds observed or heard, reptiles and any other additional species.

### ***Tracks and Traces***

Searches for tracks and traces were combined with other activities, particularly herpetological searches. Searches were conducted for hair samples, skulls, animal droppings, diggings and scratch marks, etc. Some areas and track sections were particularly suited to identifying animal tracks. Scats with hair samples were sent to Dr B Trigg to enable mammals to be identified.

### ***Targeted Surveys for Threatened Fauna Species***

A list of threatened amphibian, reptile, bird and mammal species listed in the Schedules of the TSC Act or EPBC Act considered possible occurrences within the study area or immediate surrounds is provided in Table D-1. The range of techniques utilised in this survey were also appropriate to target particular threatened species listed in Table D-1.

A survey for threatened species listed under the Schedules of the NSW *Fisheries Management Act, 1994* is not considered to be required given the absence of habitat for these species in the study area.

## D2.4 RELATIVE ABUNDANCE

The relative abundance of each species recorded was estimated as follows:

- 1 One sighting of the species, or at least one trace found.
- U Uncommon, 2-5 observations of the species, as well as an assessment of how widespread and persistent the species was.
- C Common, 6-30 observations of the species, as well as an assessment of how widespread and persistent the species was.
- A More than 30 observations of the species, as well as an assessment of how widespread and persistent the species was.
- ? Relative abundance cannot be estimated when a species presence is identified solely from tracks and traces.

Hence relative abundance was based on empirical data as well as being a value judgement made by an experienced surveyor.

## D3 SURVEY RESULTS AND DISCUSSION

### D3.1 MAJOR FAUNA HABITAT TYPES

Three major fauna habitat types were identified in the study area as follows:

- Mixed Woodland;
- Open Grassland/Shrubland with Scattered Trees; and
- Mallee Shrubland.

Photographs of each habitat type are provided in Plates D-1 to D-3.

#### ***Mixed Woodland***

The Mixed Woodland habitat type is characterised by sparse Black Oak (*Casuarina pauper*) woodland approximately 8-10 m in height with a mid-storey of Rosewood (*Alectryon oleifolius* subsp. *canescens*) and Wilga (*Geijera parvifolia*) approximately 4-5 m in height with a moderately dense shrub layer of Bluebush (*Maireana* spp.) up to 1 m in height. The Mixed Woodland habitat type is the most prevalent habitat in the study area, including the ETL and HAR extension.

Survey Sites S2, S3 and S4 were located in the Mixed Woodland habitat type (Figure D-6 and Plate D-1). Survey Site S4 was unique to the other survey sites within this habitat type in that it contained a grassy depression with scattered Black Box, Wilga and Rosewood surrounded by a ring of Black Box grassy woodland to approximately 8 m in height.

Tree hollows are rare in Black Oak trees but a number of dead trees provided lifting bark on the trunks. Some tree hollows occurred within the Black Box woodland at Survey Site S4 and sheathing bark was common on dead Rosewoods in the grassy depression at Survey Site S4 providing additional habitat niches.

The Mixed Woodland habitat type showed considerable to moderate groundcover and understorey disturbance. The habitat type is heavily grazed by sheep and goats evidenced by little to no re-growth in the middle and upper vegetation layers except at Survey Site S4 where Black Box regeneration was evident from two flood events (saplings at 1 m high and 20 cm high). Litter cover was patchy through the Mixed Woodland habitat type.

The Mixed Woodland habitat type has not been subject to fire for a long period of time.

An additional disturbance to the habitat at Survey Site S4 was the mistletoe infestation on the Rosewood within the grassy depression resulting in many dead Rosewood. Despite the impact on its host plant, the mistletoe provides foraging habitat for a number of species and was in heavy flower at the time of survey.

The Mixed Woodland habitat type is impacted habitat due mainly to past pastoral land management practices. The functionality of the area is impaired and likely to provide sub-optimal habitat for component vegetation and faunal communities. Under current pastoral land management practices the conservation and production values are slowly further degrading. The habitat type has lost some ecological resilience but has not yet moved through an irreversible ecological threshold and hence self repair under appropriate management conditions is still possible. The habitat type has a medium to a high level of degradation.

### **Open Grassland/Shrubland with Scattered Trees**

The Open Grassland/Shrubland with Scattered Trees habitat type is characterised by open grassy woodland of low sparse Black Oak (approximately 6 m) and Rosewood (approximately 3-4 m) with occasional Wilga over scattered Bluebush (approximately 1 m), sparse groundcover of low Chenopods (<50 cm) and grasses, large bare areas.

Hollows are scarce but many dead and dying trees are present and large number of logs lie on the ground. Some lichen crusting is present. A number of 'sinkholes' are also present and are currently being used by rabbits and foxes.

Considerable understorey and groundcover disturbance is evident, most likely the result of sheep, cattle and kangaroo grazing. As a result there is little to no re-growth in the mid and upper vegetation layers.

The Open Grassland/Shrubland with Scattered Trees habitat type is impacted habitat due mainly to past pastoral land management practices. The functionality of the area is impaired and likely to provide sub-optimal habitat for component vegetation and faunal communities. Under current pastoral land management practices, the conservation and production values are slowly further degrading. The habitat type has lost some ecological resilience but has not yet moved through an irreversible ecological threshold and hence self repair under appropriate management conditions is still possible. The habitat type has a medium to high level of degradation.

### **Mallee Shrubland**

The Mallee Shrubland habitat type is characterised by open Mallee to approximately 6 m in height.

Survey Sites S1 and S5 were located in the Mallee Shrubland habitat type (Figure D-6 and Plate D-3). Survey Site S1 was located in Mallee woodland with an understorey of Spinifex (*Triodia* spp.) and occasional shrubs (*Dodonaea* and *Eremophila*), while Survey Site S5 was located in Mallee woodland with an understorey of sparse Bluebush shrub layer up to 1 meter in height. Other tree species which were common included Black Oak, Rosewood, Warrior Bush and Wilga.

Some small and medium hollows (ranging up to 20 cm in diameter and 10-30 cm in length) were noted within the Mallee trees.

The groundcover was sparse with litter accumulation under the Mallee trees, some grass and scattered low chenopods. A few logs are present and randomly scattered in the groundcover, however the Mallee Shrubland habitat type showed considerable to moderate groundcover and understorey disturbance. As a result, bare soil is dominant. The habitat type has been heavily grazed by sheep and goats.

The area has been recently and repetitively burnt as indicated by the pastoral leaseholder.

The Mallee Shrubland habitat type is impacted habitat due mainly to past pastoral land management practices. The functionality of the habitat type is impaired and likely to provide sub-optimal habitat for component vegetation and faunal communities. Under current pastoral land management practices the conservation and production values are slowly further degrading. The habitat type has lost some ecological resilience but has not yet moved through an irreversible ecological threshold and hence self repair under appropriate management conditions is still possible. The habitat type has a medium to high level of degradation.

### D3.2 FAUNA SPECIES DIVERSITY AND ABUNDANCE

Fauna species which have been recorded within the wider region are tabulated within Table D-B1 in Attachment DB. Table D-B1 identifies species located in:

- the DEC *BIONET* for a user defined grid;
- by MKES (2001) during fauna surveys for the Ginkgo Mine and infrastructure areas;
- the Birds Australia database;
- the Australian Museum database; and
- the study area during this survey.

A comparison of the data from this survey with those from other relevant sources (MKES, 2001; Val *et. al.*, 2001; DEC, 2006b) is provided in Table D-4.

**Table D-4  
Comparison of Vertebrate Species Located with Other Relevant Datasets**

Faunal Group	March 2006 Survey	Existing Dataset			Species Recorded During this Survey not Recorded by DEC BIONET <sup>1</sup> or MKES (2001)
		DEC BIONET <sup>1</sup>	MKES (2001)	Val <i>et. al.</i> (2001)	
Amphibians	0	3	4	8	0
Reptiles	22	20	27	63	Nobbi Dragon ( <i>Amphibolurus nobbi</i> ) King Brown Snake ( <i>Pseudechis australis</i> ) Eastern Brown Snake ( <i>Pseudonaja textiles</i> )
Birds	53	87	136	164	Collared Sparrowhawk ( <i>Accipiter cirrhocephalus</i> ) Brown-headed Honeyeater ( <i>Melithreptus brevirostris</i> ) Varied Sitella ( <i>Daphoenositta chrysoptera</i> ) Barn Owl ( <i>Tyto alba</i> )
Mammals	15	13	15	24	Eastern Grey Kangaroo ( <i>Macropus giganteus</i> ) <i>Morphopterus</i> sp. 3, 4
Introduced	5	2	6	7	0
<b>Total</b>	95	125	188	266	8 (possibly another - <i>Morphopterus</i> sp. 3, 4)
<b>Threatened Species<sup>2</sup></b>	5	5	17	25	-

<sup>1</sup> DEC (2006b)

<sup>2</sup> Conservation Status  
NSW TSC Act  
Commonwealth EPBC Act

All species recorded during the survey were previously recorded by Val *et. al.* (2001). As indicated in Table D-4, eight species were recorded during this survey that were not previously recorded by MKES (2001) and DEC (2006b).

During the survey, a total of 95 species were identified in the study area and the immediate surrounds (including 90 native and five introduced species [Table D-5]). No amphibians were located due to the lack of suitable weather conditions (i.e. only a small amount of rainfall). Twenty-two native reptile species were located, 53 native bird species and 15 native mammal species were located. The distribution of fauna across the landscape is indicated in Tables D-5 and D-6.

**Table D-5**  
**Total Vertebrate Species Distributed within Sampling Areas**

Faunal Group	Species distribution			Total Species Recorded in Each Faunal Group
	Sites S1-S6	Opportunistic excluding S1-S6	TA - TJ	
Amphibians	0	0	0	0
Reptiles	16	13	12	22
Birds	38	48	35	53
Mammals	14	4	2	15
Introduced	5	3	3	5
<b>Total</b>	<b>73</b>	<b>68</b>	<b>52</b>	<b>95</b>

Sites S1-S6, Transects TA-TJ (Figure D-6). Opportunistic sightings (Figure D-7).

**Table D-6**  
**Distribution of Vertebrate Species Across Survey Sites S1-S6**

Faunal Group	Vertebrate Species Numbers at Survey Sites S1-S6					
	S1	S2	S3	S4	S5	S6
Amphibians	0	0	0	0	0	0
Reptiles	12	7	5	5	9	7
Birds	19	20	19	19	18	23
Mammals	10	10	3	7	5	7
Introduced	3	4	4	1	1	2
<b>Total</b>	<b>44</b>	<b>41</b>	<b>31</b>	<b>32</b>	<b>33</b>	<b>39</b>

A summary of the relative abundance of vertebrate fauna species recorded during the survey is provided in Attachment DC. Three fauna species were assessed as being abundant, 23 as common, 54 as uncommon and 15 were located as either a single sighting or from a trace.

### D3.2.1 Amphibians

No amphibians were located during the survey due to the hot weather conditions and lack of rain prior to and during the survey period.

A comparison of the data from this survey with those from other relevant sources (MKES, 2001; Val *et al.*, 2001; DEC, 2006b) is provided in Table D-4. These datasets indicate that potentially up to eight species of amphibian could be located within the study area. MKES (2001) identified four frog species at the neighbouring Ginkgo Mine ML in 2001, namely: the Spotted Marsh Frog (*Limnodynastes tasmaniensis*), Trilling Frog (*Neobatrachus centralis*), Painted Burrowing Frog (*Neobatrachus pictus*) and Painted Spadefoot Toad (*Neobatrachus sudelli*).

It appears probable that these species would also be located under appropriate survey conditions.

### D3.2.2 Reptiles

Twenty-two reptile species were located during the survey. The number of species located at sampling Sites S1-S6 varied between 5 to 12 species. The number of species located at sampling Sites S1-S6 was 16, at transects TA-TJ, 12, and located opportunistically across the site, 13 species (Tables D-5 and D-6; Attachment DC).

Two Agamidae, one Boidae, three Elapidae, six Gekkonidae, nine Scincidae, and one Varanidae were located (Attachment DB).

No reptiles were assessed as abundant, seven were considered to be common, 10 uncommon and five were observed only once or identified from a trace (Attachment DC).

Only one threatened reptilian species under the TSC Act was located, namely, the Western Blue-tongued Lizard (*Tiliqua occipitalis*), which was identified from a single recently shed skin.

A comparison of the data from this survey with those from other relevant sources (MKES, 2001; Val *et al.*, 2001; DEC, 2006b) is summarised in Table D-4. These datasets indicate that there is a reasonable representation of the potential reptilian fauna present in the study area based on a comparison with DEC (2006b) and MKES (2001). The higher reptilian diversity found by Val *et al.* (2001) is due mainly to their much larger geographic survey area. However, the similarity is much greater when their data is restricted to the NSW portion of the MDD Bioregion. Table D-4 identifies three species recorded in this survey but not found by MKES (2001) or in the DEC (2006b) BIONET.

### D3.2.3 Birds

Fifty-three native birds were identified during the survey. The number of species located at sampling Sites S1-S6 varied between 18 and 23. The number of species located at sampling sites S1-S6 was 38, at transects TA - TJ, 35, and located opportunistically across the site, 48 species (Tables D-5 and D-6; Attachment DC).

Five Acanthizidae, three Accipitridae, one Aegpthelidae, one Anatidae, three Artamidae, three Cacatuidae, one Casuariidae, two Climacteridae, two Columbidae, four Corcoracidae, one Dicaeidae, two Dicruidae, three Falconidae, one Hirundinidae, one Maluridae, six Meliphagidae, one Meropidae, one Neosittidae, three Pachycephalidae, two Petroicidae, one Podargidae, one Pomatostomidae, three Psittacidae, and one Tytonidae were located (Attachment DB).

Three birds were assessed as abundant, 13 were considered to be common, 29 uncommon and eight were observed only once or identified from a trace (Attachment DC).

Two threatened avian species under the TSC Act were located, including the Major Mitchell's Cockatoo (*Cacatua leadbeateri*) – assessed as uncommon, and the Hooded Robin (south-eastern form) (*Melanodryas cucullata*) – also assessed as uncommon.

A comparison of the data from this survey with those from other relevant sources (MKES, 2001; Val *et al.*, 2001; DEC, 2006b) is provided in Table D-4. These datasets indicate that the number of bird species located during this survey represents 61% of the total species identified in the DEC BIONET (2006b), 50.5% of the total species identified by MKES (2001) and 35.7% of the total species located by Val *et al.* (2001).

MKES (2001) identified 30 waterbird species not located with the study area, as well as an additional 40 species from 13 families, where a better representation at the Snapper Mine area might have been expected. The higher species diversity found by Val *et al.* (2001) is due mainly to their much larger geographic survey area. Table D-4 identifies four species recorded in this survey but not by MKES (2001) or located in the DEC (2006b) BIONET.

### **D3.2.4 Mammals**

Fifteen native mammal species were located during the survey. The number of native mammal species located at sampling Sites S1-S6 varied between three and 10 native mammals. The number of species located at sampling Sites S1-S6 was 14 native mammals, at transects TA - TJ, two native mammals, and located opportunistically across the site, four native mammals (Tables D-5 and D-6; Attachment DC).

One Emballonuridae, three Macropodidae, three Molossidae, one Tachyglossidae, and seven Vespertilionidae were located (Attachment DB).

No native mammal species were assessed as abundant, three were considered to be common, 15 uncommon and two were observed only once (Attachment DC).

Two mammal species listed under the TSC Act were located, the Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*) and the Little Pied Bat (*Chalinolobus pictatus*).

A comparison of the data from this survey with those from other relevant sources (MKES, 2001; Val *et al.*, 2001; DEC, 2006b) is provided in Table D-4. These datasets indicate that there is a reasonable concordance between the number of mammal species identified in this survey, the DEC Atlas (March 2006) and MKES (2001).

The higher species diversity found by Val *et al.* (2001) is due mainly to their much larger geographic survey area.

### **D3.2.5 Introduced Vertebrate Fauna**

Five introduced species were located during the survey. The number of species located at each of the Sites S1-S6 varied between one and four species. The number of species located at sampling Sites S1-S6 was five, at transects TA-TJ, three, and located opportunistically across the site, three species (Tables D-5 and D-6; Attachment DC).

Two Bovidae, one Canidae, one Leporidae and one Muridae were located (Attachment DB).

The Feral Goat (*Capra hircus*) was assessed as common, and the other four assessed as uncommon, Sheep (*Ovis aries*), Red Fox (*Vulpes vulpes*), Rabbit (*Oryctolagus cuniculus*) and House Mouse (*Mus musculus*) (Attachment D-C).

### D3.3 THREATENED FAUNA SPECIES

Five threatened species were recorded during the survey. These species together with their respective location co-ordinates, sampling site and number of individuals observed are outlined in Table D-7.

**Table D-7  
Threatened Fauna Species Located During the Survey**

Scientific name	Common name	Conservation Status <sup>1</sup>		Northings and Eastings (AMG)	Sampling Site	Number Individuals Recorded
		TSC Act	EPBC Act			
<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard	V	-	6 303525 602426	Grid4	1 trace
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	V	-	6 302865 604701	S4 above canopy	1
				6 301775 603752	TF	1
				6 298434 607296	Grid 31	1
				6 303129 605266	North of Grid 7	14
<i>Melanodryas cucullata</i> <sup>2</sup>	Hooded Robin (south-eastern form)	V	-	6 299083 607553	S2	2
				6 302766 605347	S3	1
				6 302462 603415	S6	1
				6 300601 607023	TG	1
				6 298015 609098	TJ	1
				6 303598 601488	Grid 3	1
				6 302557 605289	Grid 12	1
				6 301387 604378	Grid 17	1
				6 300256 607444	Grid 23	1
				6 629459 607485	Grid 27	1
6 629777 608221	Grid 28	1				
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V	-	6 300925 608395	S1	3
<i>Chalinolobus pictatus</i>	Little Pied Bat	V	-	6 300894 608351	S1	36
				6 299055 607533	S2	7
				6 302889 604695	S4	3
				6 302028 603776	S5	9

<sup>1</sup> Conservation Status  
NSW TSC Act  
Commonwealth EPBC Act  
V Vulnerable

<sup>2</sup> The Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*) is listed as 'vulnerable' under the TSC Act. The sighting of the Hooded Robin cannot be conclusively identified to subspecies, however it can be inferred that the sighting was of the south-eastern form based on the location of the Study area in relation to the species/subspecies distribution.

## **D4 EVALUATION OF POTENTIAL IMPACTS**

The following sections evaluate the potential impacts of the Snapper Mine on fauna species, populations and their habitats in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005).

### **D4.1 HABITAT REMOVAL/MODIFICATION**

The Snapper Mine disturbance areas cover approximately 1,630 ha of land (Figure D-6). Major fauna habitat types which would be cleared or modified for the Snapper Mine include:

- approximately 1,075 ha of Mixed Woodland;
- approximately 525 ha of Open Grassland/Shrubland with Scattered Trees; and
- approximately 30 ha of Mallee Shrubland.

'Clearing of Native Vegetation', 'Bushrock Removal' and 'Removal of Dead Wood and Dead Trees' are key threatening processes listed under the TSC Act which are applicable to the fauna habitat removal/modification resulting from the Snapper Mine.

Measures to avoid and mitigate for fauna habitat removal/modification impacts are provided in Section D5.

### **D4.2 CREATION OF BARRIERS TO FAUNA MOVEMENT**

The capacity of individual species to move into or out of, as well as within the study area would vary significantly, depending on their capacity to move through the mosaic landscape. Fauna movement in the study area and surrounds may potentially be restricted by factors such as habitat clearance, fire, road construction, track width, fences and the moving mine path which can create a barrier to dispersal and/or movement for some species. Such movements may be critical to the maintenance of genetic health and viable population numbers by enabling interaction with different populations (meta-populations) in a locality or region (Bridgewater, 1987).

Species possess a variety of dispersal/movement mechanisms by which they are able to colonise new habitats, and/or move within and between vegetation-habitat mosaics. Birds, for example, are generally highly mobile and are able to cover relatively large areas of land. However it is unlikely that all bird species would have equal capacity to move through, into or out of the study area. A small lizard species may be effectively isolated in a remnant surrounded by even narrow tracks, whereas this is unlikely to be an effective barrier for most arboreal mammals (Bennet, 1987).

### **D4.3 INTRODUCED FLORA SPECIES**

Disturbance can act as a catalyst for weed incursion and if management initiatives are not implemented, proliferation of weeds can occur which can modify fauna habitat.

Measures to avoid and mitigate impacts from the introduced flora species are provided in Section D5.

#### **D4.4 INTRODUCED ANIMAL SPECIES**

The European Rabbit (*Oryctolagus cuniculus*), Feral Goat (*Capra hircus*), European Red Fox (*Vulpes vulpes*) and Feral Cat (*Felis catus*) are introduced animal species which have been recorded within the Study area and wider region. Each of these species have a corresponding key threatening process listed under the TSC Act, viz.:

- competition and grazing by the Feral European Rabbit;
- competition and habitat degradation by the Feral Goat;
- predation by the European Red Fox; and
- predation by the Feral Cat.

There is potential for further colonisation of the study area by introduced animal species due to potentially increased refuge sites/scavenging areas and potential for introduced animal species to be transported in the area via vehicles.

#### **D4.5 FAUNA AND NOISE**

Numerous studies have been undertaken on the affects of noise on wildlife (e.g. Algers *et al.*, 1978 in Richard Heggie Associates, 1997; Allaire, 1978; Ames, 1978 in Fletcher and Busnel, 1978; Busnel, 1978 in Fletcher and Busnel, 1978; Lynch and Speake, 1978 in Fletcher and Busnel, 1978; Shaw, 1978 in Fletcher and Busnel, 1978; Streeter *et al.*, 1979; Poole, 1982 in Richard Heggie Associates, 1997).

In essence, the studies indicate that many fauna species are well adapted to human activities and noise. Notwithstanding, the Snapper Mine would increase the existing level of noise, which has the potential to disrupt the routine activities of vertebrate fauna.

#### **D4.6 FAUNA AND ARTIFICIAL LIGHTING**

Artificial lighting for the Snapper Mine has the potential to affect the behavioural patterns of some fauna species. Some bird and bat species, for example, are attracted to insects around lights. As a consequence of this, they could become prey for larger predators (e.g. owls) which may lead to changes in population structure and community composition.

#### **D4.7 VEHICULAR TRAFFIC MOVEMENTS**

Vehicular traffic movements associated with the construction and operation of the Snapper Mine have the potential to increase the incidence of mortality of fauna caused by traffic.

#### **D4.8 BUSHFIRE RISK**

'High frequency fire resulting in the disruption of lifecycle processes in plants and animals, and loss of vegetation structure and composition' is listed as a key threatening process under the TSC Act.

Measures to avoid the risk of bushfire are provided in Section D5.

#### D4.9 INFECTION OF FROGS BY AMPHIBIAN CHYTRID

'Infection of frogs by amphibian chytrid causing the disease *Chytridiomycosis*' is listed as a key threatening process under the TSC Act.

Measures to avoid and mitigate impacts from amphibian chytrid are provided in Section D5.

#### D4.10 THREATENED FAUNA SPECIES

Table D-1 in Section D1.5 provides a list of threatened fauna species which are known or considered likely to occur within the wider region. This list of threatened fauna species was refined to a list of threatened fauna species with *potential* habitat components likely to occur in the study area (Table D-8), based on the occurrence of *potential* or *known* habitat and distribution of the species.

**Table D-8**  
**Threatened Fauna Species with Habitat Components Known or Considered Likely to Occur within the Study Area**

Scientific Name	Common Name	Conservation Status <sup>1</sup>	
		TSC Act	EPBC Act
<b>Amphibians</b>			
<i>Neobatrachus pictus</i>	Painted Burrowing Frog	E	-
<b>Reptiles</b>			
<i>Diplodactylus elderi</i>	Jewelled Gecko	V	-
<i>Diplodactylus stenodactylus</i>	Crowned Gecko	V	-
<i>Delma australis</i>	Marble-faced Delma	E	-
<i>Ctenotus brooksi</i>	Wedgesnout Ctenotus	V	-
<i>Cyclodomorphus melanops elongatus</i>	Slender Mallee Blue-tongued Lizard	E	-
<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard	V	-
<b>Birds</b>			
<i>Leipoa ocellata</i>	Malleefowl	E	-
<i>Falco hypoleucos</i>	Grey Falcon	V	-
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard	V	-
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-
<i>Calamanthus cautus</i>	Shy Heathwren	V	-
<i>Cinclosoma castanotus</i>	Chestnut Quail-thrust	V	-
<i>Calamanthus fuliginosus</i>	Striated Fieldwren	V	-
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	V	-
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	-
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	V	-
<i>Manorina melanotis</i>	Black-eared Miner	E	E
<i>Pyrrholaemus brunneus</i>	Redthroat	V	-
<b>Mammals</b>			
<i>Nyctophilus timoriensis</i>	Eastern Long-eared Bat (south-eastern form)	V	V
<i>Chalinolobus picatus</i>	Little Pied Bat	V	-
<i>Vespadelus baverstocki</i>	Inland Forest Bat	V	-
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-

<sup>1</sup> Conservation Status  
NSW TSC Act  
Commonwealth EPBC Act  
V Vulnerable  
E Endangered

The Striated Fieldwren (*Calamanthus fuliginosus*) is not included in Table D-1 in Section D1.5, however this species is assessed below on advice from the DEC.

The Freckled Duck (*Stictonetta naevosa*), Blue-billed Duck (*Oxyura australis*), Regent Parrot (eastern subsp.) (*Polytelis anthopeplus monarchoides*) and Barking Owl (*Ninox connivens*) were recorded by MKES (2001) during fauna surveys for the Ginkgo Mine in habitat proximal to the Darling River. Habitat components for these species are not considered likely to occur within the study area.

Although marginal potential habitat occurs in the study area for the Pied Honeyeater (*Certhionyx variegatus*) (e.g. mistletoe), the study area is considered to be at the edge of this species range. Therefore, habitat components for this species are not considered likely to occur within the study area.

As indicated in Table D-1, it is considered unlikely that the following species could occur within the study area given limited habitat and degree of habitat disturbance: Southern Ningauai (*Ningauai yvonneae*), Southern Hairy-nosed Wombat (*Lasiorhinus latifrons*) and the Western Pygmy-possum (*Cercartetus concinnus*). Furthermore the following species that once were present in the region are now believed to be extinct: Numbat (*Myrmecobius fasciatus*), Pig-footed Bandicoot (*Chaeropus ecaudatus*), Burrowing Bettong (*Bettongia lesueur*), Eastern Hair-wallaby (*Lagorchestes leporides*), Greater Stick-nest Rat (*Leporillus conditor*) and Mitchell's Hopping Mouse (*Notomys mitchelli*).

Further, habitat components for the Red-lored Whistler (*Pachycephala rufogularis*) and Gilbert's Whistler (*Pachycephala inornata*) are not considered likely to occur within the study area.

There are numerous records for the Brown Treecreeper in the region. The Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) is listed as 'Vulnerable' under the NSW TSC Act. The study area is considered to be located outside the distribution of the threatened Brown Treecreeper (eastern subspecies) and within the distribution of the Brown Treecreeper western arid zone subspecies (*Climacteris picumnus picumnus*) which is not threatened.

Sections D4.10.1 to D4.10.24 assess the likelihood of the threatened fauna species or their habitats listed in Table D-8 being affected by the Snapper Mine.

For the purpose of this assessment, *known* habitat is considered to be habitat in which the species has been recorded, while, *potential* habitat is considered to be habitat in which the species has not been recorded but may potentially utilise.

#### **D4.10.1 Painted Burrowing Frog (*Neobatrachus pictus*)**

##### **Background**

The Painted Burrowing Frog (*Neobatrachus pictus*) breeds in summer, autumn or winter, yet only after heavy rain (DEC, 2006c), usually >25 mm in 24 hours (Roberts, 1978 in NPWS, 2000a). The Painted Burrowing Frog has been recorded breeding in February, March, April, throughout winter and early spring (*ibid.*). Breeding periods are short, rarely lasting more than a few days (*ibid.*).

Breeding sites include shallow, temporary pools such as flooded ditches and clay pans, in ponds, dams and swamps (Roberts, 1978 in NPWS, 2000a; Walker and Goonan, 2001). Mating pairs have been observed on land where they were apparently moving towards pools (NPWS, 2000a). Eggs are deposited by the female in large clumps or in long strands (Roberts, 1978 in NPWS, 2000a), often entwined with submerged vegetation (Walker and Goonan, 2001). Initially stuck together with jelly, the egg mass soon breaks down and the eggs sink to the bottom of the pond (Roberts, 1978 in NPWS, 2000a).

The diet of adult Painted Burrowing Frogs is unknown, however, is considered likely to be similar to that of other burrowing frogs, consisting of a wide variety of arthropods, in particular termites (Calaby, 1960 in NPWS, 2000a). Tadpoles feed on plant and insect material (Tyler, 1976 in NPWS, 2000a).

*Neobatrachus* species burrow beneath the soil surface and begin aestivation when free water is no longer available (Withers, 1995 in NPWS, 2000a). At the onset of aestivation, *Neobatrachus* assume a 'water-conserving' posture and become inactive. The Painted Burrowing Frog may stay in this dormant state for up to six years (Lee and Mercer, 1967 in NPWS, 2000a). Burrowing frogs emerge at the onset of rain or free water when they are able to absorb water rapidly and reproduce (Warburg, 1967 in NPWS, 2000a; Predavec and Dickman, 1993).

Individuals are active following significant rain, and have been observed near flooded dams, ditches, claypans, on roads, grassy marshes, lagoons and around swamps (Roberts, 1978 in NPWS, 2000a; Cogger, 2000; Walker and Goonan, 2001; DEC, 2006c).

The Painted Burrowing Frog has frequently been confused with Sudell's Frog (*N. sudelli*) and the Trilling Frog (*N. centralis*) (NPWS, 2000a). In south-western NSW, it is considered likely that *N. pictus* and *N. centralis*/*N. sudelli* are probably sympatric (i.e. populations of two or more species, whose geographical ranges or distributions coincide or overlap) and have been known to hybridise in other parts of their range (M. Mahony, pers. comm., in NPWS, 2000a).

Threats relevant to the Painted Burrowing Frog include (DEC, 2006c):

- Activities that disturb the soil in which this species burrows.
- Altered flooding regimes (timing, frequency and extent of flooding) may prevent the emergence and breeding activities of this species.
- Soil compaction from machinery and domestic stock.
- Loss of leaf litter, fallen timber, bark and other ground cover.
- Due to the small population size and extent, the species is susceptible to catastrophic events and localised extinction.
- Pollution of water bodies from farming and industrial chemicals.
- Predation of tadpoles by exotic fish species and common rats and predation of adults by foxes and feral cats.
- Possible infection and death from water borne pathogens such as Chytrid Fungus.

As described in Section D1.3, the study area is situated within the MDD IBRA Region, which spans NSW, South Australia and Victoria. *N. pictus* is widely distributed across the MDD IBRA Region and other IBRA Regions in southern South Australia and western Victoria (Cogger, 2000; NPWS, 2000a). The Painted Burrowing Frog was previously known only from South Australia and Victoria, until 1995 when it was recorded in Scotia Sanctuary in the far west of NSW (NPWS, 2000a; DEC, 2006c). Since 1995, the Painted Burrowing Frog has also been recorded at four locations approximately 20-40 km west of Pooncarie by MKES (2001) during fauna surveys for the Ginkgo Mine. The extent of the Painted Burrowing Frogs occurrence in NSW is largely unknown.

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine. While conditions during 2006 were not ideal for observing this species as >25 mm of rain in 24 hours had not occurred in the area, suitable conditions occurred in January 2007 and a targeted survey for the frog was conducted by Biosphere Environmental Consultants (unpublished report). The Painted Burrowing Frog was not recorded, despite the targeted survey during suitable conditions. Nonetheless, monitoring for the Painted Burrowing Frog in the Snapper Mine area and surrounds would occur when suitable conditions are present as discussed further in Section D5.

## Evaluation

### 1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Painted Burrowing Frog has non-specific lifecycle requirements through all stages of its lifecycle (i.e. breeding requires pools of free water, foraging requires anything from vegetative parts to insects for tadpoles and a wide variety of insects for adults, and substrates suitable for burrowing are required for aestivation). The Painted Burrowing Frog is also an ubiquitous species which has no obvious habitat preferences, as it found in a wide range of arid and semi-arid areas including woodland, mallee, shrubland, heathland, open grassland and a variety of disturbed areas (including farmland and house gardens) (Roberts, 1978 in NPWS, 2000a; NPWS, 2000a; Robinson, 2000; Walker and Goonan, 2001; DEC, 2006c).

It is possible that a local population of the Painted Burrowing Frog could utilise potential habitat resources within the Snapper Mine area given records of the species approximately 10 km north-east of the MLA area (MKES, 2001). However, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species (if the species were to occur in the Snapper Mine area) given:

- records of the species, and *known* habitat for the species, occur outside the Snapper Mine area; and
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5).

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Painted Burrowing Frog after consideration of the draft Priorities Action Statement (PAS) (DEC, 2006c), including:

- **Painted Burrowing Frog Monitoring** – monitoring for the Painted Burrowing Frog in the Snapper Mine area and surrounds would occur during suitable conditions as discussed further in Section D5.
- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation.
- **Threatened Species Management Protocol** – if a Painted Burrowing Frog is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.
- **Control of Introduced Animal Fauna** – measures would be implemented to control the potential adverse impacts of feral animals on the Painted Burrowing Frog.
- **Bushfire Risk Management** – implementation of a management plan to reduce the risk of bushfire.
- **Vehicular Traffic Management** – includes minimisation of the number of roads constructed for the Snapper Mine, employees and contractors would be instructed to only use the Snapper Mine roads, speed limits would be imposed on vehicles using the Snapper Mine roads and tracks and signposting would be installed to remind personnel of the danger of vehicles to wildlife.

These measures are further discussed in Section D5.

**2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

MKES (2001) recorded the Painted Burrowing Frog within Black Oak-Rosewood Woodland, a mixture of Chenopod and Speargrass and also within open cleared areas. Due to the ubiquitous nature of this species, the entire study area (approximately 1,630 ha) conservatively represents potential habitat for this species. However, the potential habitat which occurs within the study area is not unique and occurs throughout the majority of the wider region. There is no indication that the habitat resources within the study area provide more significant habitat for this species.

**3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Painted Burrowing Frog and does not represent a distributional limit for this species.

**4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Painted Burrowing Frog are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Painted Burrowing Frog):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the ground disturbance impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine has the potential to increase animal pest populations within the study area without the appropriate avoidance and mitigation measures outlined in Section D5.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an Emergency Response Plan (ERP) as described in Section D5.
- The Snapper Mine has the potential to increase soil compaction within the study area without the appropriate avoidance and mitigation measures outlined in Section D5 (e.g. vehicular traffic management).

**5. How is the proposal likely to affect habitat connectivity?**

The area of *known* or *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the ubiquitous nature of the species and connectivity of the surrounding habitat.

**6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of the Department of Environment and Heritage (DEH) (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of the DPI (DPI, 2006) or identified within the *Wentworth Local Environmental Plan 1993* (Wentworth LEP). Therefore, the Snapper Mine would not affect critical habitat for this species.

#### D4.10.2 Jewelled Gecko (*Diplodactylus elderi*)

##### **Background**

The Jewelled Gecko (*Diplodactylus elderi*) is restricted to Spinifex (*Triodia* sp.) habitat on red soils, usually in association with mallee woodlands (Sadler *et al.*, 1996 in DEC, 2006c). The species is entirely dependent on Spinifex clumps for shelter and foraging (DEC, 2006c). Individuals are generally found within relatively large, mature clumps in areas that are not frequently burnt (*ibid.*).

The Jewelled Gecko is nocturnal, foraging at night within or on the exterior portion of a clump of live hummock grass such as Spinifex (DEC, 2006c). The species are semi-arboreal and climb around grass clumps with the assistance of a semi-prehensile tail, which is used to grasp objects such as grass stems (*ibid.*). During the day, the Jewelled Gecko seeks refuge inside hummock grass and may also occupy underground burrows beneath Spinifex (*ibid.*).

The Jewelled Gecko eats a variety of insects including small crickets, caterpillars, grubs, termites, spiders, cockroaches and moths (DEC, 2006c).

Threats relevant to the Jewelled Gecko include (DEC, 2006c):

- *'Habitat clearance, in particular, clearing of Triodia (spinifex) grasslands either with or without a mallee overstorey, usually for agricultural purposes, i.e. wheat growing.*
- *Fire frequency, which directly affects the amount of cover provided by mallee trees and Triodia species. Alteration of fire frequency may reduce the availability of suitable habitat and food species.*
- *Predation by foxes and cats is possible given the feeding habits and activity times of this species.*
- *Heavy grazing and trampling of habitat and food resources by domestic stock, feral goats, rabbits and pigs.'*

The Jewelled Gecko is distributed through the arid regions of north-western Australia, through central Australia to southern Australia. In NSW records of the species are largely confined to the south-west of the state (DEC, 2006c). The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates the Jewelled Gecko has been recorded at eight locations in the region (i.e. Popiltah, Para and Arumpo 1:100,000 map sheets) the closest of which is approximately 10 km east of the MLA area. The Jewelled Gecko was also recorded by MKES (2001) during fauna surveys for the Ginkgo Mine, although MKES (2001) did not give a scientific name or describe the location at which the species was recorded. Therefore there is a degree of uncertainty with respect to this species identification by MKES (2001).

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine (Section D3.3).

## Evaluation

### 1. **How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Jewelled Gecko could utilise potential habitat resources within the Study area, given that this species was recorded by MKES (2001). The Jewelled Gecko is restricted to Spinifex (*Triodia* spp.) habitat on red soils, usually in association with mallee woodlands (Sadler *et al.*, 1996 in DEC, 2006b). While Mallee Shrubland occurs within the MLA area, only a small portion would be cleared/modified for the Snapper Mine (in the order of 16 ha). Further, the pastoral leaseholder of the land underlying the MLA area has indicated that the Mallee within the Study area has been frequently and recently (2005) burnt, which would reduce the likelihood that the species would utilise the potential habitat.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Jewelled Gecko after consideration of the draft PAS (DEC, 2006c), including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation.
- **Threatened Species Management Protocol** – if a Jewelled Gecko is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.
- **Control of Introduced Animal Fauna** – measures would be implemented to control the potential adverse impacts of feral animals on the Jewelled Gecko.
- **Vehicular Traffic Management** – includes minimisation of the number of roads constructed for the Snapper Mine and employees and contractors would be instructed to only use the Snapper Mine roads.
- **Bushfire Risk Management** – implementation of a management plan to reduce the risk of bushfire.

These measures are further discussed in Section D5.

### 2. **How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The Jewelled Gecko is restricted to Spinifex (*Triodia* spp.) habitat on red soils, usually in association with mallee woodlands (Sadler *et al.*, 1996 in DEC, 2006b). While Mallee Shrubland occurs within the MLA area and associated infrastructure areas, only a small portion would be cleared/modified for the Snapper Mine (in the order of 16 ha).

### 3. **Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Jewelled Gecko and does not represent a distributional limit for this species.

#### **4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Jewelled Gecko are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Jewelled Gecko):

- The Snapper Mine has the potential to increase animal pest populations within the study area without the appropriate avoidance and mitigation measures outlined in Section D5.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP as described in Section D5.

#### **5. How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat or *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the minimal disturbance to potential habitat for this species and the connectivity of the surrounding potential habitat (Figure D-5).

#### **6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

### **D4.10.3 Crowned Gecko (*Diplodactylus stenodactylus*)**

#### **Background**

The Crowned Gecko (*Diplodactylus stenodactylus*) has a large range of habitat preferences in NSW (DEC, 2006c) and is described as widespread through a variety of habitats in arid and semi-arid areas (Wilson and Swan, 2005). The species has been reported as known or predicted to occur anywhere from red sand habitats, savannah woodland and stony areas with shrubs (NSW Scientific Committee, 2004a).

The Crowned Gecko is a nocturnal species that forages on small insects within the shrub understorey or tussock grass ground layers (DEC, 2006c).

Threats relevant to the Crowned Gecko include (DEC, 2006c):

- *'Grazing by introduced herbivores affects the density and structure of spinifex, adjacent shrubs and ground cover. This may reduce habitat quality and increase the risk of predation for individuals moving between patches of vegetation.'*
- *'Fragmentation of populations increases the risk of extinction due to genetic effects and chance events (e.g., drought and fire).'*
- *'Predation by foxes or cats.'*

The distribution of the Crowned Gecko is heavily fragmented. Distribution stretches from the west and north-west coast of Western Australia through the Northern Territory and across central Australia into NSW (Cogger, 2000; NSW Scientific Committee, 2004a). In NSW, the species has been recorded at four separate locations in the state's far west: 21 records from Sturt National Park; a 1995 record from Mutawintji National Park; a 1991 record from near Lilly Loch, 125 km south of Broken Hill; and eight records from 1981 near Thurloo Downs, 145 km east of Tibooburra (NSW Scientific Committee, 2004a). There are no records of the Crowned Gecko in the DEC Atlas of NSW Wildlife (DEC, 2006a) in the region (i.e. Popiltah, Cuthero, Pooncarie, Bunnerungee, Para and Arumpo 1:100,000 map sheets). No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area and this species was not recorded during targeted surveys for the Snapper Mine (Section D3.3).

The Crowned Gecko was recorded by MKES (2001) during fauna surveys for the Ginkgo Mine. MKES (2001) did not describe the location at which the species was recorded and does not identify the species to scientific name. Therefore there is a degree of uncertainty with respect to this species identification by MKES (2001).

### **Evaluation**

#### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Crowned Gecko could utilise potential habitat resources within the Snapper Mine area given MKES (2001) indicates this species has been locally recorded. Although, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species (if the species were to occur in the Snapper Mine area) given:

- records of the species, and *known* habitat for the species, occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of the Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Crowned Gecko after consideration of the draft PAS (DEC, 2006c), including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation.
- **Threatened Species Management Protocol** – if a Crowned Gecko is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.
- **Control of Introduced Animal Fauna** – measures would be implemented to control the potential adverse impacts of feral animals on the Crowned Gecko.
- **Vehicular Traffic Management** – includes minimisation of the number of roads constructed for the Snapper Mine and employees and contractors would be instructed to only use the Snapper Mine roads.

These measures are further discussed in Section D5.

**2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), some of which may represent potential habitat for the Crowned Gecko.

**3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Crowned Gecko and does not represent a distributional limit for this species.

**4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Crowned Gecko are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Crowned Gecko):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine has the potential to increase animal pest populations within the study area without the appropriate avoidance and mitigation measures outlined in Section D5.

**5. How is the proposal likely to affect habitat connectivity?**

An area of *known* or *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the connectivity of the surrounding potential habitat (Figure D-5).

**6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

#### **D4.10.4 Marble-faced Delma (*Delma australis*)**

##### **Background**

The Marble-faced Delma is usually found in temperate mallee woodlands or spinifex grasslands but also in chenopod shrublands, heathlands and Bulloak associated with mallee habitats or from eucalypt lined watercourses (DEC, 2006c). The species is also found in deep leaf litter, under rocks, logs, fallen timber or in grass clumps such as spinifex (*ibid.*). They occupy areas with a sandy substrate but may also make use of cracking red loam soils (*ibid.*).

The Marble-faced Delma's breeding habitat is described as loose surface rocks, tussock clumps, leaf litter, fallen timber, sandy substrates or cracking red loam soils (DEC, 2006c).

The Marble-faced Delma has a diet that consists of various types of insects and spiders (DEC, 2006c).

The Marble-faced Delma is generally active during the day but has been observed being active at night or around sunrise and sunset (DEC, 2006c). They are considered to be terrestrial but they may climb into hummock grass and even sleep in the branches of small shrubs (*ibid.*).

Threats relevant to the Marble-faced Delma include (DEC, 2006c):

- *'Habitat clearance, in particular, clearing of mallee areas containing Triodia (spinifex) usually for agricultural purposes but also heathland and riparian habitats.*
- *Fire frequency, which directly affects the amount of cover provided by mallee trees and Triodia species. Alteration of fire frequency may reduce the availability of suitable habitat and food species.*
- *Predation by foxes is possible given the feeding habits and activity times of this species.*
- *Heavy grazing and trampling of habitat and food resources by domestic stock, feral goats, rabbits and pigs.*
- *Loss of leaf litter, surface rocks, fallen timber & bark and other ground cover, which supports not only this species but also its food species.'*

The Marble-faced Delma is distributed from southern Western Australia, through South Australia and the south of the Northern Territory, to north-western Victoria and western NSW (NSW Scientific Committee, 2004b). In NSW, the species occurs at scattered locations within two separate populations: in central-western NSW in the vicinity of Round Hill and Yathong Nature Reserves; and in the south-western corner of the state (*ibid.*). There are two records of the Marble-faced Delma in the DEC Atlas of NSW Wildlife (DEC, 2006a) in the region (i.e. Popiltah and Bunnerungee 1:100,000 map sheets), both of which are greater than 50 km west of the study area.

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine (Section D3.3), or during surveys for the Ginkgo Mine and infrastructure (MKES, 2001).

## **Evaluation**

### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Marble-faced Delma could occur in the Snapper Mine area given the occurrence of marginal *potential* habitat resources within the species range, however it is unlikely that a local population of the Marble-faced Delma occurs within the Snapper Mine area given the lack of records nearby (despite targeted surveys). Therefore, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species.

### **2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6) some of which may represent potential habitat for the Marble-faced Delma.

**3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Marble-faced Delma and does not represent a distributional limit for this species.

**4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Marble-faced Delma are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Marble-faced Delma):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine has the potential to increase animal pest populations within the study area without the appropriate avoidance and mitigation measures outlined in Section D5.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP as described in Section D5.

**5. How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the species has not been recorded near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the minimal disturbance to potential habitat for this species and the connectivity of the surrounding potential habitat (Figure D-5).

**6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

**D4.10.5 Wedgesnout Ctenotus (*Ctenotus brooksi*)**

**Background**

The Wedgesnout Ctenotus (*Ctenotus brooksi*) occurs in desert sand ridge arid and semi-arid habitats (DEC, 2006c). The species may be very specialised as it has only been recorded from large unconsolidated sand dunes and not from the low consolidated red sand ridges that occur in the east of Sturt National Park (NSW Scientific Committee, 2005). The Wedgesnout Ctenotus prefers areas of loose sand interspersed with vegetation on and near the crests of dunes (*ibid.*) and it is probably restricted to habitats containing *Triodia spinifex* (Sadler and Pressey, 1994 in DEC, 2006c).

The Wedgesnout Ctenotus is diurnal and feeds on a variety of small invertebrates (DEC, 2006c).

Threats relevant to the Wedgesnout Ctenotus include (DEC, 2006c):

- *'Fragmentation, resulting from clearing or degradation of habitat, may reduce the size of populations and increase the extent to which they are isolated. Small, isolated populations have a greater risk of extinction due to genetic effects and chance events (e.g., drought and fire).*
- *Degradation of the habitat, a result of inappropriate grazing or fire regimes, may result in changes to the physical and biological nature of the habitat (e.g., changes in the structure and floristics of vegetation, diversity and abundance of invertebrates). These changes may render habitat unsuitable or increase the risk posed by other threatening processes (e.g., predation).*
- *Fire may cause the direct loss of individuals.*
- *Predation by foxes or cats, particularly where populations have already declined.*
- *Catastrophic events such as drought or extensive wildfire.*
- *Anthropogenic climate change is a long term threat as it may alter habitat characteristics (e.g., change in physical structure or productivity) such that its capacity to support viable populations is reduced.'*

The distribution of Wedgesnout Ctenotus is heavily fragmented, and it is known from a few records all from Sturt and Paroo-Darling National Parks (DEC, 2006c). There are no records of the Wedgesnout Ctenotus in the DEC Atlas of NSW Wildlife (DEC, 2006a) in the region (i.e. Popiltah, Cuthero, Pooncarie, Bunnerungee, Para and Arumpo 1:100,000 map sheets). The Wedgesnout Ctenotus may have been recorded by MKES (2001) during fauna surveys for the Ginkgo Mine. However, MKES (2001) does not give their record a scientific name or describe the location at which the species was recorded.

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine (Section D3.3).

### **Evaluation**

#### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Wedgesnout Ctenotus could utilise potential habitat resources within the Snapper Mine area given this species may have been previously recorded by MKES (2001). Although, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species (if the species were to occur in the Snapper Mine area) given:

- the species may be very specialised, as it has only been recorded from large unconsolidated sand dunes and not from the low consolidated red sand ridges that occur in the east of Sturt National Park (NSW Scientific Committee, 2005);
- records of the species, and *known* habitat for the species, occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of the Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Wedgesnout Ctenotus after consideration of the draft PAS (DEC, 2006c), including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation.
- **Threatened Species Management Protocol** – if a Wedgesnout Ctenotus is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.
- **Control of Introduced Animal Fauna** – measures would be implemented to control the potential adverse impacts of feral animals on the Wedgesnout Ctenotus.
- **Vehicular Traffic Management** – includes minimisation of the number of roads constructed for the Snapper Mine and employees and contractors would be instructed to only use the Snapper Mine roads.
- **Bushfire Risk Management** – implementation of a management plan to reduce the risk of bushfire.

These measures are further discussed in Section D5.

**2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6) some of which may represent potential habitat for the Wedgesnout Ctenotus.

**3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the southern area of the known distribution of the Wedgesnout Ctenotus and may represent a distributional limit for this species (were it to occur in the study area).

**4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Wedgesnout Ctenotus are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Wedgesnout Ctenotus):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine has the potential to increase animal pest populations within the study area without the appropriate avoidance and mitigation measures outlined in Section D5.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP as described in Section D5.

### 5. **How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat or *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

### 6. **How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

#### D4.10.6 Slender Mallee Blue-tongue Lizard (*Cyclodomorphus melanops elongatus*)

##### **Background**

The Slender Mallee Blue-tongue Lizard (*Cyclodomorphus melanops elongatus*) is restricted to mallee woodlands with a spinifex, *Triodia* spp., understorey on a sandy or mixed sand/gravel substrate (plains, ridges or hillslopes) (Sadler *et al.*, 1996 in DEC, 2006c). Individuals are usually found within relatively large, mature spinifex clumps in areas that are not frequently burnt (DEC, 2006c). The species is also found under rock slabs, leaf litter, fallen timber or vegetation (*ibid.*).

The Slender Mallee Blue-tongue Lizard is entirely dependent on spinifex clumps for shelter and foraging sites (DEC, 2006c). They usually eat spiders, termites, grasshoppers, cockroaches, small snails, moths, beetles, small lizards, flowers and fleshy leaves and fruit (*ibid.*).

The Slender Mallee Blue-tongue Lizard is a solitary and nocturnal creature, these animals can be active or opportunistic hunters, often waiting in the cover of vegetation from which they ambush their prey (DEC, 2006c). Foraging movements can range from plains to ridges and hillslopes but are limited to areas of spinifex as described above (*ibid.*).

Threats relevant to the Slender Mallee Blue-tongue Lizard, include (DEC, 2006c):

- *'Habitat clearance, in particular, clearing of mallee areas containing Triodia (spinifex) usually for agricultural purposes, i.e. wheat growing.*
- *Fire frequency, which directly affects the amount of cover provided by mallee trees and Triodia species. Alteration of fire frequency may reduce the availability of suitable habitat and food species.*
- *Predation by foxes is possible given the feeding habits and activity times of this species.*
- *Heavy grazing and trampling of habitat and food resources by domestic stock, feral goats, rabbits and pigs.*
- *Loss of leaf litter, surface rocks, fallen timber & bark and other ground cover.'*

The Slender Mallee Blue-tongue Lizard is distributed from southern Western Australia, through South Australia to the south-western corner of NSW (NSW Scientific Committee, 2004c). In NSW from Coombah Roadhouse and Pooncarie in the north, south to the riparian vegetation on the Murray River, west to the border and east to Mungo National Park (DEC, 2006c). The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates the Slender Mallee Blue-tongue Lizard has been recorded at two locations in the region (i.e. Para 1:100,000 map sheet) the closest of which is approximately 40 km south of the MLA area, east of the Darling River.

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine (Section D3.3), or during surveys for the Ginkgo Mine and infrastructure (MKES, 2001).

### **Evaluation**

#### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Slender Mallee Blue-tongue Lizard could occur in the Snapper Mine area given the occurrence of marginal *potential* habitat resources within the species range, however it is unlikely that a local population of the Slender Mallee Blue-tongue Lizard occurs given the lack of records near the Snapper Mine area (despite targeted surveys). Therefore it is considered unlikely that the Snapper Mine would affect the lifecycle of the species.

#### **2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6) some of which may represent potential habitat for the Slender Mallee Blue-tongue Lizard.

#### **3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Slender Mallee Blue-tongue Lizard and does not represent a distributional limit for this species.

#### **4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Slender Mallee Blue-tongue Lizard are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Slender Mallee Blue-tongue Lizard):

- The Snapper Mine is unlikely to increase the disturbance of *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified, via disturbance to the soil and relocation of leaf litter, fallen timber, bark and other groundcover. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine has the potential to increase animal pest populations within the study area without the appropriate avoidance and mitigation measures outlined in Section D5.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP as described in Section D5.

#### 5. **How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the species has not been recorded near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the minimal disturbance to potential habitat for this species and the connectivity of the surrounding potential habitat (Figure D-5).

#### 6. **How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

#### D4.10.7 Western Blue-tongued Lizard (*Tiliqua occipitalis*)

##### **Background**

The Western Blue-tongued Lizard (*Tiliqua occipitalis*) inhabits dry to open arid areas with shrublands, heaths and mallee woodlands with Spinifex (Wilson and Swan, 2005). Its preferred vegetation type appears to be mixed mallee/Triodia communities (DEC, 2006c). A dense shrub layer is also important for the Western Blue-tongued Lizard (Sadlier *et. al.*, 1996 in Val *et. al.*, 2001).

The Western Blue-tongued Lizard is a diurnal species which is known to utilise rabbit burrows for shelter (Swan, 1990 in Ayers *et al.*, 1996). The species feed on insects, snails, native vegetation and carrion (*ibid.*).

Threats relevant to the Western Blue-tongued Lizard include (DEC, 2006c):

- *'Clearing and heavy grazing of mallee destroys or fragments habitat.'*
- *Ripping of rabbit warrens potentially reduces shelter.*
- *Predation by foxes and cats may be problematic.'*

The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates the Western Blue-tongued Lizard has been recorded at two locations in the region (i.e. Cuthero and Bunnerungee 1:100,000 map sheets) the closest of which is approximately 900 m north of the MLA area.

The Western Blue-tongued Lizard was also recorded by MKES (2001) during fauna surveys for the Ginkgo Mine and during targeted surveys for the Snapper Mine (Section D3.3) from a single recently shed skin (Figure D-8).

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area.

## Evaluation

### 1. **How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

*Known* habitat resources for the Western Blue-tongued Lizard occur within the Snapper Mine area given this species was recorded in habitat consisting of open grassland/shrubland with scattered trees within the MLA area (Figure D-8). Although, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species given:

- records of the species, and *known* habitat for the species also occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of the Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Western Blue-tongued Lizard after consideration of the draft PAS (DEC, 2006c), including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation.
- **Threatened Species Management Protocol** – if a Western Blue-tongued Lizard is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.
- **Control of Introduced Animal Fauna** – measures would be implemented to control the potential adverse impacts of feral animals on the Western Blue-tongued Lizard.
- **Vehicular Traffic Management** – includes minimisation of the number of roads constructed for the Snapper Mine, employees and contractors would be instructed to only use the Snapper Mine roads, speed limits would be imposed on vehicles using the Snapper Mine roads and tracks, and signposting would be installed to remind personnel of the danger of vehicles to wildlife.

These measures are further discussed in Section D5.

### 2. **How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6) some of which represents *known* and *potential* habitat for the Western Blue-tongued Lizard.

### 3. **Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Western Blue-tongued Lizard and does not represent a distributional limit for this species.

#### **4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Western Blue-tongued Lizard are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Western Blue-tongued Lizard):

- As stated above, the Snapper Mine would involve some clearance and modification of *known* and *potential* habitat for this species. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine has the potential to increase animal pest populations within the study area without the appropriate avoidance and mitigation measures outlined in Section D5.

#### **5. How is the proposal likely to affect habitat connectivity?**

The Snapper Mine may potentially reduce habitat connectivity for this species. However, an area of *known* habitat or *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

#### **6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

### **D4.10.8 Malleefowl (*Leipoa ocellata*)**

#### **Background**

The Malleefowl (*Leipoa ocellata*) utilises trees and low bushes for roosting and perching at night (Marchant and Higgins, 1993; Lindsey, 1992). Nesting takes place in areas with light soils and abundant litter for constructing the egg-incubating mounds (Marchant and Higgins, 1993; Benshemesh, 2000). The litter within the mounds must be dampened for it to decompose and provide heat for incubation, hence this species prefers mallee areas receiving reliable winter rainfall (Brickhill, pers. comm., in Ayers *et al.*, 1996). Mound construction begins in autumn and eggs are laid from September to March/April (Schodde and Tidemann, 1997).

The Malleefowl forages mainly in open areas near mallee (Ayers *et al.*, 1996) and largely on insects, flowers and green shoots, as well as fruits and seeds of Acacias and other shrubs (Lindsey, 1992). Malleefowl are strongly sedentary and territorial (Lindsey, 1992; Marchant and Higgins, 1993).

Threats relevant to the Malleefowl, include (DEC, 2006c):

- *Loss of habitat due to clearing has led to a decline in distribution and abundance.*
- *Fragmentation, resulting from clearing or degradation of habitat, may reduce the size of populations and increase the extent to which they are isolated. Small, isolated populations have a greater risk of extinction due to genetic effects and chance events (e.g., drought and fire).*

- *Degradation of the habitat, a result of inappropriate grazing or fire regimes, may result in changes to the physical and biological nature of the habitat (e.g., changes in the structure and floristics of vegetation, diversity and abundance of invertebrates). These changes may render habitat unsuitable or increase the risk posed by other threatening processes (e.g., predation).*
- *Fire removes litter for mound construction, shelter from predators, and food sources, especially seeds. Mounds are not usually constructed in an area within 15-20 years after a fire and it may be 40 years before maximum densities are attained.*
- *Predation by foxes or cats has a significant impact on populations.*
- *Catastrophic events such as drought or extensive wildfire. Climate change may increase the intensity and frequency of such events.*
- *Accidental death of a small number of birds occurs each year. For small isolated population these losses can be significant. Birds crossing roads or feeding on spilt grain beside roads are particularly vulnerable.*
- *Anthropogenic climate change is a long term threat as it may alter habitat characteristics (e.g., change in physical structure or productivity) such that its capacity to support viable populations is reduced.'*

The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates the Malleefowl has been recorded at 16 locations in the region (i.e. Popiltah, Bunnerungee, Para, Arumpo, Middle Camp and Wild Dog 1:100,000 map sheets) the closest of which is approximately 39 km south of the MLA area.

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine (Section D3.3), or during surveys for the Ginkgo Mine and infrastructure (MKES, 2001).

### **Evaluation**

#### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Malleefowl could occur in the Snapper Mine area given the occurrence of *potential* habitat resources within the species range, however it is unlikely that a local population of the Malleefowl occurs given the lack of records near the Snapper Mine area (despite targeted surveys). Therefore it is considered unlikely that the Snapper Mine would affect the lifecycle of the species.

#### **2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), some of which may represent potential habitat for the Malleefowl.

#### **3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Malleefowl and does not represent a distributional limit for this species.

#### 4. **How is the proposal likely to affect current disturbance regimes?**

The threats to the Malleefowl are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Malleefowl):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine has the potential to increase animal pest populations within the study area without the appropriate avoidance and mitigation measures outlined in Section D5.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP as discussed in Section D5.

#### 5. **How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the species has not been recorded near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the minimal disturbance to potential habitat for this species and the connectivity of the surrounding potential habitat (Figure D-5).

#### 6. **How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

### D4.10.9 Grey Falcon (*Falco hypoleucos*)

#### **Background**

The Grey Falcon (*Falco hypoleucos*) inhabits flat, mainly treeless or lightly timbered plains with open drier vegetation types, including Acacia/low shrubland, Spinifex and tussock grasslands, as well as Eucalypt-lined watercourses (Ayers *et al.*, 1996).

The Grey Falcon roosts in live and dead trees, requiring large Eucalypts near water or a dry watercourse for nesting (Ayers *et al.*, 1996). Nests built by other species, particularly corvids, are often reused by the Grey Falcon (Olsen and Olsen, 1986; Lindsey, 1992).

Favouring lightly timbered plains and Eucalypt-lined watercourses, the Grey Falcon hunts either on the wing or from an exposed perch, feeding on birds, some small mammals and reptiles, occasional insects and rarely carrion (Barker and Vestjens, undated in Ayers *et al.*, 1996; Olsen and Olsen, 1986; Lindsey, 1992; Marchant and Higgins, 1993; Schodde and Tidemann, 1997; Slater *et al.*, 1999).

Some pairs of the Grey Falcon are resident, others are dispersive or migratory with parts of the population undergoing seasonal (autumn) movements north (Pizzey and Knight, 1980 in Ayers *et al.*, 1996; Olsen and Olsen, 1986; Pizzey and Knight, 1999).

Threats relevant to the Grey Falcon, include (DEC, 2006c):

- *'Grazing and clearing of arid and semi-arid zone rangelands.*
- *Secondary poisoning through mouse and locust control programs.*
- *Taking of eggs and young for collections and falconry.'*

The Grey Falcon is distributed throughout arid and semi-arid Australia, including the Murray-Darling basin, Eyre basin, central Australia and Western Australia (Garnett and Crowley, 2000) where less than 250 mm annual rainfall occurs (Brouwer and Garnett, 1990). In drought years it may be sighted throughout continental Australia including the central tablelands and east of the Great Dividing Range (Blakers *et al.*, 1984; Olsen and Olsen, 1986; Pizzey and Knight, 1999). The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates *F. hypoleucos* has been recorded at four locations in the region (i.e. Popiltah and Para 1:100,000 map sheets) the closest of which is approximately 32 km south of the MLA area.

While the Grey Falcon was recorded by MKES (2001) during fauna surveys for the Ginkgo Mine, the species was not recorded during targeted surveys for the Snapper Mine (Section D3.3).

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area.

### **Evaluation**

#### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Grey Falcon could utilise potential habitat resources within the Snapper Mine area given this species was recorded by MKES (2001) during fauna surveys of the Ginkgo Mine and infrastructure. Although, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species (if the species were to occur in the Snapper Mine area) given:

- records of the species, and *known* habitat for the species, occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of the Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Grey Falcon after consideration of the draft PAS (DEC, 2006c), including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation. Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Grey Falcon. The surveys would include observations to determine completion of nesting activities (i.e. young have left the nest and the nest is no longer used for nesting).
- **Threatened Species Management Protocol** – if a member of this species is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.

These measures are further discussed in Section D5.

**2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6) some of which may represent potential habitat for the Grey Falcon.

**3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Grey Falcon and does not represent a distributional limit for this species.

**4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Grey Falcon are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Grey Falcon):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.

**5. How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the species has not been recorded near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

**6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

#### D4.10.10 Square-tailed Kite (*Lophoictinia isura*)

##### **Background**

The Square-tailed Kite (*Lophoictinia isura*) inhabits dry woodland and open forest, while vegetation along major rivers and belts of trees in urban or semi-urban areas are favoured for hunting (NPWS, 2000b). In NSW, *L. isura* is often associated with ridge and gully forests dominated by Woollybutt (*Eucalyptus longiflora*), Spotted Gum (*C. maculata*) or Peppermint Gum (*E. elata*, *E. smithii*), however the species has also been sighted in forests containing other eucalypts, *Angophora* sp. and *Callitris* sp. with a shrubby understorey and Box-Ironbark Woodland (Debus and Czechura, 1989 in NPWS, 1999a).

The Square-tailed Kite breeds from July to December (Lindsey, 1992; Pizzey and Knight, 1999) and while little is known of its requirements for breeding in terms of habitat, it appears to need a large wooded area in the order of hundreds of hectares (Marchant and Higgins, 1993). Nests are constructed in a mature tree near an assured food supply and often within 100 m of a watercourse (Marchant and Higgins, 1993; Schodde and Tidemann, 1997). The nests of this species consist of large platforms made from sticks, which are lined with eucalypt leaves. Square-tailed Kites may re-use nests in successive years (Lindsey, 1992; Schodde and Tidemann, 1997).

The Square-tailed Kite specialises in taking small prey from the tree canopy, such as birds (including nestlings), reptiles and insects (Ayers *et al.*, 1996; Schodde and Tidemann, 1997), and rarely, if ever, visits the ground (NPWS, 2000b). It hunts primarily over open forest, woodlands and mallee communities that are rich in passerines, as well as over adjacent heaths and other low scrubby habitats and in wooded towns (Storr, 1980; Debus and Czechura, 1989 in Garnett and Crowley, 2000).

Resident pairs have a large hunting range of at least 100 km<sup>2</sup> (NPWS, 2000b). Records suggest that this species moves north to tropical areas in winter (Blakers *et al.*, 1984; Brouwer and Garnett, 1990), and Marchant and Higgins (1993 in Ayers *et al.*, 1996) describe the species as migratory across much of its distribution.

Threats relevant to the Square-tailed Kite include (DEC, 2006c):

- 'Clearing, logging, burning, and grazing of habitats resulting in a reduction in nesting and feeding resources.
- Disturbance to or removal of potential nest trees near watercourses.
- Illegal egg collection and shooting.'

The Square-tailed Kite is uncommon, yet widespread, occurring across most parts of NSW (Marchant and Higgins, 1993 in Ayers *et al.*, 1996; NPWS, 2000b). The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates the Square-tailed Kite has been recorded at 3 locations in the region (i.e. Popiltah and Bunnerungee 1:100,000 map sheets) the closest of which is approximately 50 km north-west of the MLA area.

While the Square-tailed Kite was recorded by MKES (2001) during fauna surveys for the Ginkgo Mine, the species was not recorded during targeted surveys for the Snapper Mine (Section D3.3).

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area.

## **Evaluation**

### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Square-tailed Kite could utilise potential habitat resources within the Snapper Mine area given this species was recorded by MKES (2001) during fauna surveys of the Ginkgo Mine and infrastructure. Although, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species (if the species were to occur in the Snapper Mine area) given:

- records of the species, and *known* habitat for the species, occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of the Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Square-tailed Kite after consideration of the draft PAS (DEC, 2006c), including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation. Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Square-tailed Kite. The surveys would include observations to determine completion of nesting activities (i.e. young have left the nest and the nest is no longer used for nesting).
- **Threatened Species Management Protocol** – if a member of this species is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.

These measures are further discussed in Section D5.

### **2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6) some of which may represent potential habitat for the Square-tailed Kite.

### **3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Square-tailed Kite and does not represent a distributional limit for this species.

#### **4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Square-tailed Kite are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Square-tailed Kite):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.

#### **5. How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the species has not been recorded near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the Snapper Mine and the mobility of the species.

#### **6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

### **D4.10.11 Black-breasted Buzzard (*Hamirostra melanosternon*)**

#### **Background**

The Black-breasted Buzzard (*Hamirostra melanosternon*) utilises a variety of open habitats (DEC, 2006c). In western NSW, this species is most frequently observed along watercourses (Ayers *et al.*, 1996) where it prefers tree-lined watercourses, billabongs and ephemeral lakes and the open woodlands of associated floodplains (Marchant and Higgins, 1993).

The Black-breasted Buzzard nests in mature, dead or partially dead eucalypts, often along timbered watercourses or near waterholes (Ayers *et al.*, 1996). This species constructs a large nest platform made of sticks in the fork of a tree lined with green leaves (Schodde and Tidemann, 1997). Adults probably mate permanently and hold or return to the same nest site each year. Breeding occurs from July to December (*ibid.*). Two eggs are normally laid (DEC, 2006c).

The Black-breasted Buzzard is a generalist and opportunist feeder, taking most of its prey from the ground (Marchant and Higgins, 1993). The diet of the Black-breasted Buzzard consists of live animals including reptiles, grasshoppers and a variety of birds and small mammals such as rabbits and sometimes wallabies (Schodde and Tidemann, 1997). The species also hunts over grasslands and sparsely timbered woodlands (DEC, 2006c).

This species has a large home range and is usually solitary, occasionally seen in pairs and rarely in small groups (Ayers *et al.*, 1996).

Threats relevant to the Black-breasted Buzzard, include (DEC, 2006c):

- *'Clearing of trees along inland watercourses.*
- *Degradation of foraging habitat through overgrazing and tree clearing.*
- *Illegal egg collection and shooting.'*

The Black-breasted Buzzard is distributed mainly throughout the northern interior, along the adjacent coasts and in the semi-arid and arid central regions of Australia (Ayers *et al.*, 1996; Schodde and Tidemann, 1997). In NSW, this species can occur over any part of the Western Division, however is more likely in the north and west (Ayers *et al.*, 1996).

The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates the Black-breasted Buzzard has been recorded at four locations in the region (i.e. Popiltah, Cuthero and Bunnerungee 1:100,000 map sheets) the closest of which is approximately 30 km east and west of the MLA area.

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine (Section D3.3), or during surveys for the Ginkgo Mine and infrastructure (MKES, 2001).

### **Evaluation**

#### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Black-breasted Buzzard could utilise potential habitat resources within the Snapper Mine area. Although, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species (if the species were to occur in the Snapper Mine area) given:

- records of the species, and *known* habitat for the species, occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of the Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Black-breasted Buzzard after consideration of the draft PAS (DEC, 2006c), including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation.
- **Threatened Species Management Protocol** – if a member of this species is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.

These measures are further discussed in Section D5.

#### **2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6) some of which may represent potential habitat for the Black-breasted Buzzard.

**3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Black-breasted Buzzard and does not represent a distributional limit for this species.

**4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Black-breasted Buzzard are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Black-breasted Buzzard):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.

**5. How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the species has not been recorded near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the Snapper Mine and mobility of the species.

**6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

**D4.10.12 Bush Stone-curlew (*Burhinus grallarius*)**

**Background**

In inland NSW, the Bush Stone-curlew (*Burhinus grallarius*) favours habitat associated with riverine woodlands of Casuarina, Eucalypt, Acacia or Epolycarpa with a cover of litter, fallen branches and short grasses (NPWS, 1999b; Pizzey and Knight, 1999; NPWS, 2003a). Further, dry open grassland or cropland with nearby cover may also provide habitat for this species (*ibid.*).

The Bush Stone-curlew nests consist of a slight depression in the ground usually near dead timber where they roost during the day relying on camouflage to hide them from predators (NPWS, 1999b; Pizzey and Knight, 1999). Breeding occurs in spring with both parents caring for and actively defending their young (Marchant and Higgins, 1993 in NPWS, 1999b).

Foraging by night, the Bush Stone-curlew feeds on invertebrates (molluscs, centipedes, crustaceans, spiders, grasshoppers, moths, etc.), small vertebrates (frogs, lizards, snakes and small rodents) and some vegetation (Marchant and Higgins, 1993 in NPWS, 1999b). This species is mainly sedentary although is known to be locally dispersive outside breeding periods, occurring singly or in pairs (NPWS, 1999b).

Threats relevant to the Bush Stone-curlew, include (DEC, 2006c):

- *'Predation by foxes and cats.*
- *Trampling of eggs by cattle.*
- *Clearance of woodland habitat for agricultural and residential development.*
- *Modification and destruction of ground habitat through removal of litter and fallen timber, introduction of exotic pasture grasses, grazing and frequent fires.*
- *Disturbance in the vicinity of nest sites.'*

The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates the Bush Stone-curlew has been recorded at two locations in the region (i.e. Popiltah and Para 1:100,000 map sheets) the closest of which is 40 km south of the MLA area.

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine (Section D3.3), or during surveys for the Ginkgo Mine and infrastructure (MKES, 2001).

### **Evaluation**

#### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Bush Stone-curlew could occur in the Snapper Mine area given the occurrence of *potential* habitat resources within the species range, however it is unlikely that a local population of the Bush Stone-curlew occurs given the lack of records near the Snapper Mine area (despite targeted surveys). Therefore it is considered unlikely that the Snapper Mine would affect the lifecycle of the species.

#### **2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), some of which may represent potential habitat for the Bush Stone-curlew.

#### **3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Bush Stone-curlew and does not represent a distributional limit for this species.

#### 4. **How is the proposal likely to affect current disturbance regimes?**

The threats to the Bush Stone-curlew are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Bush Stone-curlew):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine has the potential to increase animal pest populations within the study area without the appropriate avoidance and mitigation measures outlined in Section D5.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP outlined in Section D5.

#### 5. **How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the species has not been recorded near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

#### 6. **How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

#### D4.10.13 **Shy Heathwren (*Calamanthus cautus*)**

##### **Background**

The Shy Heathwren inhabits mallee woodlands with a relatively dense understorey of shrubs and heath plants (DEC, 2006c). It has been found in vegetation with a post-fire age of four to 40 years, but is most abundant in areas with a post-fire age of four to eight years (*ibid.*). They build a dome-shaped nest in a concealed location on the ground, using a variety of plant materials (*ibid.*).

The Shy Heathwren breeds in Mallee with shrubs and heath, burnt between four and 40 years ago, as well as Callitris and Ironbark woodland (DEC, 2006c).

The Shy Heathwren feeds on the ground, almost entirely on insects (cockroaches, grasshoppers, bugs, lerps, beetles, weevils, caterpillars, moths, ants, spiders and insect eggs) and rarely on seeds, including those of saltbush (DEC, 2006c).

Threats relevant to the Shy Heathwren, include (DEC, 2006c):

- *'Loss of habitat due to clearing has led to a decline in distribution and abundance.*
- *Fragmentation, resulting from clearing or degradation of habitat, may reduce the size of populations and increase the extent to which they are isolated; small, isolated populations have a greater risk of extinction due to genetic effects and chance events (e.g. drought and fire).*
- *Degradation of the habitat, a result of inappropriate grazing or fire regimes, has resulted in changes to the physical and biological nature of the habitat (e.g. changes in the structure and floral composition of the vegetation, and diversity and abundance of invertebrates); these changes may render habitat unsuitable or increase the risk posed by other threatening processes (e.g. predation).*
- *Fire may cause the direct loss of individuals.*
- *Predation by foxes or cats, particularly where populations have already declined.*
- *Catastrophic events such as drought or extensive wildfire.*
- *Human-induced climate change is a long-term threat as it may alter habitat characteristics (e.g. changes in physical structure or productivity) such that its capacity to support viable populations is reduced.'*

The Shy Heathwren occurs at two isolated populations, one in central NSW between Leeton, Willandra, Nymagee and West Wyalong, and the other in south-west NSW from Balranald to Trentham Cliffs, north into the Scotia Mallee (DEC, 2006c). The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates that the Shy Heathwren has been recorded at 2 locations in the region (i.e. Arumpo and Wild Dog 1:100,000 map sheets) the closest of which is approximately 63 km south-east of the MLA area.

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine (Section D3.3), or during surveys for the Ginkgo Mine and infrastructure (MKES, 2001).

### **Evaluation**

#### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Shy Heathwren could occur in the Snapper Mine area given the occurrence of *potential* habitat resources within the species range, however it is unlikely that a local population of the Shy Heathwren occurs given the lack of records near the Snapper Mine area (despite targeted surveys). Further, the pastoral leaseholder of the land within the MLA area has indicated that the Mallee within the Study area has been frequently and recently (2005) burnt, which reduces the likelihood that the species would utilise the potential habitat.

Given the above it is considered unlikely that the Snapper Mine would affect the lifecycle of the species.

#### **2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), some of which may represent potential habitat for the Shy Heathwren.

### **3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located in the western limits of the known distribution of the Shy Heathwren and therefore may represent a distributional limit for this species if it were to occur in the Study area.

### **4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Shy Heathwren are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Shy Heathwren):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine has the potential to increase animal pest populations within the study area without the appropriate avoidance and mitigation measures outlined in Section D5.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP outlined in Section D5.

### **5. How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the species has not been recorded near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the minimal disturbance to potential habitat for this species and the connectivity of the surrounding potential habitat (Figure D-5).

### **6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

#### **D4.10.14 Chestnut Quail-thrush (*Cinlosoma castanotus*)**

##### **Background**

The Chestnut Quail-thrush (*Cinlosoma castanotus*) inhabits mallee, Acacia (mulga), scrub, native pine and eucalypt woodland areas, preferably those with a shrub layer and in proximity to heath (Pizzey and Knight, 1980 in Ayers *et al.*, 1996). This species occupies vegetation with a post-fire age of 4-40 years, however it is most abundant in areas more recently burnt (DEC, 2006a). It is a species which prefers sandy soil (Ayers *et al.*, 1996).

The Chestnut Quail-thrush breeds from July to December but is influenced by local rainfall (Lindsey, 1992). Breeding pairs maintain small territories (Schodde and Tidemann, 1997). The nest of the Chestnut Quail-thrush consists of a shallow depression in the ground lined with grass (Lindsey, 1992).

The Chestnut Quail-thrush feeds on insects and seeds (Blakers *et al.*, 1984). These birds forage on the ground on invertebrates, seeds and some berries (Ayers *et al.*, 1996). The Chestnut Quail-thrush is a highly mobile species which is capable of dispersal over long distances. Populations of the species are nomadic (Schodde and Tidemann, 1997).

Threats relevant to the Chestnut Quail-thrush, include (DEC, 2006c):

- *'Loss of habitat as a result of clearing has led to a decline in species distribution and abundance.*
- *Fragmentation, resulting from clearing or degradation of the habitat has reduced genetic variability and reproductive opportunities and has increased genetic isolation and the potential for significant impacts arising from stochastic events such as drought or fire.*
- *Degradation of the habitat, as a result of inappropriate grazing or fire regimes, has resulted in changes to the physical nature of the habitat, for example change in diversity and structure of floristics or invertebrates. Changes to the habitat may result in it being unsuitable for the species or may increase other threatening processes such as predation.*
- *Fire may cause the direct loss of individuals, and inappropriate fire regimes may cause long-term changes to physical features such as floristic structure or leaf litter, which is unfavourable to sustaining a viable population of the species.*
- *Predation by foxes or cats may have an impact, particularly where populations have already declined.*
- *Catastrophic events such as drought or extensive wildfire.*
- *Anthropogenic climate change is a long term significant threat as it will alter physical characteristics of the habitat such that it is no longer able to sustain a viable population.'*

The Chestnut Quail-thrush is distributed across the semi-arid parts of southern Australia to western NSW mallee areas (Ayers *et al.*, 1996). This species occurs throughout the eastern mallee regions, including Flinders Range, Eyre Peninsula, Ninety Mile Plain and Murray Mallee, S.A., Big and Little Deserts and Sunset Country, Vic., and central and south-western NSW (Schodde and Mason, 1999). In NSW the species has a scattered distribution west of a line from near Cobar, through Nymagee and Condobolin, to West Wyalong, west to 'Scotia mallee' west of Great Anabranche, and south of the line joining Cobar and Kinchega NP, to Cocoparra NP, Euston and Wentworth (DEC, 2006c).

The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates that the Chestnut Quail-thrush has been recorded at approximately a dozen locations in the region (i.e. Popiltah, Cuthero, Pooncarie, Bunnerunjee, Para and Arumpo 1:100,000 map sheets) the closest of which is approximately 50-60 km north-west of the MLA area.

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine (Section D3.3), or during surveys for the Ginkgo Mine and infrastructure (MKES, 2001).

## **Evaluation**

### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Chestnut Quail-thrush could occur in the Snapper Mine area given the occurrence of *potential* habitat resources within the species range, however it is unlikely that a local population of the Chestnut Quail-thrush occurs given the lack of records near the Snapper Mine area (despite targeted surveys). Therefore it is considered unlikely that the Snapper Mine would affect the lifecycle of the species.

### **2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), some of which may represent potential habitat for the Chestnut Quail-thrush.

### **3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Chestnut Quail-thrush and does not represent a distributional limit for this species.

### **4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Chestnut Quail-thrush are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Chestnut Quail-thrush):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine has the potential to increase animal pest populations within the study area without the appropriate avoidance and mitigation measures outlined in Section D5.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP outlined in Section D5.

### **5. How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the species has not been recorded near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

## 6. **How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

### D4.10.15 **Striated Fieldwren (*Calamanthus fuliginosus*)**

#### **Background**

The DEC website (2006c) states:

*'The current listing of this species incorporates two sub-species. However, the sub-species have now been elevated to species status. The Striated Fieldwren Sericornis fuliginosus occurs in coastal areas while the Rufous Fieldwren S. campestris inhabits parts of western NSW in arid and semi-arid gibber and shrublands. Whilst the listing does not recognise this elevation legally both species remain listed as threatened under the auspices of Calamanthus fuliginosus.'*

Based on the above, the Rufous Fieldwren (*S. campestris*) rather than the Striated Fieldwren (*S. fuliginosus*) has the potential to occur in the region of the Snapper Mine.

Threats relevant to the Rufous Fieldwren, include (DEC, 2006c):

- *'Loss of swampy heath and tussocky habitats due to clearing for urban and agricultural development.*
- *Heavy grazing and trampling by stock causing habitat degradation through root damage, prevention of seedling establishment and erosion.*
- *Habitat degradation as a result of weed invasion.*
- *Poor understanding of the species' habitat.*
- *Poor understanding of habitat characteristics that support the species.'*

There are no records of the Rufous Fieldwren in the DEC Atlas of NSW Wildlife (DEC, 2006a) in the region (i.e. Popiltah, Cuthero, Pooncarie, Bunnerungee, Para and Arumpo 1:100,000 map sheets). No records of this species occur in the Australian Museum (2006) or Birds Australia (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area and this species was not recorded during targeted surveys for the Snapper Mine (Section D3.3).

#### **Evaluation**

### 1. **How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Rufous Fieldwren could occur in the Snapper Mine area given the occurrence of *potential* habitat resources within the species range, however it is unlikely that a local population of the Rufous Fieldwren occurs given the lack of records near the Snapper Mine area (despite targeted surveys). Therefore it is considered unlikely that the Snapper Mine would affect the lifecycle of the species.

**2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), some of which may represent potential habitat for the Rufous Fieldwren.

**3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area maybe located within the known distribution of the Rufous Fieldwren although there are no local records of the species (DEC, 2006a; Australian Museum, 2006; Birds Australia, 2006).

**4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Rufous Fieldwren are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Rufous Fieldwren):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine has the potential to increase introduced weed within the study area without the appropriate avoidance and mitigation measures outlined in Section D5.

**5. How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the species has not been recorded near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

**6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

#### D4.10.16 Major Mitchell's Cockatoo (*Cacatua leadbeateri*)

##### **Background**

The Major Mitchell's Cockatoo (*Cacatua leadbeateri*) inhabits sparsely treed grassy woodlands of eucalypts, cypress, *Casuarina* spp. and *Acacia* spp., as well as grasslands near watercourses (Pizzey and Knight, 1999).

The Major Mitchell's Cockatoo nests in cavities in living or dead trees (Lindsey, 1992; Pizzey and Knight, 1999), generally close to water (DEC, 2006c). Nests are generally found in old growth Mallee and Black Oak in the south of their distribution and in Bimble Box and other eucalypts in the north, or any other tree that provides hollows (Pizzey and Knight, 1980 in Ayers *et al.*, 1996). The Major Mitchell's Cockatoo breeds from July to January. Breeding pairs occupy large territories of around 500 ha and are strongly territorial within several km of the nest site (Ayers *et al.*, 1996).

The Major Mitchell's Cockatoo forages on the ground and in trees and shrubs (Ayers *et al.*, 1996). The Major Mitchell's Cockatoo feeds on seeds, nuts, fruits and roots, particularly of the Cypress Pine and *Acacia* species (Schodde and Tidemann, 1997; Barker and Vestjens, undated in Ayers *et al.*, 1996). *Eucalyptus*, *Bassia* and *Casuarina* are also utilised (Schodde and Tidemann, 1997; Barker and Vestjens, undated in Ayers *et al.*, 1996).

This species is sedentary where there is a reliable supply of food and water, but nomadic elsewhere (Pizzey and Knight, 1980 in Ayers *et al.*, 1996). After fledging, young birds typically form wandering parties (Lindsey, 1992).

Threats relevant to the Major Mitchell's Cockatoo, include (DEC, 2006c):

- 'Clearing of woodlands.
- Heavy grazing of feeding areas resulting in the removal of seeding grasses and preventing regeneration of food plants.
- Loss of existing and future hollow-bearing trees.
- Illegal nest-robbing and trapping'.

The Major Mitchell's Cockatoo is widely but sporadically distributed throughout the arid and semi-arid interior of Australia, from inland Queensland, NSW and Victoria to the coast of Western Australia and the Great Australian Bight (Ayers *et al.*, 1996; Pizzey and Knight, 1999). The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates the Major Mitchell's Cockatoo has been recorded at 162 locations in the region (i.e. Popiltah, Cuthero, Pooncarie, Bunnerungee, Para, Arumpo, Scotia and Wild Dog 1:100,000 map sheets) the closest of which is within the north of the MLA area. Birds Australia (2006) also hold records of this species in the locality.

The Major Mitchell's Cockatoo was recorded by MKES (2001) during fauna surveys for the Ginkgo Mine and during targeted surveys for the Snapper Mine (Section D3.3) (Figure D-8).

## Evaluation

### 1. **How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It appears likely that a local population of the Major Mitchell's Cockatoo occasionally utilises *known* habitat resources within the Snapper Mine area given this species was recorded within the MLA area as well as flying overhead at S4, in Transect TF, Grid 31 and north of Grid 7. (Figure D-8). Although, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species given:

- records of the species, and *known* habitat for the species also occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of the Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Major Mitchell's Cockatoo after consideration of the draft PAS (DEC, 2006c), including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation. Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Major Mitchell's Cockatoo. The surveys would include observations to determine completion of nesting activities (i.e. young have left the nest and the nest is no longer used for nesting).
- **Threatened Species Management Protocol** – if a member of this species is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.

These measures are further discussed in Section D5.

### 2. **How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are provided above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), of which only a portion is *known* or *potential* habitat for the Major Mitchell's Cockatoo.

### 3. **Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Major Mitchell's Cockatoo and does not represent a distributional limit for this species.

#### **4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Major Mitchell's Cockatoo are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Major Mitchell's Cockatoo):

- As stated above, the Snapper Mine would involve some clearance and modification of *known* and *potential* habitat for this species. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.

#### **5. How is the proposal likely to affect habitat connectivity?**

An area of *known* or *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the mobility of the species, localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

#### **6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

### **D4.10.17 Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*)**

#### **Background**

The Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*) inhabits a wide range of Eucalypt woodlands, mallee, Acacia scrubland and open forests (Garnett and Crowley, 2000). In temperate woodlands, this species favours open areas which adjoin large areas of woodland, with areas of dead timber and sparse shrub cover (Fitri and Ford, 1997 in NSW Scientific Committee, 2004d).

The Hooded Robin (south-eastern form) feeds on the ground on insects and small lizards in areas with a mix of bare ground, groundcover and leaf litter (Garnett and Crowley, 2000; NSW Scientific Committee, 2004d).

The Hooded Robin (south-eastern form) breeds from July to December communally in groups of three or more individuals (Pizzey and Knight, 1999). The nest is an open cup made from bark-strips, rootlets, grass and/or spiders' web. The nest is built in a tree fork, crevice or hollow on or near dead wood, approximately 1-6 m above the ground (Schodde and Tidemann, 1997; Pizzey and Knight, 1999). Within these nests, two eggs are laid and incubated for approximately 14 days (Schodde and Tidemann, 1997).

This species is often observed in small family groups and sometimes in isolated pairs (NSW Scientific Committee, 2004d). The species is typically territorial and has a home range of approximately 10-20 ha (Schodde and Tidemann, 1997). Juveniles of this species are dispersive (Pizzey and Knight, 1999).

Threats relevant to the Hooded Robin (south-eastern form), include (DEC, 2006c):

- '*Clearing of woodlands, resulting in loss and fragmentation of habitat.*
- *Modification and destruction of ground habitat through heavy grazing and compaction by stock, removal of litter and fallen timber, introduction of exotic pasture grasses and frequent fire.'*

*M. cucullata cucullata* is distributed throughout south-eastern Australia, from Central Queensland to the Spencer Gulf in South Australia (NSW Scientific Committee, 2004d). The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates the Hooded Robin (south-eastern form) has been recorded at 21 locations in the region (i.e. Popiltah, Cuthero, Pooncarie, Bunnerungee, Para, Arumpo and Wild Dog 1:100,000 map sheets) the closest of which is approximately 30 km south-west of the MLA area. Birds Australia (2006) also holds records of this species in the locality.

The Hooded Robin (south-eastern form) was recorded by MKES (2001) during fauna surveys for the Ginkgo Mine and during targeted surveys for the Snapper Mine (Section D3.3) (Figure D-8).

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area.

### **Evaluation**

#### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

A local population of the Hooded Robin (south-eastern form) appears to utilise *known* habitat resources within the Snapper Mine area given this species was recorded within the MLA at S2, S3, S6, TG, TJ and Grids 3, 12, 17, 23, 27 and 28 (Table D7). Although, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species given:

- records of the species, and *known* habitat for the species also occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of the Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Hooded Robin (south-eastern form) after consideration of the draft PAS (DEC, 2006c), including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation. Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Hooded Robin (south-eastern form). The surveys would include observations to determine completion of nesting activities (i.e. young have left the nest and the nest is no longer used for nesting).
- **Threatened Species Management Protocol** – if a member of this species is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.
- **Bushfire Risk Management** – implementation of a management plan to reduce the risk of bushfire.

These measures are further discussed in Section D5.

**2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), of which only a portion is *known* or *potential* habitat for the Hooded Robin (south-eastern form).

**3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Hooded Robin (south-eastern form) and does not represent a distributional limit for this species.

**4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Hooded Robin (south-eastern form) are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Hooded Robin (south-eastern form)):

- As stated above, the Snapper Mine would involve some clearance and modification of *known* and *potential* habitat for this species. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP as described in Section D5.

**5. How is the proposal likely to affect habitat connectivity?**

The area of *known* or *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the mobility of the species, localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

**6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

**D4.10.18 Grey-crowned Babbler (eastern subsp.) (*Pomatostomus temporalis temporalis*)****Background**

The Grey-crowned Babbler (eastern subsp.) (*Pomatostomus temporalis temporalis*) inhabits open forests, Acacia shrubland, open woodlands (dominated by mature Eucalypts with regenerating trees, tall shrubs and an intact groundcover of grass and forbs) and adjoining farmland (Garnett and Crowley, 2000; Schodde and Tidemann, 1997).

The Grey-crowned Babbler (eastern subsp.) lives and breeds in a co-ordinated communal group which may include up to 12 individuals (Schodde and Tidemann, 1997). These extended family parties are essential for both the co-operative feeding of young and predator avoidance (Garnett and Crowley, 2000).

The Grey-crowned Babbler (eastern subsp.) typically breeds between July and February (DEC, 2006c). Pairs mate for life and are usually the only breeding birds within the group (Schodde and Tidemann, 1997). A domed nest, up to 500 mm wide (with a roomy cavity reached by a small tunnel) is made of strong twigs and lined with grass, fur or cow dung (*ibid.*). The nest is built in the fork of small branches usually about 4 m above the ground. Approximately 2-3 eggs are laid, and incubated for 18-23 days by the female (*ibid.*).

The Grey-crowned Babbler (eastern subsp.) feeds on invertebrates (spiders and insects) and lizards, foraging on the ground, in leaf litter, on the bark of trees and in shrubs and foliage (Schodde and Tidemann, 1997; DEC, 2006c; Garnett and Crowley, 2000). Populations of the Grey-crowned Babbler are nomadic ground foragers (DEC, 2006c).

Threats relevant to the Grey-crowned Babbler, include (DEC, 2006c):

- 'Clearing of woodland remnants.
- Heavy grazing and removal of coarse, woody debris within woodland remnants.
- Nest predation by species such as ravens and butcherbirds may be an issue in some regions where populations are small and fragmented.'

In NSW, *P. temporalis temporalis* occurs on the western slopes and plains (DEC, 2006c). There are no records of the Grey-crowned Babbler in the DEC Atlas of NSW Wildlife (DEC, 2006a) in the region (i.e. Popiltah, Cuthero, Pooncarie, Bunnerungee, Para and Arumpo 1:100,000 map sheets). No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area.

The Grey-crowned Babbler was also recorded by MKES (2001) during fauna surveys for the Ginkgo Mine. However, MKES (2001) did not give a scientific name or describe the location at which the species was recorded. Therefore there is a degree of uncertainty with respect to this species identification by MKES (2001).

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine (Section D3.3).

## **Evaluation**

### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Grey-crowned Babbler (eastern subsp.) could utilise potential habitat resources within the Snapper Mine area given this species was recorded by MKES (2001) during fauna surveys of the Ginkgo Mine and infrastructure. It is considered unlikely that the Snapper Mine would affect the lifecycle of the species given (if the species were to occur in the Snapper Mine area):

- records of the species, and *known* habitat for the species also occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of the Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Grey-crowned Babbler (eastern subsp.) after consideration of the draft PAS (DEC, 2006c), including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation. Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Grey-crowned Babbler (eastern subsp.). The surveys would include observations to determine completion of nesting activities (i.e. young have left the nest and the nest is no longer used for nesting).
- **Threatened Species Management Protocol** – if a member of this species is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.

These measures are further discussed in Section D5.

### **2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), of which a portion may be potential habitat for the Grey-crowned Babbler (eastern subsp.).

### **3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Grey-crowned Babbler (eastern subsp.) and does not represent a distributional limit for this species.

#### 4. **How is the proposal likely to affect current disturbance regimes?**

The threats to the Grey-crowned Babbler (eastern subsp.) are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Grey-crowned Babbler (eastern subsp.):

- As stated above, the Snapper Mine would involve some clearance and modification of *potential* habitat for this species. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.

#### 5. **How is the proposal likely to affect habitat connectivity?**

The area of *known* or *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the mobility of the species, localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

#### 6. **How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

#### D4.10.19 **Black-eared Miner (*Manorina melanotis*)**

##### **Background**

The Black-eared Miner (*Manorina melanotis*) inhabits vegetation with a post-fire age of greater than 25 years, but is more common in areas with a post-fire age of 50 years or more (DEC, 2006c). The species prefers old-growth, dense, undisturbed mallee (Garnett and Crowley, 2000 in NPWS, 2003b). The most extensive, potential habitat area for the species within NSW is the old-growth, mature mallee community between Euston and Balranald (McLaughlin, 1996 in NPWS, 1999c). The species has also been sighted in Black Oak and Buloke woodland (Pizzey, 1991 in NPWS, 1999c). Previous records also indicate that the species was locally common in small areas of more fertile soils within suitable habitats (Franklin, 1996 in NPWS, 2003a).

The Black-eared Miner breeds communally and uses a cup-shaped nest constructed from grasses and sticks within mallee eucalypts located in a fork or mistletoe clump (DEC, 2006c). They interbreed with the more common Yellow-throated Miner (*Manorina flavigula*) (NPWS, 1999c). Hybrids of these species range between the preferred habitat of both of the species and make it difficult to determine the number of pure Black-eared Miner populations remaining (*ibid.*).

Black-eared Miners are opportunistic breeders, breeding when conditions are suitable (NPWS, 2003b). Nests have been found in all months, but breeding typically extends from September to December (*ibid.*). Widespread breeding has also been observed from March to May on three occasions (Backhouse *et. al.*, 1997 in NPWS, 2003b, Boulton and Clarke, 2000 in NPWS, 2003b). Breeding is most likely linked to rainfall events during mild to warm seasons, promoting elevated insect activity, increased lerp abundance and flowering events of mallee and understorey shrubs (NPWS, 2003b).

The Black-eared Miner's diet consists of arthropods (including grasshoppers, bugs, lerps, beetles, weevils, flies, caterpillars, bees, wasps, ants, and spiders) obtained by gleaning and probing loose and hanging bark of mallee trunks (DEC, 2006c). Their diet also includes nectar, pollen, plant material, seeds and fruit (*ibid.*).

The Black-eared Miner is a sedentary species during breeding (Morcombe, 2004). When not breeding, the birds move in groups (either as an entire colony or in smaller congregations) over great distances to forage (NPWS, 2003b). Non-breeding birds remain within a non-breeding territory of several hundred hectares and sightings of marked individuals have been made up to 2 km from the core home range during these non-breeding periods (Clarke and Clarke, 1999).

Threats relevant to the Black-eared Miner, include (DEC, 2006c):

- *'Loss of habitat as a result of clearing has led to a decline in species distribution and abundance.*
- *Fragmentation, resulting from clearing or degradation of the habitat has reduced genetic variability and reproductive opportunities and has increased genetic isolation and the potential for significant impacts arising from stochastic events such as drought or fire.*
- *Degradation of the habitat, as a result of inappropriate grazing or fire regimes, has resulted in changes to the physical nature of the habitat, for example change in diversity and structure of floristics or invertebrates. Changes to the habitat may result in it being unsuitable for the species or may increase other threatening processes such as predation.*
- *Fire may cause the direct loss of individuals, and inappropriate fire regimes may cause long-term changes to physical features such as floristic structure or leaf litter, which is unfavourable to sustaining a viable population of the species.*
- *Catastrophic events such as drought or extensive wildfire.*
- *Anthropogenic climate change is a long term significant threat as it will alter physical characteristics of the habitat such that it is no longer able to sustain a viable population.*
- *Intro-specific aggression and genetic introgression, which typically associated with a change in habitat features is a threat.'*

Phenotypically pure birds (i.e. those that do not appear to be interbred with the Yellow-throated Miner) are thought to occur almost exclusively (approximately 95% of known colonies) in the Bookmark Biosphere Reserve, north-west of Renmark, South Australia (Backhouse *et al.*, 1997 in NPWS, 2003b). NSW has only eight confirmed historical records of this species, three records are from the Scotia block of mallee west of the Darling River and the others from Euston, in the far south-east of NSW (Ayers *et al.*, 1996). Recent reports of the Black-eared Miner in NSW may all refer to hybrid individuals (Smith *et al.*, 1995 in NPWS, 2003b). Extensive surveys in December 1999 located three hybrid colonies in south-western NSW but no phenotypically pure individuals (DEC, 2006c). The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates the Black-eared Miner has been recorded at one location in the region (i.e. Popiltah 1:100,000 map sheets) the closest of which is approximately 50 km north-west of the MLA area.

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine (Section D3.3), or during surveys for the Ginkgo Mine and infrastructure (MKES, 2001).

## **Evaluation**

### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Black-eared Miner could occur in the Snapper Mine area given the occurrence of *potential* habitat resources within the species range, however it is unlikely that a local population of the Black-eared Miner occurs given the lack of records near the Snapper Mine area (despite targeted surveys). Therefore it is considered unlikely that the Snapper Mine would affect the lifecycle of the species.

### **2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), some of which may represent potential habitat for the Black-eared Miner.

### **3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Black-eared Miner and does not represent a distributional limit for this species.

### **4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Black-eared Miner are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Black-eared Miner):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP as described in Section D5.

### **5. How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the species has not been recorded near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

## 6. How is the proposal likely to affect critical habitat?

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

### D4.10.20 Redthroat (*Pyrrholaemus brunneus*)

#### Background

The Redthroat (*Pyrrholaemus brunneus*) inhabits undergrowth of acacia scrub (especially Mulga) and saltbush, particularly along watercourses in arid and semi-arid areas; also in eucalypt woodlands (including mallee), Black Oak, Lignum, Spinifex, eucalypt regrowth, Ti-tree and bluebush (Pizzey and Knight, 1980 in DEC, 2006c). They create bulky dome-shaped nests with a side entrance constructed from coarse strips of bark, grass and feathers, in shrubs or small trees up to 1 m above the ground (Slater *et al.*, 1993; DEC, 2006c).

The Redthroat's diet consists of a wide variety of terrestrial invertebrates (beetles, ants, termites, earwigs, grasshoppers, bugs, caterpillars, butterflies, moths, wasps and spiders) and grass seeds gathered from the ground and amongst low foliage (Barker and Vestjens, 1989 in DEC, 2006c).

The Redthroat is a sedentary, solitary bird (DEC, 2006c). Males frequently mimic the calls of other birds (*ibid.*).

Threats relevant to the Redthroat, include (DEC, 2006c):

- 'Severe grazing of saltbush and bluebush communities destroys the habitat of the Redthroat by removing shelter and affecting food sources.
- Ongoing grazing also prevents regeneration of suitable vegetation.
- Frequent fires - destroy the habitat of this species.
- Cat predation.
- Pushing mulga for stock fodder.'

The Redthroat occurs across southern Australia and east to "Penarie" (amongst Old Man Saltbush) and the Great Cumbungi Swamp area north-east of Balranald (DEC, 2006c). Also known from the mallee around the Willandra World Heritage Area, west of the Darling (including areas of scotia mallee), near the Murray River west of Wentworth (including along a natural drainage line with Canegrass on "Moorra" station), on the Anabranth north of Wentworth ("Nindethana") and in Sturt National Park (DEC, 2006c). The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates the Redthroat has been recorded at three locations in the region (all within the Popiltah 1:100,000 map sheet west of the MLA). Birds Australia (2006) also holds records of this species in the locality, the closest of which is approximately 5 km north of the MLA area on the Manilla Station.

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine (Section D3.3), or during surveys for the Ginkgo Mine and infrastructure (MKES, 2001).

## **Evaluation**

### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Redthroat could utilise potential habitat resources within the Snapper Mine area given local records of the species in the Birds Australia (2006) database. Although, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species (if the species were to occur in the Snapper Mine area) given:

- records of the species, and *known* habitat for the species, occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of the Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Redthroat after consideration of the draft PAS (DEC, 2006c), including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation. Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Redthroat. The surveys would include observations to determine completion of nesting activities (i.e. young have left the nest and the nest is no longer used for nesting).
- **Threatened Species Management Protocol** – if a member of this species is identified during construction or operation of the Snapper Mine, the Threatened Species Protocol developed for the Snapper Mine would be applied.
- **Control of Introduced Animal Fauna** – measures would be implemented to control the potential adverse impacts of feral animals on this species.

These measures are further discussed in Section D5.

### **2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), some of which may represent potential habitat for the Redthroat.

### **3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Redthroat and does not represent a distributional limit for this species.

#### 4. **How is the proposal likely to affect current disturbance regimes?**

The threats to the Redthroat are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Redthroat):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP as described in Section D5.

#### 5. **How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the species has not been recorded near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

#### 6. **How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

#### D4.10.21 Eastern Long-eared Bat (south-eastern form) (*Nyctophilus timoriensis*)

##### **Background**

The Eastern Long-eared Bat (south-eastern form) (*Nyctophilus timoriensis*) inhabits dry open woodlands and around River Red Gums that line watercourses and lakes on the inland plains of the semi-arid zone (Parnaby, 1995 in Ayers *et al.*, 1996).

The Eastern Long-eared Bat appears to be quite flexible in their roost selection, but has a predilection for tree hollows, exfoliating bark or dense foliage (Lunney *et al.*, 1988 in North Limited, 1998).

The Eastern Long-eared Bat forages for large moths and beetles over water or in arid habitats; hovers around the foliage of trees and may glean insects from leaves and branches as do other long-eared bats; and also hovers low to the ground (Hall and Richards, 1979; Richards, 2004a in Strahan, 2004).

Threats relevant to the Eastern Long-eared Bat, include (DEC, 2006c):

- 'Loss of remnant semi-arid woodland and mallee habitat.
- Loss of hollow-bearing trees.
- Application of pesticides in or adjacent to foraging areas.'

Atlas of NSW Wildlife (DEC, 2006a) indicates the Eastern Long-eared Bat has been recorded at four locations in the region (all within the Arumpo 1:100,000 map sheet), east of the Darling River more than 30 km to the east of the MLA area.

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area. This species was not recorded during targeted surveys for the Snapper Mine (Section D3.3), or during surveys for the Ginkgo Mine and infrastructure (MKES, 2001).

### **Evaluation**

#### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Eastern Long-eared Bat could utilise *potential* habitat resources within the species range (Figure D-5). Although, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species (if the species were to occur in the Snapper Mine area) given:

- records of the species, and *known* habitat for the species, occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of the Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Eastern Long-eared Bat, including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation. Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential roosting/breeding habitat for the Eastern Long-eared Bat.
- **Threatened Species Protocol** – if a member of this species is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.

These measures are further discussed in Section D5.

#### **2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), some of which may represent potential habitat for the Eastern Long-eared Bat.

#### **3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Eastern Long-eared Bat and does not represent a distributional limit for this species.

#### 4. **How is the proposal likely to affect current disturbance regimes?**

The threats to the Eastern Long-eared Bat are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Eastern Long-eared Bat):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP as described in Section D5.

#### 5. **How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the species has not been recorded near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

#### 6. **How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

### D4.10.22 Little Pied Bat (*Chalinolobus picatus*)

#### **Background**

The Little Pied Bat (*Chalinolobus picatus*) has been found to inhabit dry open forest, open woodland, Mulga woodlands, chenopod shrublands, *Callitris* forest and mallee (Churchill, 1998).

The Little Pied Bat was originally thought to only roost in caves or their substitutes including buildings (Hall and Richards, 1979; Reardon and Flavel, 1987; Richards, 2004b in Strahan 2004). However, roost site flexibility is known for this primarily subterranean species, and roost locations such as mud nests of Fairy Martins and disused buildings have been recorded (Richards, 1979). In arid or semi-arid environments, the Little Pied Bat forages on insects and may occur near permanent or semi-permanent water (Duncan *et al.*, 1999). Flexibility in foraging habitat is also known as this species is distributed in open areas in semi-arid and arid zones.

Threats relevant to the Little Pied Bat, include (DEC, 2006c):

- 'Loss or modification of habitat.
- Predation by cats.
- Application of pesticides in or adjacent to foraging areas.'

The Little Pied Bat lives only in the dry areas of southern Queensland, NSW and South Australia (Richards, 2004b in Strahan, 2004). The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates the Little Pied Bat has been recorded at 25 locations in the region (i.e. Popiltah, Cuthero, Pooncarie, Bunnerungee, Para, Arumpo and Wild Dog 1:100,000 map sheets) the closest of which is 18 km north-east of the MLA area.

The Little Pied Bat was recorded by MKES (2001) during fauna surveys for the Ginkgo Mine and targeted surveys for the Snapper Mine (Section D3.3) (Figure D-8).

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area.

### **Evaluation**

#### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It appears likely that a local population of the Little Pied Bat occasionally utilises *known* habitat resource within the Snapper Mine area given this species was recorded within the MLA area (Figure D-8). Although, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species given:

- records of the species, and *known* habitat for the species also occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of the Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Little Pied Bat, including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation. Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential roosting/breeding habitat for the Little Pied Bat.
- **Threatened Species Management Protocol** – if a member of this species is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.

These measures are further discussed in Section D5.

#### **2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), of which only a portion is *known* or *potential* habitat for the Little Pied Bat.

**3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Little Pied Bat and does not represent a distributional limit for this species.

**4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Little Pied Bat are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Little Pied Bat):

- As stated above, the Snapper Mine would involve some clearance and modification of *known* and *potential* habitat for this species. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP as described in Section D5.

**5. How is the proposal likely to affect habitat connectivity?**

The area of *known* or *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given mobility of the species, the localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

**6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

**D4.10.23 Inland Forest Bat (*Vespadelus baverstocki*)**

**Background**

The Inland Forest Bat (*Vespadelus baverstocki*) roosts in tree hollows (sometimes in extremely small hollows in trees only a few metres high) and abandoned buildings (Strahan, 2004). It has been recorded in a variety of woodland, including Mallee, Mulga, River Red Gum (DEC, 2006c) and inhabits grassland, savannah and shrubland (Strahan, 2004). Colony size varies from a few individuals to more than fifty (DEC, 2006c).

Females congregate whilst raising young; the single young is carried by its mother until its weight affects her flight, and is then left in the roost at night (DEC, 2006c).

The foraging behaviour of the Inland Forest Bat reflects its open habitat. It covers its extensive search area quickly but is able to react swiftly upon detection of moths (Strahan, 2004).

Threats relevant to the Inland Forest Bat, include (DEC, 2006c):

- *'Removal of old hollow trees.*
- *Predation by feral cats at roost sites.*
- *Degradation of vegetation and the consequent reduction in arthropod prey diversity and abundance.'*

The Inland Forest Bat has been recorded from scattered localities in western NSW (DEC, 2006c). The DEC Atlas of NSW Wildlife (DEC, 2006a) indicates the Inland Forest Bat has been recorded at 14 locations in the region (i.e. Popiltah, Pooncarie, Bunnerungee, Para, Arumpo and Scotia 1:100,000 map sheets) the closest of which is approximately 30 km south-west of the MLA area.

The Inland Forest Bat was recorded by MKES (2001) during fauna surveys for the Ginkgo Mine, although it was not recorded during targeted surveys for the Snapper Mine (Section D3.3).

No records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area.

### **Evaluation**

#### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It is possible that a local population of the Inland Forest Bat could utilise potential habitat resources within the Snapper Mine area given this species was recorded by MKES (2001) during fauna surveys of the Ginkgo Mine and infrastructure. Although, it is considered unlikely that the Snapper Mine would affect the lifecycle of the species (if the species were to occur in the Snapper Mine area) given:

- records of the species, and *known* habitat for the species, occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Inland Forest Bat , including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation. Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential roosting/breeding habitat for the Inland Forest Bat.
- **Threatened Species Management Protocol** – if a member of this species is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.

These measures are further discussed in Section D5.

**2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), some of which may represent potential habitat for the Inland Forest Bat.

**3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Inland Forest Bat and does not represent a distributional limit for this species.

**4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Inland Forest Bat are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Inland Forest Bat):

- The Snapper Mine would not increase the disturbance of currently *known* habitat for this species. As stated above, some *potential* habitat would be cleared or modified. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.

**5. How is the proposal likely to affect habitat connectivity?**

An area of *known* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the lack of records near the Snapper Mine area (despite targeted surveys). The area of *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

**6. How is the proposal likely to affect critical habitat?**

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

#### D4.10.24 Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)

##### **Background**

The Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) roosts in tree hollows in a wide range of habitats (NPWS, 2000b). Roosts are predicted to be large and situated such that there is enough clear space at the exit to allow an unencumbered drop until the bat attains normal flight speed (Greg Richards and Associates, 2000). *S. flaviventris* has been found to utilise multiple roost sites (*ibid.*).

The Yellow-bellied Sheathtail-bat is insectivorous and forages above the tree canopy. A variety of prey items are eaten including long-horned grasshoppers, shield bugs and flying ants, while beetles comprise up to 90% of this species' diet (Churchill, 1998).

Threats relevant to the Yellow-bellied Sheathtail-bat, include (DEC, 2006c):

- 'Disturbance to roosting and summer breeding sites.
- Foraging habitats are being cleared for residential and agricultural developments, including clearing by residents within rural subdivisions.
- Loss of hollow-bearing trees; clearing and fragmentation of forest and woodland habitat.
- Pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individuals' fat stores.'

There are no records of the Yellow-bellied Sheathtail-bat in the DEC Atlas of NSW Wildlife (DEC, 2006a) in the region (i.e. Popiltah, Cuthero, Pooncarie, Bunnerungee, Para and Arumpo 1:100,000 map sheets) and no records of this species occur in the Australian Museum (2006) database for a search area of 400 km<sup>2</sup> surrounding the study area.

The Yellow-bellied Sheathtail-bat was recorded by MKES (2001) during fauna surveys for the Ginkgo Mine. This species was also recorded during targeted surveys for the Snapper Mine (Section D3.3) (Figure D-8).

##### **Evaluation**

#### **1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

It appears likely that a local population of the Yellow-bellied Sheathtail-bat occasionally utilises *known* habitat resource within the Snapper Mine area given this species was recorded proximal to the MLA area (Figure D-8). It is considered unlikely that the Snapper Mine would affect the lifecycle of the species given:

- records of the species, and *known* habitat for the species also occur outside the Snapper Mine area;
- the localised nature of the Snapper Mine area disturbance and wider distribution of potential habitat resources for the species in the greater area (Figure D-5); and
- the progressive nature of the Snapper Mine disturbance and rehabilitation.

Notwithstanding, a number of avoidance and mitigation measures have been developed for the Snapper Mine to minimise potential impacts on the Yellow-bellied Sheathtail-bat, including:

- **Vegetation Clearance Protocol** - a Vegetation Clearance Protocol would be developed for the Snapper Mine and would include details of the delineation of areas to be cleared of vegetation. Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential roosting/breeding habitat for the Yellow-bellied Sheathtail-bat.
- **Threatened Species Management Protocol** – if a member of this species is identified during construction or operation of the Snapper Mine, the Threatened Species Management Protocol developed for the Snapper Mine would be applied.
- **Control of Introduced Animal Fauna** – measures would be implemented to control the potential adverse impacts of feral animals on this species.

These measures are further discussed in Section D5.

**2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The habitat requirements for this species are outlined above. Less than 1,630 ha of remnant vegetation would be cleared or modified for the Snapper Mine (Figures D-2 and D-6), of which only a portion is *known* or *potential* habitat for the Yellow-bellied Sheathtail-bat.

**3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

Considering the distribution of the species which is described above, the study area is located within the known distribution of the Yellow-bellied Sheathtail-bat and does not represent a distributional limit for this species.

**4. How is the proposal likely to affect current disturbance regimes?**

The threats to the Yellow-bellied Sheathtail-bat are listed above. The Snapper Mine is likely to have the following effects on the current disturbance regimes operating within the study area (which are applicable to the Yellow-bellied Sheathtail-bat):

- As stated above, the Snapper Mine would involve some clearance and modification of *known* and *potential* habitat for this species. Notwithstanding, the impact avoidance and mitigation measures outlined in Section D5 would reduce this potential impact.
- The Snapper Mine would aim to minimise bushfire risk within the MLA area through the implementation of an ERP as described in Section D5.

**5. How is the proposal likely to affect habitat connectivity?**

The area of *known* or *potential* habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the mobility of the species, localised nature of the Snapper Mine and connectivity of the surrounding potential habitat (Figure D-5).

## 6. *How is the proposal likely to affect critical habitat?*

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect critical habitat for this species.

### D4.11 SEPP 44 – KOALA HABITAT PROTECTION

In response to a state-wide decline of Koala populations, the NSW Department of Urban Affairs and Planning (now the NSW Department of Planning [DoP]) gazetted the State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) in January 1995.

The policy aims to “*encourage the conservation of proper management of areas of natural vegetation that provide habitat for Koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline.*”

In order to determine whether SEPP 44 applies to the study area, it is necessary to consider the following points:

- (1) *Does the subject land occur in a Local Government Area identified in Schedule 1?*

The study area is located within the LGA of Wentworth listed within Schedule 1 of SEPP 44.

- (2) *Is the landholding to which the DA applies greater than 1 hectare in area?*

The area is larger than 1 ha in area.

- (3) *Is the land potential Koala habitat? That is, does the site “contain areas of native vegetation where the trees of types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component?”*

No.

- (4) *Is there core Koala habitat on the subject land and is there a requirement for the preparation of a Plan of Management for the identified core Koala habitat?*

No. SEPP 44 describes core Koala habitat as an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (i.e. females with young) and recent sightings of, and historical records of, a population.

The study area does not fall within the definition of core Koala habitat. The study area does not have a resident population of Koalas and there are no recent records of a population occurring in the area. Koalas were not observed during the survey.

Based on the above, it is concluded that the provisions of SEPP 44 do not apply to the study area.

## **D5 IMPACT AVOIDANCE AND MITIGATION MEASURES**

Impact avoidance and mitigation measures have been developed to avoid and mitigate potential impacts of the Snapper Mine on fauna. These measures would be detailed in a Flora and Fauna Management Plan (FFMP) which would be prepared prior to the Snapper Mine construction. The FFMP would include measures which would be undertaken during construction and operation, including a Vegetation Clearance Protocol, Threatened Species Management Protocol, grazing management, control of introduced flora species, control of introduced animal species, fauna habitat monitoring, Painted Burrowing Frog monitoring and bushfire management. These management measures are described below.

### ***Vegetation Clearance Protocol***

A Vegetation Clearance Protocol would be implemented to minimise the removal/modification of fauna and their habitats. Key components of the Vegetation Clearance Protocol would include the delineation of areas to be cleared of remnant vegetation, a pre-clearance survey, identification of fauna management strategies and specific procedures for vegetation clearance.

Vegetation clearance would be timed to minimise disturbance to potential roosting/breeding activities of fauna.

Vegetation clearance along the ETL would be minimised where practical using techniques such as selective clearing (i.e. minimising vegetation clearance to higher midstorey and upperstorey vegetation).

### ***Threatened Species Management Protocol***

A Threatened Species Management Protocol would be prepared and implemented to facilitate the management and minimisation of potential impacts on threatened fauna species. Key components of the Threatened Species Management Protocol would include site observations/surveys, threatened species management strategies and reporting. The Threatened Species Management Protocol would be conducted by suitably qualified person(s).

### ***Grazing Management***

Appropriate fencing would be used to prevent the uncontrolled entry of livestock within the mine work and progressive rehabilitation areas for the life of the mine.

### ***Control of Introduced Flora Species***

Control measures would be conducted to minimise the occurrence of weeds. These may include the mechanical removal of identified weeds and/or the application of approved herbicides in authorised areas. Herbicides that contain glyphosate as the active ingredient and/or surfactants (detergent additive used as a dispersant/wetting agent) would not be utilised due to potential adverse impacts on amphibians.

### ***Control of Introduced Animal Species***

A clean, rubbish-free environment would be mandated to discourage scavenging and reduce the potential for further colonisation of the study area by non-endemic fauna (e.g. introduced rodents and foxes). The introduction of animals on to the site would be prohibited. Domestic pets would not be allowed on the mine site.

In addition, control measures would be conducted to minimise the occurrence of declared pests (e.g. Rabbits) and other introduced animal species (e.g. Red Fox). These may include the removal of rabbit harbour, feral cat trapping and fox baiting. Animal pest control would be undertaken by a licensed contractor.

### ***Vegetation Monitoring***

A photographic monitoring programme would be developed to assess the performance of the rehabilitation areas and monitor the health of the vegetation surrounding the mine path and initial overburden emplacement with regard to potential impacts from airborne salts.

### ***Painted Burrowing Frog Monitoring***

As stated in Section D4.10.1, Painted Burrowing Frog individuals are known to emerge from their burrows following heavy rain (>25 mm in 24 hours) when they are able to absorb water rapidly and reproduce. Site personnel would monitor the amount of rainfall at the mine site using the on-site rain gauge. Painted Burrowing Frog monitoring would be conducted by suitably qualified person(s). Selection of monitoring locations would primarily be based on rainfall distribution and intensity.

Frog populations can be particularly sensitive to the introduction of infectious pathogens such as the chytrid fungus. To reduce the likelihood of spreading infection, the Painted Burrowing Frog monitoring programme would be conducted in accordance with the guidelines for the collection, handling and transport of amphibians.

### ***Dust Suppression***

Dust suppression techniques would be undertaken on the Snapper Mine roads within the MLA area.

### ***Vehicular Traffic Management***

The movement of vehicles associated with the Snapper Mine has the potential to increase the incidence of fauna mortality via vehicular strike. To reduce this potential, the number of roads constructed for the Snapper Mine would be minimised, employees and contractors would be instructed to only use the Snapper Mine roads, speed limits would be imposed on vehicles using the Snapper Mine roads and tracks, and signposting would be installed to remind personnel of the danger of vehicles to wildlife. Vehicle speed would be restricted to 50 km/hour on all roads inside the MLA area and on the HAR at the Great Darling Anabranch crossing.

### ***Bushfire Risk Management***

The potential for a change in the frequency of fires due to the Snapper Mine would be reduced through implementation of the ERP. The ERP would establish a bushfire management strategy to reduce the risk of bushfire outbreaks in the Snapper Mine area and to establish emergency response.

### ***Site Induction***

An environmental education programme would be included in employee and contractor inductions.

## D6 KEY THRESHOLDS

Key thresholds are discussed below in relation to the Snapper Mine in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005).

***Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.***

It is likely that the biodiversity values of the region would be maintained or improved considering the Snapper Mine's proposed measures to avoid and mitigate for potential impacts outlined in Section D5.

***Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.***

The Snapper Mine is unlikely to reduce the long-term viability of a local population of any fauna species or population as the fauna habitat components which occur within the study area are wide-spread within the region.

***Whether or not the proposal is likely to accelerate the extinction of a species, population or ecological community or place it at risk of extinction.***

The Snapper Mine is unlikely to accelerate the extinction of any fauna species or population or place it at risk of extinction as the fauna habitat components which occur within the study area are wide-spread within the region.

***Whether or not the proposal will adversely affect critical habitat.***

No critical fauna habitat occurs within the vicinity of the study area as designated by the Register of Critical Habitat held by the Commonwealth Minister of DEH (DEH, 2006b), Register of Critical Habitat held by the Director-General of DEC (DEC, 2006d), the Register of Critical Habitat held by the Director-General of DPI (DPI, 2006) or identified within the Wentworth LEP. Therefore, the Snapper Mine would not affect any critical habitat.

## D7 SUMMARY AND CONCLUSION

In summary the following conclusions can be made:

- All habitat types in the study area have been adversely impacted mainly due to past pastoral land management practices. Both the functionality and health of habitat types in the area have been impaired and consequently are likely to be sub-optimal for both vegetation and fauna. Under current pastoral land management practices the conservation and production values appear to be slowly further degrading. Although ecological resilience appears to have been adversely impacted, it does not yet seem to have moved through an irreversible ecological threshold. Hence, self repair under appropriate management conditions appears to be still possible, albeit likely to be very slow under the given climatic conditions.
- It is likely that the vertebrate fauna values of the region are likely to be maintained and possibly improved, considering the Snapper Mine's proposed measures to avoid, mitigate and/or offset potential impacts.
- The Snapper Mine is unlikely to reduce the long-term viability of any local population of vertebrate fauna species.
- The Snapper Mine is unlikely to lead to the extinction of any vertebrate species or population or place any at risk of extinction.
- The Snapper Mine is unlikely to adversely affect critical habitat as no critical habitats are known to occur within the vicinity of the Snapper Mine area.
- The Snapper Mine is unlikely to adversely affect areas of high conservation value.
- Habitat that is likely to be adversely affected by the Snapper Mine is not considered likely, if removed, to impact adversely the long-term viability of any vertebrate species, population or ecological community.
- Adverse impacts from the Snapper Mine on vertebrate fauna are likely to continue to diminish throughout the life of the mine. At the time of mining lease relinquishment, the DPI-MR would ensure that relevant relinquishment requirements (e.g. demonstration of a stable final landform which is generally consistent with the surrounding landscape) have been fulfilled. It should be noted that appropriate impact mitigation measures would be implemented from the commencement of the Snapper Mine.
- Given the above, from a regional perspective, adverse impacts from the Snapper Mine on vertebrate fauna are unlikely to be permanent or irreversible.

**D8 REFERENCES**

- Algers, B. *et al.* (1978) *The Impact of Continuous Noise on Animal Health*.
- Allaire, P.N. (1978) *Effects on Avian Populations Adjacent to an Active Strip Mine*. Symposium on Surface Mining and Fish/Wildlife Needs in Eastern United States, West Virginia.
- Ames, D.R. (1978) *Physiological Responses to Auditory Stimuli*. In J.L. Fletcher and R.G. Busnel (eds) (1978) *Effects of Noise on Wildlife*. Academic Press, New York.
- Anderson, R.H. (1961) Introduction. *Contr. NSW Natl. Herb.* Fl Nos. 1-18:1-15.
- Australian Museum (2006) *Database records within a search area of approximately 400 km<sup>2</sup> surrounding the study area*. Data received May 2006.
- Ayers, D., Nash, S. and Baggett, K. (1996) *Threatened Species of Western New South Wales*. NSW National Parks and Wildlife Service, Hurstville.
- Backhouse, G., McLaughlin, J., Clarke, M. and Copley, P. (1997) *Recovery Plan for the Black-eared Miner Manorina melanotis 1997-2001*.
- Barker, R.D. and Vestjens, W.J.M. (1989) *The Food of Australian Birds Volume 2: Passerines*.
- Barker, R.D. and Vestjens, W.J.M. (undated) *The Food of Australian Birds, Non-Passerine*. CSIRO Division of Wildlife and Ecology.
- Barret, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003) *The New Atlas of Australian Birds*. Royal Australasian Ornithologists Union, Hawthorn East.
- Bell, M. M. and Hoyer, S. (2002) *Flora and Fauna Survey Guidelines: Lower Hunter Central Coast Region. Vols 1 & 2*. Lower hunter Central Coast regional Environmental Management Strategy. Callegan.
- Bennet, A. (1987) Conservation of Mammals within a Fragmented Forest Environment: The contribution of Insular Biogeography and Autecology. *Nature Conservation: The Role of Native Vegetation*, pp41-52. (Ed by Denis Saunders, G.W. Arnold, Andrew A. Burbridge and J.M Hopkins). Surrey Beatty and Sons Pty Limited in association with CSIRO and CALM.
- Benshemesh, J. (2000) *National Recovery Plan for Malleefowl*. Environment Australia.
- Birds Australia (2006) *Database records within a search area of approximately 400 km<sup>2</sup> surrounding the study area*. Data received May 2006.
- Blakers, M., Davies, S.J.J.F. and Reilly, P.N. (1984) *The Atlas of Australian Birds*. RAOU and Melbourne University Press, Melbourne.
- Boulton, R. and Clarke, M. (2000) *Field Management of the Black-eared Miner*. Unpublished. Final Report to the Black-eared Miner Recovery Team, La Trobe University.
- Bridgewater, P.B. (1987) Connectivity: An Australian Perspective. *Nature Conservation: The Role of Native Vegetation*, pp195-200. (Ed by Denis Saunders, G.W. Arnold, Andrew A. Burbridge and J.M Hopkins). Surrey Beatty and Sons Pty Limited in association with CSIRO and CALM.

- Brouwer, J. and Garnett, S. (eds.) (1990) *Threatened Birds of Australia*. An Annotated list. RAOU Report No.69. Royal Australian Ornithologists Union and Australian National Parks and Wildlife Service.
- Busnel, R.G. (1978) *Introduction*.
- Cadia Holdings Pty Ltd (2000) *Ridgeway Project Environmental Impact Statement*. Report prepared by Resource Strategies Pty Ltd.
- Calaby, J.H. (1960) A Note on the Food of Australian Desert Frogs. *Western Australian Naturalist* 7: 79-80.
- Churchill, S. (1998) *Australian Bats*. Reed New Holland, Sydney.
- Clarke, R. and Clarke, M. (1999) *Translocation Proposal for the Black-eared Miner*.
- Cogger, H.G. (2000) *Reptiles and Amphibians of Australia* (Sixth Edition). Reed New Holland, Sydney.
- Debus, S.J.S. and Czechura, G.V. (1989) Square-tailed Kite (*Lophoictinia isura*): A Review. *Australian Bird Watcher* 13:81-97.
- Department of Environment and Conservation (DEC) (2004) *Threatened Species Survey and Assessment: Guidelines for Developments and Activities*. Working Draft. Prepared by DEC.
- Department of Environment and Conservation (DEC) (2006a) *Atlas of NSW Wildlife Records*. For the Popiltah, Cuthero, Pooncarie, Bunnerungee, Para and Arumpo 1:100,000 map sheets.  
Date received: February, 2006.
- Department of Environment and Conservation (DEC) (2006b) *BIONET- User Defined Grid of Lat/Long - 141.57,-33.63,142.2,-33.12*.  
Internet Site: <http://www.bionet.nsw.gov.au>  
Date Accessed: 20/03/06.
- Department of Environment and Conservation (DEC) (2006c) *Threatened Species Home Page*  
Internet Site: <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>  
Date Accessed: July 2006.
- Department of Environment and Conservation (DEC) (2006d) *Department of Environment and Conservation*.  
Internet Site: <http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Home>  
Date Accessed: July 2006.
- Department of Environment and Conservation (DEC) and Department of Primary Industries (DPI) (2005) *Draft Guidelines for Threatened Species Assessment*. NSW DEC and DPI.
- Department of the Environment and Heritage (DEH) (2006a) *Interim Biogeographic Regionalisation for Australia (IBRA) Version 6.1*.  
Internet Site: <http://www.deh.gov.au/>  
Date Accessed: July 2006.
- Department of the Environment and Heritage (DEH) (2006b) *EPBC Act Protected Matters Search*. 14,400 km<sup>2</sup> Search Centred on the Study Area from the South Australian Border to east of the Darling River.  
Internet Site: <http://www.deh.gov.au/>  
Date Accessed: July 2006.

Department of Natural Resources (DNR) (2005) *Present Day Vegetation Communities*.

Internet Site: <http://www.lmd.cma.nsw.gov.au/nativeveg/communities.shtml>

Date Accessed: July 2006.

Department of Primary Industries (DPI) (2006) *Register of Critical Habitat held by the Director-General of DPI*.

Internet Site: <http://dpi.nsw.gov.au/fisheries>

Date Accessed: July 2006.

Duncan, A., Baker, G.B. and Montgomery, N. (1999) *The Action Plan for Australian Bats*. Environment Australia, Australia.

Fitri, L.L. and Ford, H.A. (1997) Status, Habitat and Social Organisation of the Hooded Robin *Melanodryas cucullata* in the New England Region of New South Wales. *Australian Bird Watcher* 17:142-155.

Fletcher, J.L. and Busnel, R.G. (eds.) (1978) *Effects of Noise on Wildlife*. Academic Press, New York.

Franklin, D. (1996) *The Status of the Black-eared Miner Manorina melanotis in New South Wales*.

Garnett, S.T. and Crowley, G.M. (2000) *The Action Plan for Australian Birds*.

Greg Richards and Associates (2000) *An Assessment of the Bat Fauna in Infrastructure Zones at the Ridgeway Mining Project, Central New South Wales*.

Hall, L. and Richards, G. (1979) *The Bats of Eastern Australia*. Queensland Museum Booklet No.12.

Krefft, G. (1866) On the Vertebrated animals of the Lower Murray and Darling, Their Habits, Economy and Geographical Distribution. *Transactions of the Philisophical Society of New South Wales* 1862-1865: 1-33.

Lee, A.K. and Mercer, E. H. (1967) Cocoon surrounding desert dwelling frogs. *Science* 157: 87-88.

Lindsey, T.R. (1992) *Encyclopaedia of Australian Animals: Birds*. The Australian Museum, Sydney.

Lunney, D., Barker, J., Priddel, D. and O'Connell, M. (1988) Roost Selection by Gould's Long-eared Bat [sic] (*Nyctophilus gouldi*) Tones (*Microchiroptera: Vespertilionidae*) in a Logged Forest on the South Coast of New South Wales. *Australian Wildlife Research* 15:375-384.

Lynch, T.E. and Speake, D.W. (1978) *Eastern Wild Turkey Behavioural Responses Induced by Sonic Boom*.

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

Mazzer, T., Ellis, M., Smith, J., Ayers, D., Cooper, M., Wallace, G. and Langdon, A. (1998) *Fauna of Western New South Wales, the Southern Mallee Region*. NSW NPWS.

McLaughlin, J. (1996) Cheating extinction: faith, hardwork and a well timed miracle bring hope for the Black-eared Miner. *Wingspan* Sept: 6-11.

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

- Morcombe, M. (2004) *Field Guide to Australian Birds*. Steve Parish Publishing Pty Ltd, Archerfield, QLD.
- Morgan (2001) *Delineation and description of the Eastern Environmental Subregions (provinces) in New South Wales*. NSW National Parks and Wildlife Service, Hurstville.
- Morgan, G. and Terrey, P. (1992) *Nature Conservation in Western NSW*. National Parks Association, Sydney.
- Mount King Ecological Surveys (MKES) (2001) *Ginkgo Mineral Sands Project Fauna Assessment*. Attachment H of the *Ginkgo Mineral Sands Project Environmental Impact Statement*. Report prepared by Resource Strategies Pty Ltd.
- North Limited (1998) *Cowal Gold Project Environmental Impact Statement*. Report prepared by Resource Strategies Pty Ltd.
- NSW National Parks and Wildlife Service (NPWS) (1999a) *Threatened Species Information – Square-tailed Kite (Lophoictinia isura)*.
- NSW National Parks and Wildlife Service (NPWS) (1999b) *Threatened Species Information – Bush Stone-Curlew (Burhinus grallarius)*.
- NSW National Parks and Wildlife Service (NPWS) (1999c) *Threatened Species Information – Black-eared Miner (Manorina melanotis)*.
- NSW National Parks and Wildlife Service (NPWS) (2000a) *Threatened Species of the Lower North Coast of New South Wales*. NSW National Parks and Wildlife Service, Australia.
- NSW National Parks and Wildlife Service (NPWS) (2000b) *Painted Burrowing Frog (Neobatrachus pictus) Recovery Plan*. NSW National Parks and Wildlife Service, Hurstville, NSW.
- NSW National Parks and Wildlife Service (NPWS) (2003a) *Benambra National Park and Tabletop Nature Reserve – Draft Plan of Management*.
- NSW National Parks and Wildlife Service (NPWS) (2003b) *Black-eared Miner (Manorina melanotis) Recovery Plan*.  
Internet Site:  
[http://www.nationalparks.nsw.gov.au/PDFs/recovery\\_plan\\_final\\_blackeared\\_miner.pdf](http://www.nationalparks.nsw.gov.au/PDFs/recovery_plan_final_blackeared_miner.pdf)  
Date Accessed: 14/08/2006.
- NSW Scientific Committee (2004a) *Final Determination for Crowned Gecko (Diplodactylus stenodactylus)*.
- NSW Scientific Committee (2004b) *Final Determination for Marble-faced Delma (Delma australis)*.
- NSW Scientific Committee (2004c) *Final Determination for Slender Mallee Blue-tongue Lizard (Cyclodomorphus melanops elongatus)*.
- NSW Scientific Committee (2004d) *Final Determination for Hooded Robin (south-east form) (Melanodryas cucullata cucullata)*.
- NSW Scientific Committee (2005) *Final Determination for Wedgesnout Ctenotus (Ctenotus brooksi)*.
- Olsen, P.D. and Olsen, J. (1986) Distribution, status, movements and breeding of the Grey Falcon *Falco hypoleucos*. *Emu* 86: 46-51.

- Parnaby, H. (1995) *Greater Long-eared Bat (Nyctophilus timoriensis)*.
- Pizzey, G. (1991) *A Field Guide to Australian Birds*. Revised Edition. Angus and Robertson, Sydney.
- Pizzey, G. and Knight, F. (1980) *Field Guide to the Birds of Australia*. Harper Collins Publishers, Sydney, Australia.
- Pizzey, G. and Knight, F. (1997) *The Graham Pizzey and Frank Knight Field Guide to the Birds of Australia*. Angus and Robertson, Pymble.
- Pizzey, G. and Knight, F. (1999) *Field Guide to the Birds of Australia*. Harper Collins Publishers. Sydney, Australia.
- Predavec, M. and Dickman C.R. (1993) Ecology of desert frogs: a study from south-western Queensland. *Herpetology in Australia: a diverse discipline*, pp159-169. (Ed. by D. Lunney and D. Ayers). Transactions of the Royal Zoological Society of New South Wales.
- Poole, G. (1982) *Sound Advice Poultry Notes*. NSW Department of Agriculture and Fisheries.
- Reardon, T.B. and Flavel S.C. (1987) *A guide to the bats of South Australia*. South Australian Museum, Adelaide.
- Richard Heggie Associates Pty Ltd (1997) *Cowal Gold Project Noise, Transportation and Blasting Impact Assessment*. Report prepared for North Limited.
- Richards, G.C. (1979) New information on the little pied bat, *Chalinolobus picatus*. *Australian Bat Research News* 14: 7-8.
- Richards, G.C. (2004a) *Greater Long-eared Bat*.
- Richards, G.C. (2004b) *Little Pied Bat*.
- Roberts, J.D. (1978) Redefinition of the Australian Leptodactylid frog *Neobatrachus pictus*. *Transaction of the Royal Society of South Australia* 102 (4): 97–105.
- Robinson, M. (2000) *A Field Guide to Frogs of Australia*. An Australian Museum/Reed New Holland Publication.
- Sadlier, R.A. and Pressey, R.L. (1994) Reptiles and amphibians of particular conservation concern in the Western Division of New South Wales: a preliminary review. *Biological Conservation* 69, 41-54.
- Sadlier, R.A., Pressey, R.L. and Whish, G.L. (1996) Reptiles and Amphibians of Particular Conservation Concern in the Western Division of New South Wales: Distributions, Habitats and Conservation Status. *Occasional Paper 21*. NSW National Parks and Wildlife Service, Hurstville.
- Sahukar, R., Gallery, C., Smart, J. and Mitchell, P. (2003) *The Bioregions of NSW - their biodiversity, conservation and history*. NSW National Parks and Wildlife Service.
- Schodde, R. and Mason, I.J. (1999) *The Directory of Australian Birds: Passerines*. CSIRO Publishing, Melbourne.
- Schodde, R. and Tidemann, S. (eds.) (1997) *Readers Digest Complete Book of Australian Birds*. Readers Digest, Sydney.

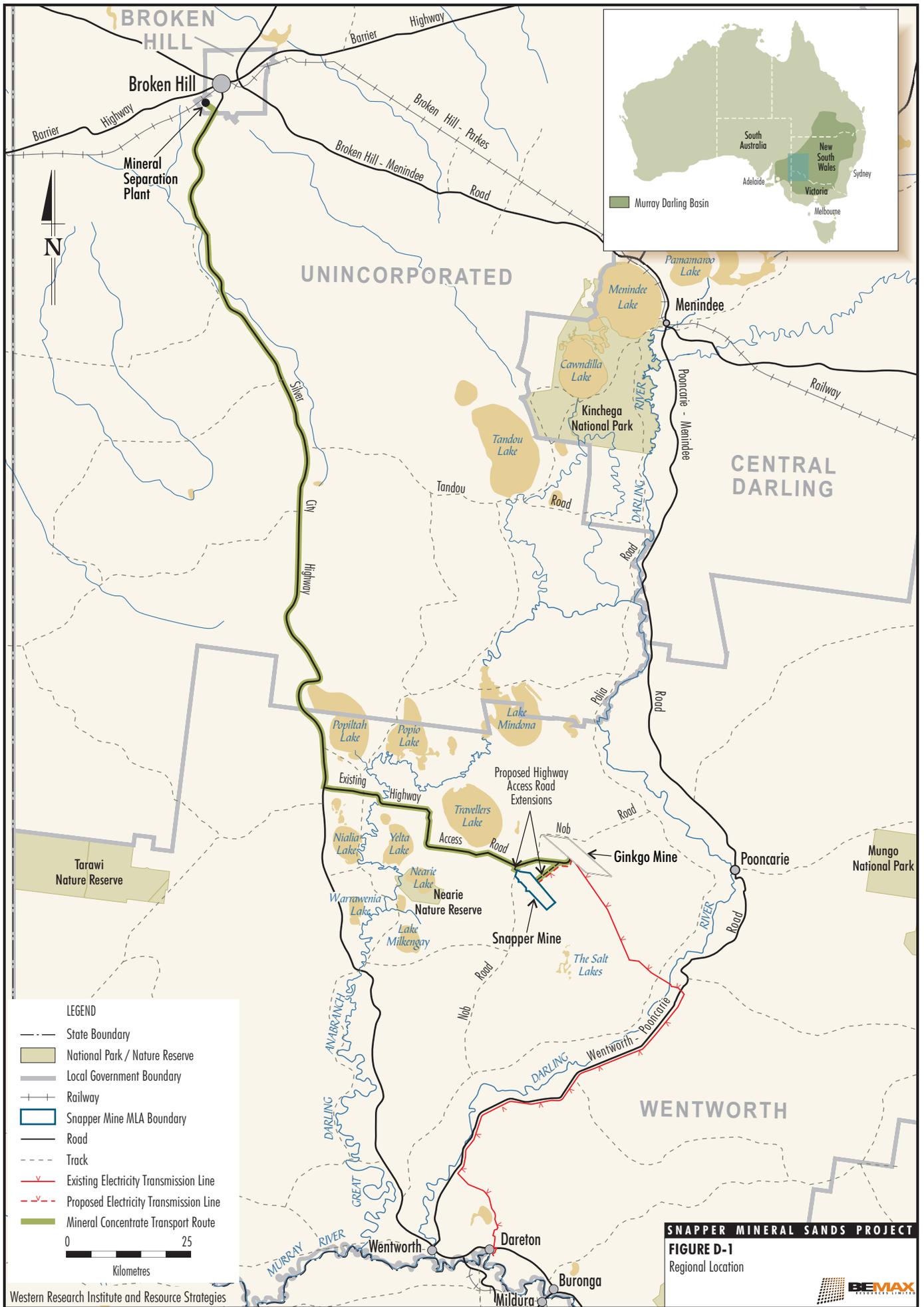
- Shaw, E.A. (1978) *Symposium of the Effects of Noise on Wildlife*.
- Slater, P., Slater, P. and Slater, R. (1993) *The Slater Field Guide to Australian Birds* (revised edition). Lansdowne, Sydney, NSW.
- Slater, P., Slater, P. and Slater, R. (1999) *The Slater Field Guide to Australian Birds*. Lansdowne Publishing, The Rocks, NSW.
- Smart, J.M. (2002) *The Bioregions of New South Wales, a Practical Guide to the Assessment of their Biodiversity*. NSW National Parks and Wildlife Service, Hurstville.
- Smith, P.J., Smith, J.E., Pressey, R.L. and Whish, G.L. (1995) *Birds of Particular Conservation Concern in the Western Division of New South Wales: Distributions, Habitats and Threats. Occasional Paper 20*.
- Stewart, D.A. (1992) *Bird Calls of North-East NSW*. Field Survey Tape, Nature Sound, Mullumbimby.
- Stewart, D.A. (1994) *Bird Calls of Coastal North-East NSW*. Nature Sound, Mullumbimby.
- Stewart, D.A. (1997) *Bird Calls of South-East NSW*. Nature Sound, Mullumbimby.
- Stewart, D. (1998) *Calls of Threatened Fauna of Eastern NSW Survey (IFOA)*. State Forests of NSW, Nature Sound, Mullumbimby.
- Stewart, D.A. (1999a) *Rail and Bittern Calls*. Playback Surveys, Nature Sound, Mullumbimby.
- Stewart, D.A. (1999b) *Bird and Mammal Calls of NE-NSW Western Slopes and Plains*. Nature Sound, Mullumbimby.
- Stewart, D.A. (1999c) *Australian Frog Calls*. Subtropical East, Nature Sound, Mullumbimby.
- Storr, G. M. (1980) *Birds of the Kimberley Division Western Australia*. W. Aust. Mus. Spec. Publ. 11.
- Strahan, R. (ed.) (2004) *The Mammals of Australia*. Reed New Holland, Sydney.
- Streeter, I.P., Moore, R.T., Skinner, J.J., Martin, S.G., Terrel, T.L., Klimstra, W.D., Tate, J. Jnr. and Nolde, M.J. (1979) *Energy Impacts and Wildlife Management: Which Way to Turn? Proceedings of the 44<sup>th</sup> North American Wildlife Conference*.
- Swan, G. (1990) *A field guide to the snakes and lizards of New South Wales*. Three Sisters Productions, Winmalee.
- Swan, G., Shea, G. and Sadler, R. (2004) *A Field Guide to the Reptiles of NSW*. Reed New Holland, Second Edition.
- 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.
- Thackway, R. and Cresswell, I.D. (eds.) (2000) *An Interim Biogeographic Regionalisation for Australia: a Framework for Establishing the National System of Reserves, Version 5.1*. Australian Nature Conservation Agency, Canberra.
- Triggs, B. (2004) *Tracks, Scats and Other Traces. A Field Guide to Australian Mammals*. Oxford University Press, Melbourne. Revised edition.

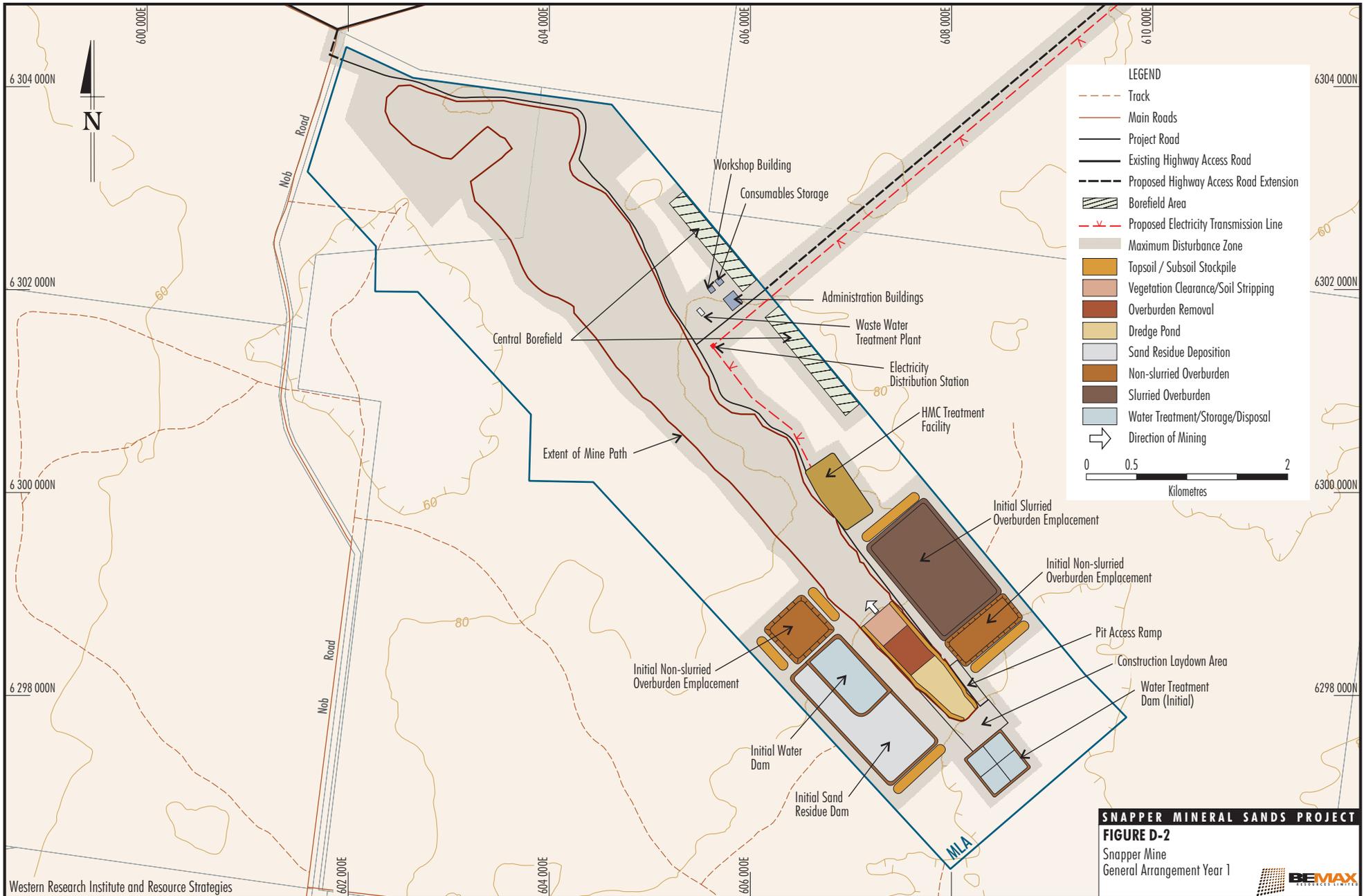
- Tyler, M.J. (1976) *Frogs*. Australian Natural History series. Collins, Sydney.
- Val, J., Foster, E. and Le Breton, M. (2001) *Biodiversity Survey of the Lower Murray Darling*. Report for Natural Heritage Trust, Environment Australia. Environment Australia and NSW Department of Land and Water Conservation.
- Wakefield, N.A. (1966) Mammals of the Blandowski Expedition to north-western Victoria, 1856-57. *Proceedings of the Royal Society of Victoria* 79: 371-391.
- Walker, S.J. and Goonan, P.M. (2001) *Frog Census 2000 – A report on community monitoring of water quality and habitat condition in South Australia using frogs as indicators*. Government of South Australia.
- Warburg, M.R. (1967) On thermal and water balance of three Central Australian frogs. *Comp. Biochem. Physio.* 20:27-43.
- Webster, R., Belcher, C. and Leslie, D. (2003) A survey for threatened fauna in south-western New South Wales. *Australian Zoologist* 32(2):214-228.
- Wilson, S. and Swan, G. (2005) *The Complete Guide to Reptiles of Australia*. Reed New Holland, Sydney.
- Withers, P.C. (1995) Cocoon Formation and Structure in the Aestivating Australian Desert Frogs, *Neobatrachus* and *Cyclorana*. *Australian Journal Zoology* 43: 429-441.

## **D9 ACKNOWLEDGEMENTS**

1. Field staff were Dr Anne Kerle, Mr Rick Webster, Mr Ray Mjadwesch.
2. Dr Barbara Triggs for mammalian hair analysis.
3. Staff from BEMAX Resources Limited at the Ginkgo Mine and Mildura for logistical support.
4. DEC and NSW Agriculture for survey licences needed and animal ethics clearance.

## FIGURES

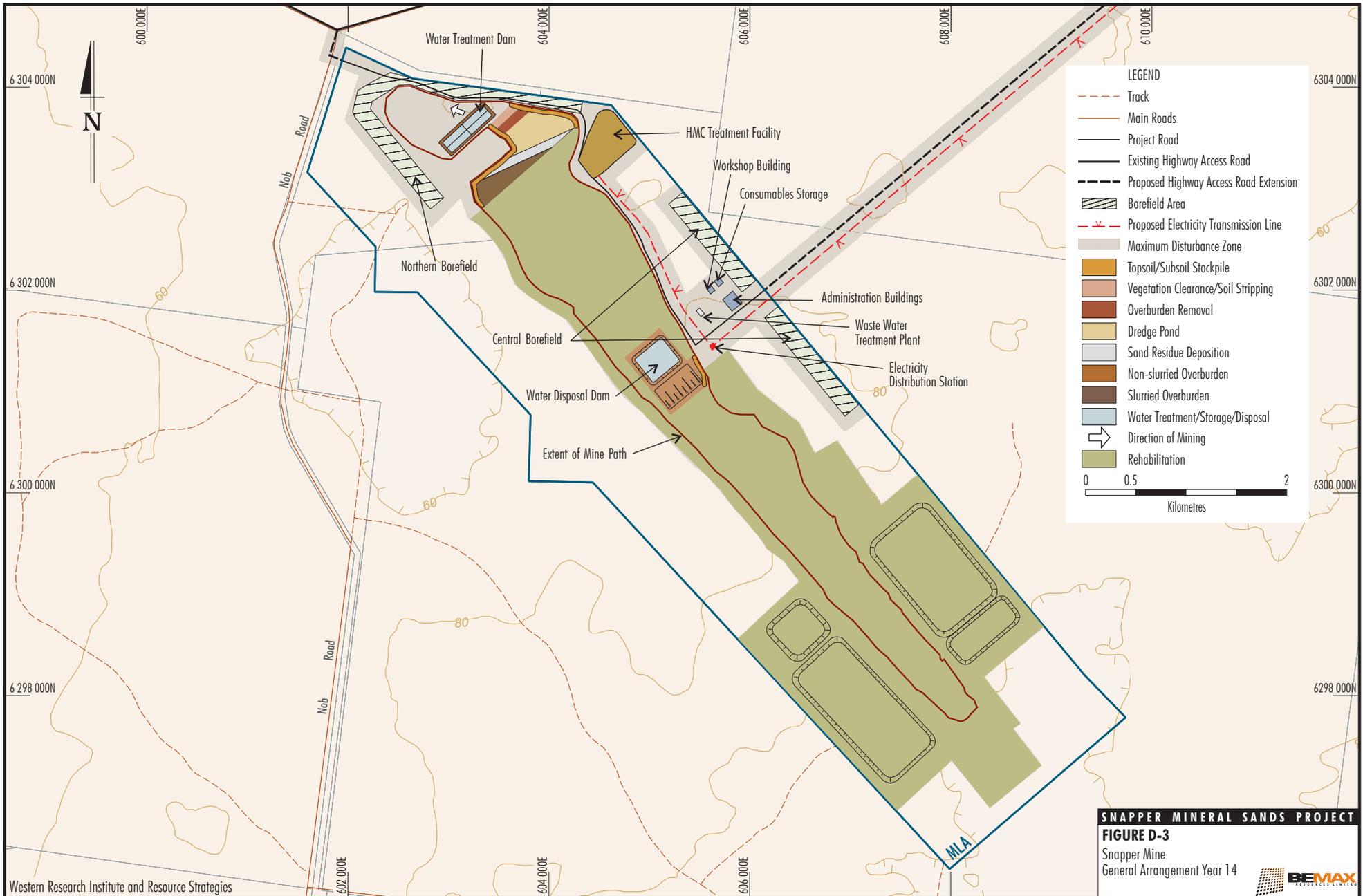


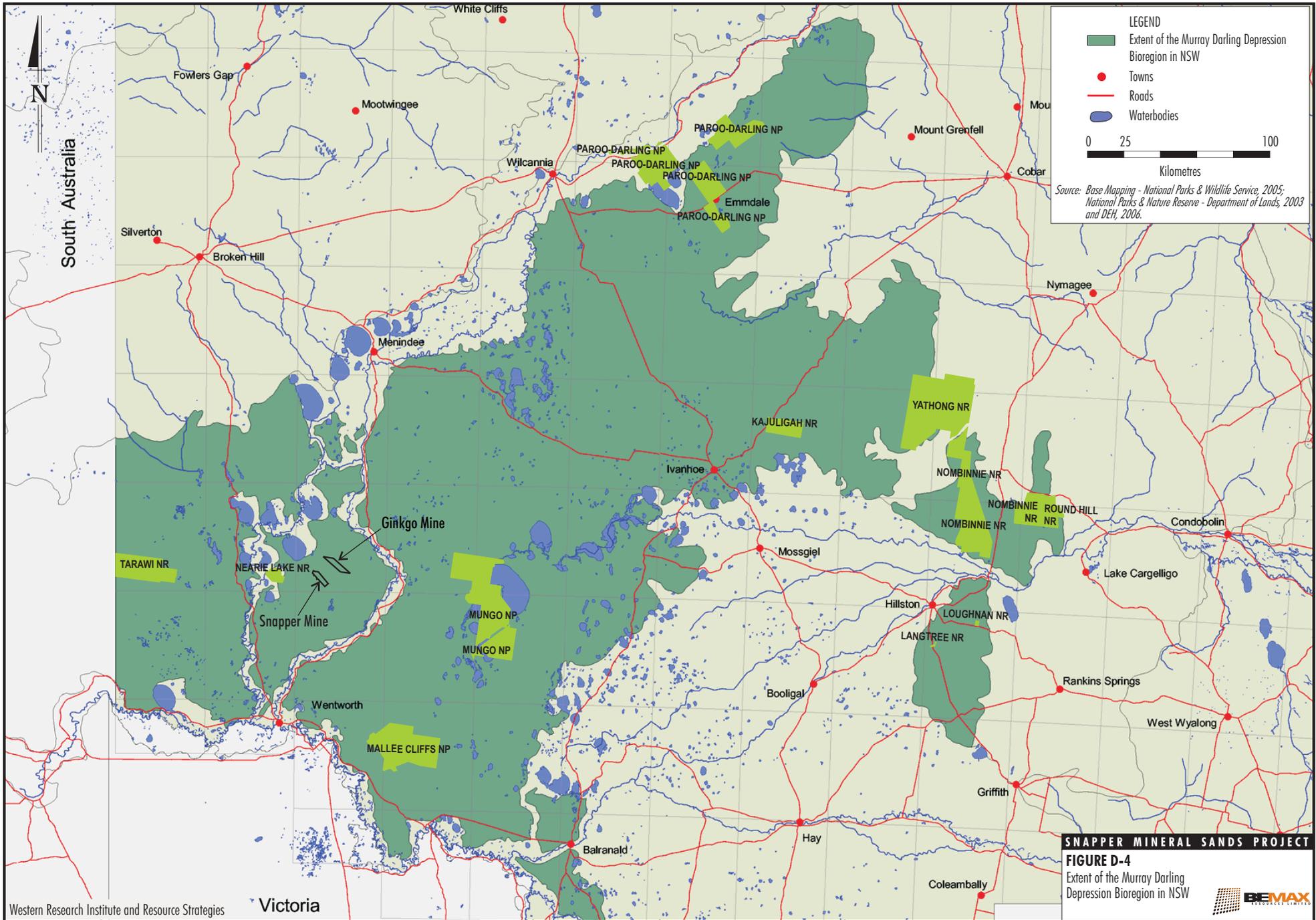


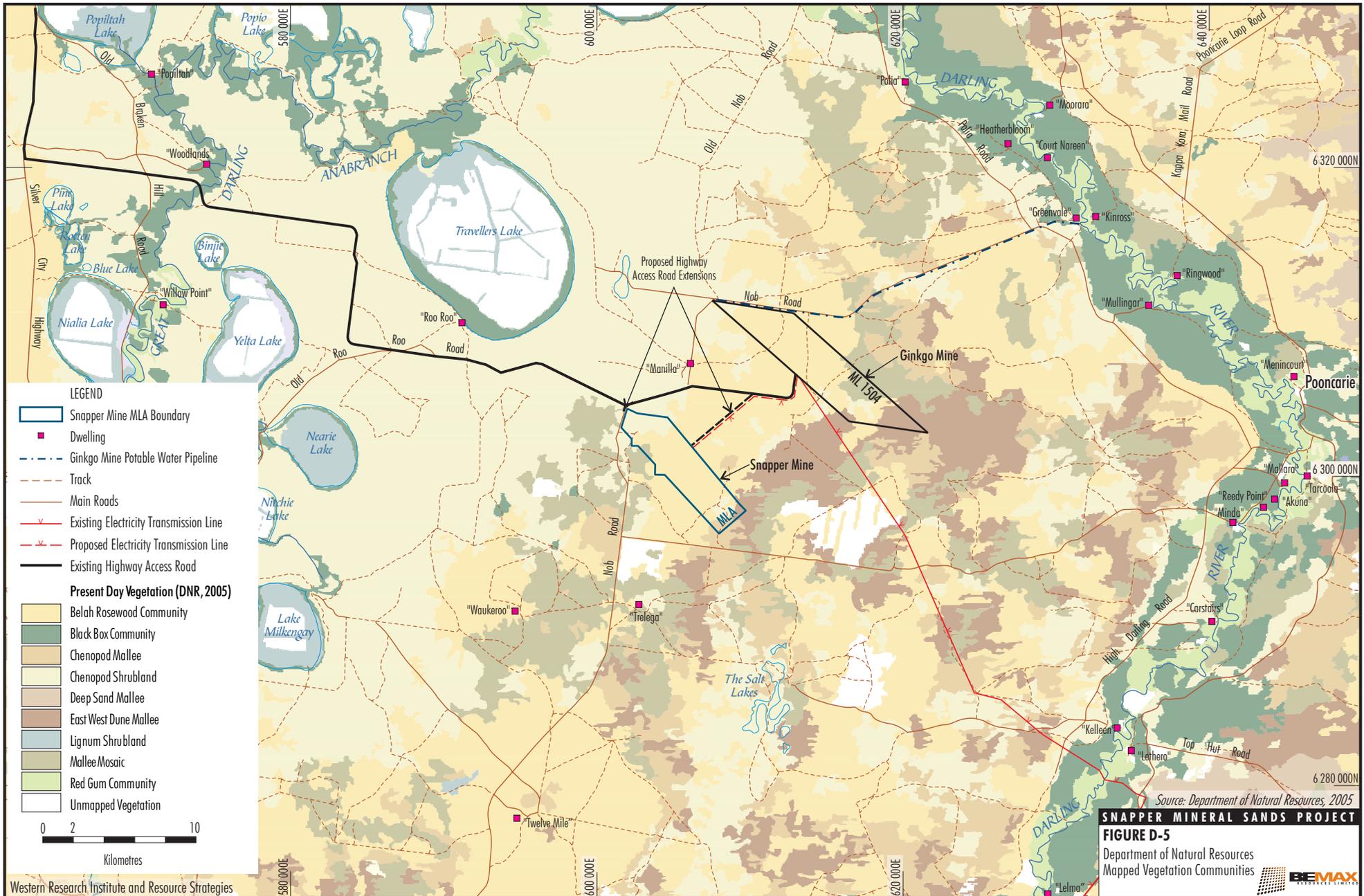
**SNAPPER MINERAL SANDS PROJECT**

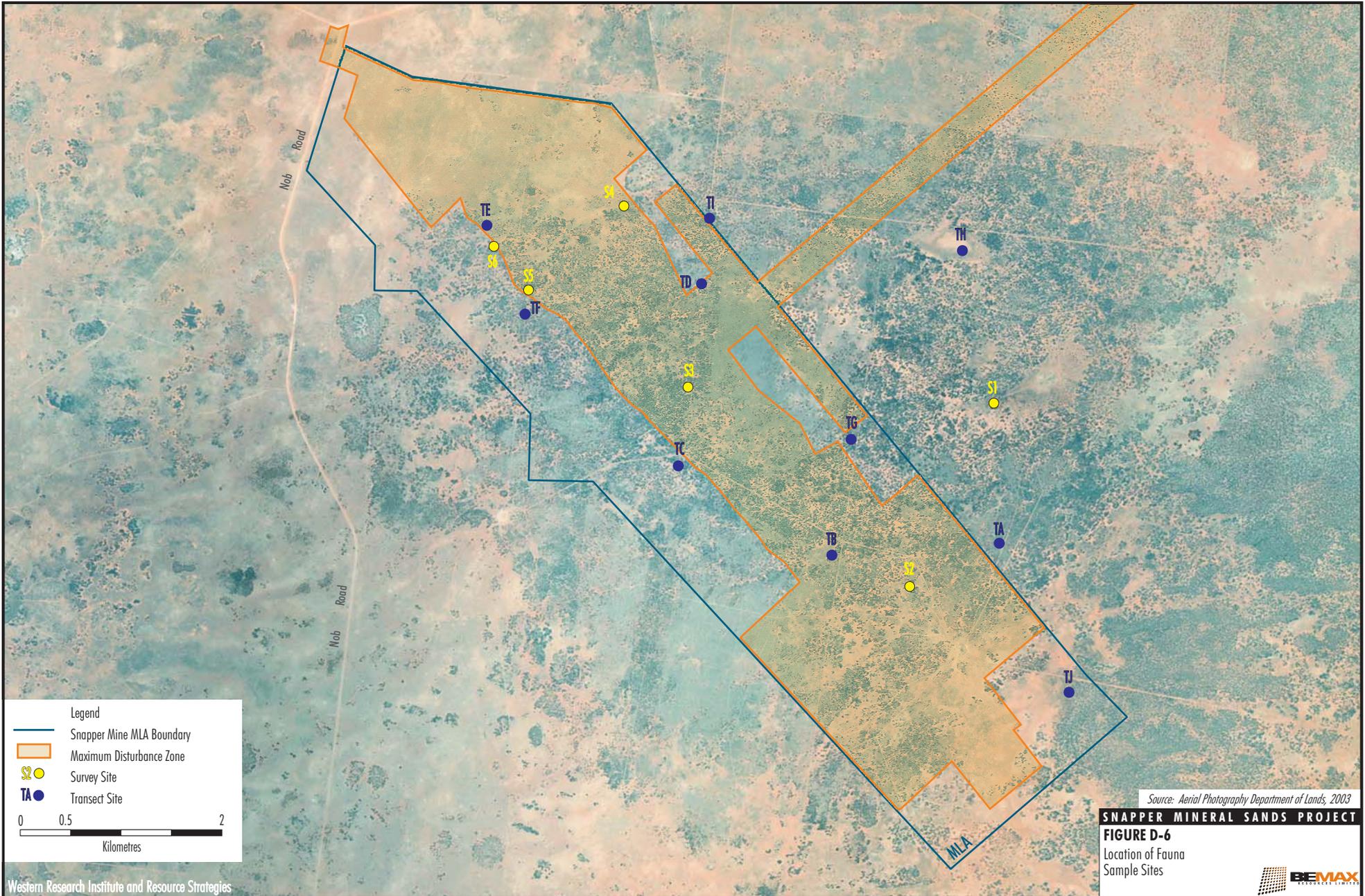
**FIGURE D-2**  
Snapper Mine  
General Arrangement Year 1











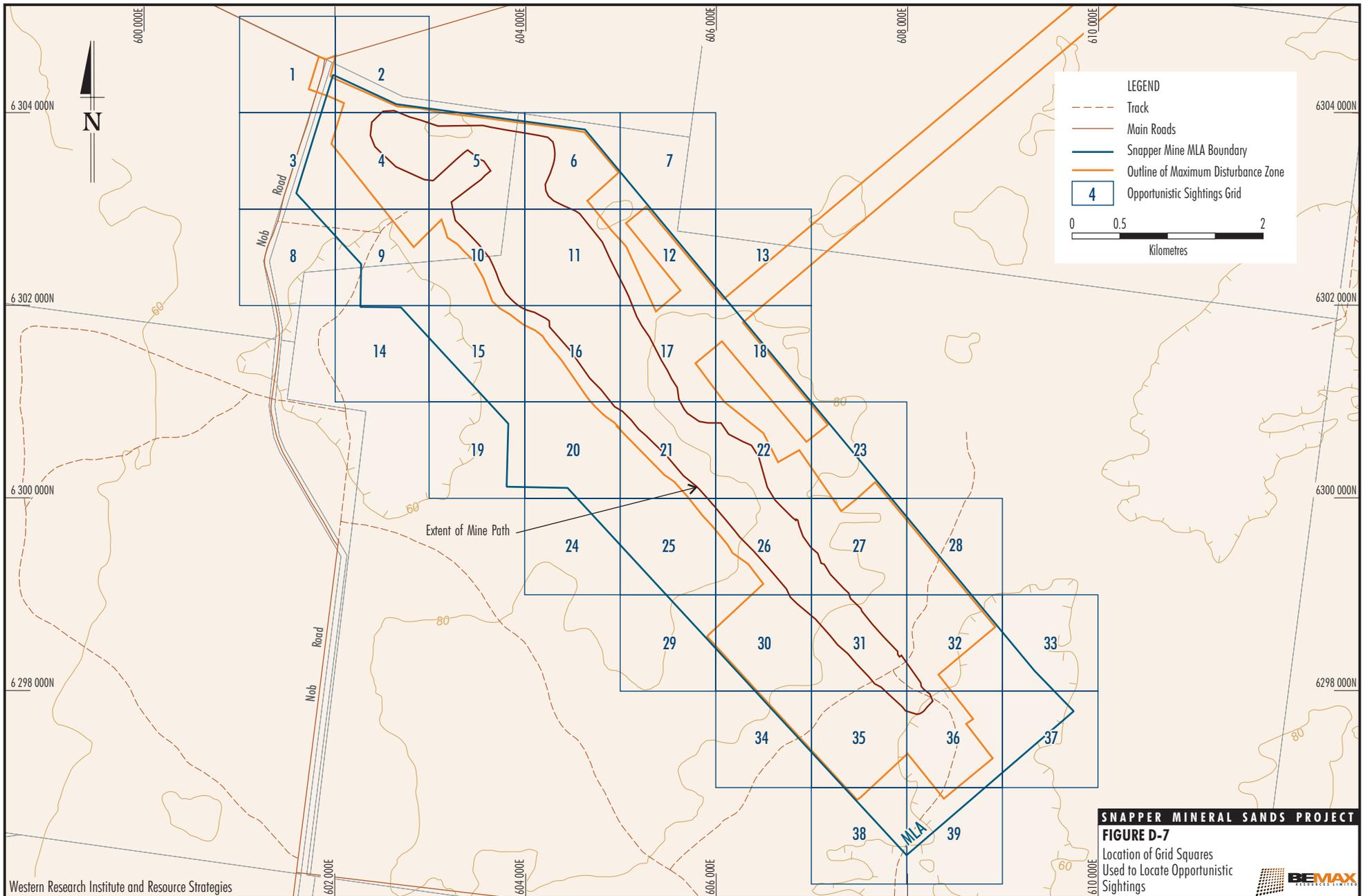
Source: Aerial Photography Department of Lands, 2003

**SNAPPER MINERAL SANDS PROJECT**

**FIGURE D-6**

Location of Fauna  
Sample Sites



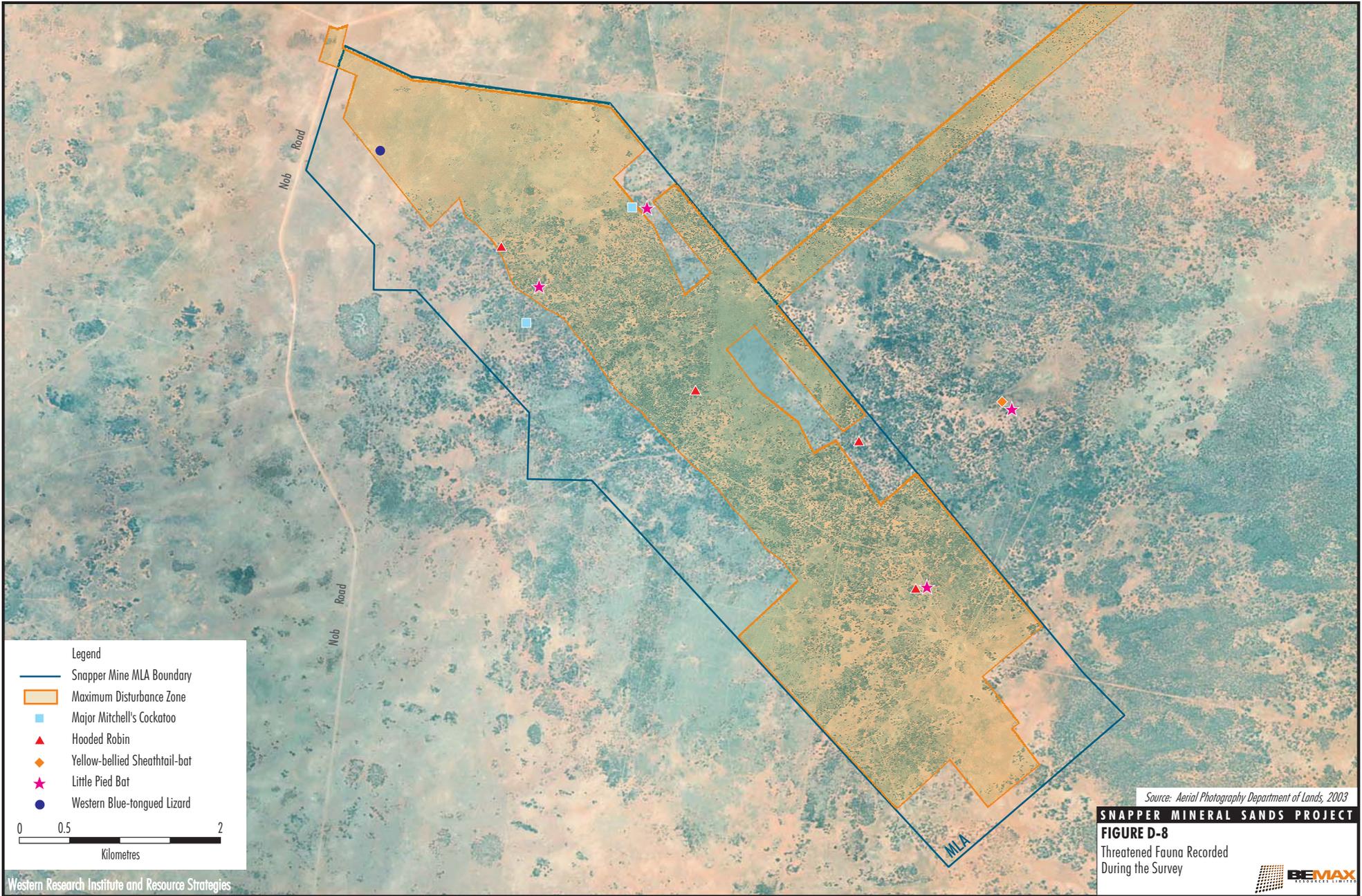


**SNAPPER MINERAL SANDS PROJECT**

**FIGURE D-7**

Location of Grid Squares  
Used to Locate Opportunistic  
Sightings





ATTACHMENT DA  
SURVEY EFFORT  
MARCH 2006

**Table DA-1  
Survey Effort**

Method	Site location					
	S1	S2	S3	S4	S5	S6
Elliott Type A on Ground	100 TN	100 TN	100 TN	100 TN	100 TN	100 TN
Elliott Type B on Ground	60 TN	60 TN	60 TN	60 TN	60 TN	60 TN
Tree Elliott	40 TN	40 TN	40 TN	40 TN	40 TN	40 TN
Hair Tube on Ground (large + small)	150 TN	150 TN	150 TN	150 TN	150 TN	150 TN
Tree Hair Tube	60 TN	60 TN	60 TN	60 TN	60 TN	60 TN
Pitfall Traps	48 TN	48 TN	48 TN	42 TN	42 TN	42 TN
Spotlighting	2 x 1 hour (hr)	2 x 1 hr	2 x 1 hr	2 x 1 hr	2 x 1 hr	2 x 1 hr
Spotlighting along Tracks	Two nights with three separate observers, covering all tracks in the area totalling six spotlight hours.					
Herpetological Searches (2 people)	2 x 1 hr	2 x 1 hr	2 x 1 hr	2 x 1 hr	2 x 1 hr	2 x 1 hr
Bird Surveys (1 person)	2 x 1 hr	2 x 1 hr	2 x 1 hr	2 x 1 hr	2 x 1 hr	2 x 1 hr
Nocturnal Call Playback	2 x 30 minutes (mins)	2 x 30 mins	2 x 30 mins	2 x 30 mins	2 x 30 mins	2 x 30 mins
Harp Traps	4 harp trap nights (TN)	-	-	4 harp TN	4 harp TN	-
Anabat Detectors	4 Anabat Detector nights	-	4 Anabat Detector nights			
Harp Traps and Anabat Detectors	4 Anabat Detector nights at dam near Site S2; 4 harp TN at dam near Site S2.					
Opportunistic Observations, Surveys and Searches	<i>Ad lib.</i> across the survey site: estimated 50-75 person hours, location noted within one kilometre grid square with the date of observation.					
Additional Transects	10 transects were established to cover additional habitats at 2 hours per transect.					

TN = Trap Nights

ATTACHMENT DB  
VERTEBRATE FAUNA SPECIES WITHIN  
THE STUDY AREA AND THE SURROUNDS

**Table DB-1**  
**Vertebrate Fauna Species within the study area and the Surrounds**

**Source of Record**

- <sup>1</sup> Department of Environment and Conservation (2006) *BIONET- User Defined Grid of Lat/Long - 141.57,-33.63,142.2,-33.12*. Accessed 20/3/06.
- <sup>2</sup> Mount King Ecological Surveys (2001) *Ginkgo Mineral Sands Project Fauna Assessment*. Prepared for BEMAX Pty Ltd.
- <sup>3</sup> Birds Australia (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the Study area. Data received May 2006.
- <sup>4</sup> Australian Museum (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the Study area. Data received May 2006.
- <sup>5</sup> Species recorded during the fauna survey conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006.

Scientific Name	Common Name	Status**		Source of Record					Detailed Results of the Fauna Survey Conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006														Opportunistic Observation (Grid No)			
									Site						Transect											
									TSC Act	EPBC Act	1	2	3	4	5	S1	S2	S3	S4	S5	S6	TA		TB	TC	TD
<b>AMPHIBIA</b>																										
<b>Hylidae</b>																										
<i>Litoria caerulea</i>	Green Tree Frog	P	-	✓	-	-	-	-																		
<i>Litoria peronii</i>	Peron's Tree Frog	P	-	✓	-	-	-	-																		
<b>Myobatrachidae</b>																										
<i>Limnodynastes tasmaniensis</i>	Spotted Marsh Frog	P	-	✓	✓	-	-	-																		
<i>Neobatrachus centralis</i>	Trilling Frog	P	-	-	✓	-	-	-																		
<i>Neobatrachus pictus</i>	Painted Burrowing Frog	E	-	-	✓	-	-	-																		
<i>Neobatrachus sudelli</i>	Painted Spadefoot Toad	P	-	-	✓	-	✓	-																		
<b>REPTILIA</b>																										
<b>Cheluidae</b>																										
<i>Chelodonia longicollis</i>	Eastern Snake-necked Turtle	P	-	-	✓	-	-	-																		
<b>Agamidae</b>																										
<i>Amphibolurus nobbi</i>	Nobbi Dragon	P	-	-	-	-	-	✓	1																	23
<i>Ctenophorus fordi</i>	Mallee Dragon	P	-	-	✓	-	-	-																		
<i>Pogona vitticeps</i>	Central Bearded Dragon	P	-	✓	✓	-	-	✓	1																	12, 13, 27
<i>Tympanocryptis lineata</i>	Lined Earless Dragon	P	-	✓	✓	-	✓	-																		
<b>Boidae</b>																										
<i>Morelia spilota variegata</i>	Carpet Python	P	-	✓	✓	-	-	✓																		10-B
<b>Elapidae</b>																										
<i>Pseudechis australis</i>	King Brown Snake	P	-	-	-	-	-	✓																		On road between Ginkgo and Snapper MLA's

**Table DB-1 (Continued)**  
**Vertebrate Fauna Species within the study area and the Surrounds**

**Source of Record**

- <sup>1</sup> Department of Environment and Conservation (2006) *BIONET- User Defined Grid of Lat/Long - 141.57,-33.63,142.2,-33.12*. Accessed 20/3/06.  
<sup>2</sup> Mount King Ecological Surveys (2001) *Ginkgo Mineral Sands Project Fauna Assessment*. Prepared for BEMAX Pty Ltd.  
<sup>3</sup> Birds Australia (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the Study area. Data received May 2006.  
<sup>4</sup> Australian Museum (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the Study area. Data received May 2006.  
<sup>5</sup> Species recorded during the fauna survey conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006.

Scientific Name	Common Name	Status**		Source of Record					Detailed Results of the Fauna Survey Conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006																	
									Site						Transect										Opportunistic Observation (Grid No)	
									TSC Act	EPBC Act	1	2	3	4	5	S1	S2	S3	S4	S5	S6	TA	TB	TC		TD
<b>AMPHIBIA (Cont.)</b>																										
<i>Pseudonaja textilis</i>	Eastern Brown Snake	P	-	-	-	-	-	✓																		Near Greentree T/O on Pooncarie Rd
<i>Suta nigriceps</i>	Short-tailed Snake	P	-	-	-	-	-	✓	1																	
<b>Gekkonidae</b>																										
<i>Strophurus elderi</i>	Jewelled Gecko	V	-	-	✓	-	-	-																		
<i>Diplodactylus stenodactylus</i>	Crowned Gecko	V	-	-	✓	-	-	-																		
<i>Diplodactylus tessellatus</i>	Tesselated Gecko	P	-	✓	✓	-	-	-																		
<i>Diplodactylus vittatus</i>	Eastern Stone Gecko	P	-	✓	✓	-	-	✓		1				1												
<i>Gehyra variegata</i>	Varied Dtella	P	-	✓	✓	-	-	✓	1	1	2	1	5				1	1								
<i>Heteronotia binoei</i>	Prickly Gecko	P	-	✓	✓	-	-	✓	1	X	1	4	4			2							X		5, 12, 15	
<i>Lucasium damaeum</i>	Beaded Gecko	P	-	✓	✓	-	-	✓	1				1												10	
<i>Rhynchoedura ornata</i>	Beaked Gecko	P	-	✓	✓	-	-	✓	2	6			1	2	6									X	10	
<i>Underwoodisaurus milii</i>	Thick-tailed Gecko	P	-	✓	-	-	-	✓							2											
<b>Pygopidae</b>																										
<i>Pygopus schraderi</i>	Eastern Hooded Scaly-foot	P	-	-	✓	-	-	-																		
<b>Scincidae</b>																										
<i>Cryptoblepharus carnabyi</i>	Shiny-palmed Shinning-skink	P	-	✓	✓	-	-	✓			1	1					1	1								
<i>Ctenotus atlas</i>	Southern Mallee Ctenotus	P	-	-	✓	-	-	✓	1													X			23	
<i>Ctenotus brachyonix</i>	-	P	-	-	-	-	-	✓	4																	
<i>Ctenotus brooksi</i>	Wedgesnout Ctenotus	V	-	-	✓	-	-	-																		
<i>Ctenotus leonhardi</i>	Leonardi's Ctenotus	P	-	-	✓	-	-	-																		
<i>Ctenotus regius</i>	Pale-rumped Ctenotus	P	-	✓	-	-	-	✓	4			1	2	3	1		1	1		X	2	X			5	10, 12

**Table DB-1 (Continued)**  
**Vertebrate Fauna Species within the study area and the Surrounds**

**Source of Record**

- <sup>1</sup> Department of Environment and Conservation (2006) *BIONET- User Defined Grid of Lat/Long - 141.57,-33.63,142.2,-33.12*. Accessed 20/3/06.
- <sup>2</sup> Mount King Ecological Surveys (2001) *Ginkgo Mineral Sands Project Fauna Assessment*. Prepared for BEMAX Pty Ltd.
- <sup>3</sup> Birds Australia (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the Study area. Data received May 2006.
- <sup>4</sup> Australian Museum (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the Study area. Data received May 2006.
- <sup>5</sup> Species recorded during the fauna survey conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006.

Scientific Name	Common Name	Status**		Source of Record					Detailed Results of the Fauna Survey Conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006																	
									Site						Transect											Opportunistic Observation (Grid No)
									TSC Act	EPBC Act	1	2	3	4	5	S1	S2	S3	S4	S5	S6	TA	TB	TC	TD	
<b>AMPHIBIA (Cont.)</b>																										
<i>Ctenotus schomburgkii</i>	Barred Wedge-snout Ctenotus	P	-	✓	✓	-	✓	✓		X	2			1	2				X				X	1	5, 6, 17	
<i>Egernia inornata</i>	Unadorned Desert-skink	P	-	✓	-	-	-	-																		
<i>Egernia striolata</i>	Tree-crevice Skink	P	-	✓	-	-	-	-																		
<i>Eremiascincus fasciolatus</i>	Narrow-banded Sand-swimmer	P	-	-	✓	-	-	-																		
<i>Lerista punctatovittata</i>	Eastern Robust Slider	P	-	✓	✓	-	-	✓	1					2	1											
<i>Morethia adelaidensis</i>	Shrubland Morethia Skink	P	-	-	✓	-	-	-																		
<i>Morethia boulengeri</i>	South-eastern Morethia Skink	P	-	✓	✓	-	-	✓	1				8	1		X			1						11	
<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard	V	-	✓	✓	-	-	✓																	4 (recent skin)	
<i>Trachydosaurus rugosus</i>	Shingleback Lizard	P	-	✓	✓	-	-	✓		2					1									R		
<b>Typhlopidae</b>																										
<i>Rhamphotyphlops bituberculatus</i>	Prong-snouted Blind-snake	P	-	-	✓	-	-	-																		
<b>Varanidae</b>																										
<i>Varanus gouldii</i>	Sand Monitor	P	-	✓	✓	-	-	✓		1 J													X			
<i>Varanus varius</i>	Lace Monitor	P	-	-	✓	-	-	-																		
<b>AVES</b>																										
<b>Acanthizidae</b>																										
<i>Acanthiza apicalis</i>	Inland Thornbill	P	-	-	✓	-	-	✓			2					X						X				
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	P	-	✓	✓	✓	-	✓				4										X			10, 11, 12	
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill	P	-	✓	✓	✓	-	✓	4+	16	8	2	13	2+, 4-O		x	X	X		X	X	X	X		6, 7, 8, 10, 11, 26, 27, 28	

**Table DB-1 (Continued)**  
**Vertebrate Fauna Species within the study area and the Surrounds**

**Source of Record**

- <sup>1</sup> Department of Environment and Conservation (2006) *BIONET- User Defined Grid of Lat/Long - 141.57,-33.63,142.2,-33.12*. Accessed 20/3/06.  
<sup>2</sup> Mount King Ecological Surveys (2001) *Ginkgo Mineral Sands Project Fauna Assessment*. Prepared for BEMAX Pty Ltd.  
<sup>3</sup> Birds Australia (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the Study area. Data received May 2006.  
<sup>4</sup> Australian Museum (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the Study area. Data received May 2006.  
<sup>5</sup> Species recorded during the fauna survey conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006.

Scientific Name	Common Name	Status**		Source of Record					Detailed Results of the Fauna Survey Conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006														Opportunistic Observation (Grid No)		
		TSC Act	EPBC Act	1	2	3	4	5	Site						Transect										
									S1	S2	S3	S4	S5	S6	TA	TB	TC	TD	TE	TF	TG	TH		TI	TJ
<b>AVES (Cont.)</b>																									
<i>Aphelocephala leucopsis</i>	Southern Whiteface	P	-	✓	✓	✓	-	✓						8			X			X		X	X		4, 6, 7, 8, 10, 12, 17, 21, 23, 28
<i>Aphelocephala nigricincta</i>	Banded Whiteface	P	-	-	✓	-	-	-																	
<i>Pyrholaemus brunneus</i>	Redthroat	V	-	-	✓	✓	-	-																	
<i>Smicromis brevirostris</i>	Weebill	P	-	✓	-	✓	-	✓	5					3											10
<b>Accipitridae</b>																									
<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk	P	-	-	-	-	-	✓		O															17
<i>Aquila audax</i>	Wedge-tailed Eagle	P	-	✓	✓	✓	-	✓									N								10
<i>Circus approximans</i>	Swamp Harrier	P	-	-	✓	-	-	-																	
<i>Circus assimilis</i>	Spotted Harrier	P	-	-	-	✓	-	-																	
<i>Elanus axillaris</i>	Black-shouldered Kite	P	-	-	✓	-	-	-																	
<i>Elanus scriptus</i>	Letter-winged Kite	P	-	-	✓	-	-	-																	
<i>Haliastur sphenurus</i>	Whistling Kite	P	-	✓	✓	✓	-	-																	
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard	V	-	✓	-	✓	-	-																	
<i>Hieraaetus morphnoides</i>	Little Eagle	P	-	✓	✓	-	-	✓																	26
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	-	✓	-	-	-																	
<i>Milvus migrans</i>	Black Kite	P	-	-	✓	-	-	-																	
<b>Aegothelidae</b>																									
<i>Aegotheles cristatus</i>	Australian Owllet-nightjar	P	-	✓	✓	✓	-	✓	4+O	H	2	1	H	2 H,O											6, 10, 12, 15/16, 23, 36
<b>Alaudidae</b>																									
<i>Mirafra javanica</i>	Singing Bushlark	P	-	-	✓	-	-	-																	
<b>Anatidae</b>																									

**Table DB-1 (Continued)**  
**Vertebrate Fauna Species within the study area and the Surrounds**

**Source of Record**

- <sup>1</sup> Department of Environment and Conservation (2006) *BIONET- User Defined Grid of Lat/Long - 141.57,-33.63,142.2,-33.12*. Accessed 20/3/06.  
<sup>2</sup> Mount King Ecological Surveys (2001) *Ginkgo Mineral Sands Project Fauna Assessment*. Prepared for BEMAX Pty Ltd.  
<sup>3</sup> Birds Australia (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the Study area. Data received May 2006.  
<sup>4</sup> Australian Museum (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the Study area. Data received May 2006.  
<sup>5</sup> Species recorded during the fauna survey conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006.

Scientific Name	Common Name	Status <sup>1</sup>		Source of Record					Detailed Results of the Fauna Survey Conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006														Opportunistic Observation (Grid No)			
		TSC Act	EPBC Act	1	2	3	4	5	Site						Transect											
									S1	S2	S3	S4	S5	S6	TA	TB	TC	TD	TE	TF	TG	TH		TI	TJ	
<b>AVES (Cont.)</b>																										
<i>Anas gracilis</i>	Grey Teal	P	-	✓	✓	-	-	✓																		5
<i>Anas rhynchotis</i>	Australasian Shoveler	P	-	✓	-	-	-	-																		
<i>Anas superciliosa</i>	Pacific Black Duck	P	-	-	✓	✓	-	-																		
<i>Aythya australis</i>	Hardhead	P	-	✓	✓	-	-	-																		
<i>Chenonetta jubata</i>	Australian Wood Duck	P	-	✓	✓	✓	-	-																		
<i>Cygnus atratus</i>	Black Swan	P	-	✓	✓	-	-	-																		
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck	P	-	✓	-	-	-	-																		
<i>Oxyura australis</i>	Blue-billed Duck	V	-	-	✓	-	-	-																		
<i>Stricktonetta naevosa</i>	Freckled Duck	V	-	-	✓	-	-	-																		
<i>Tadorna tadornoides</i>	Australian Shelduck	P	-	-	✓	-	-	-																		
<b>Anhingidae</b>																										
<i>Anhinga melanogaster</i>	Darter	P	-	-	✓	✓	-	-																		
<b>Ardeidae</b>																										
<i>Ardea alba</i>	Great Egret	P	-	✓	-	✓	-	-																		
<i>Bubulcus ibis</i>	Cattle Egret	P	-	-	✓	-	-	-																		
<i>Ardea intermedia</i>	Intermediate Egret	P	-	✓	-	✓	-	-																		
<i>Ardea pacifica</i>	White-necked Heron	P	-	✓	✓	✓	-	-																		
<i>Egretta novaehollandiae</i>	White-faced Heron	P	-	✓	✓	✓	-	-																		
<i>Nycticorax caledonicus</i>	Nankeen Night Heron	P	-	✓	-	-	-	-																		
<b>Artamidae</b>																										
<i>Artamus cinereus</i>	Black-faced Woodswallow	P	-	✓	✓	✓	-	-																		
<i>Artamus cyanopterus</i>	Dusky Woodswallow	P	-	✓	✓	✓	-	-																		
<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	P	-	✓	-	-	-	-																		
<i>Artamus personatus</i>	Masked Woodswallow	P	-	-	✓	✓	-	-																		



**Table DB-1 (Continued)**  
**Vertebrate Fauna Species within the study area and the Surrounds**

**Source of Record**

- <sup>1</sup> Department of Environment and Conservation (2006) *BIONET- User Defined Grid of Lat/Long - 141.57,-33.63,142.2,-33.12*. Accessed 20/3/06.
- <sup>2</sup> Mount King Ecological Surveys (2001) *Ginkgo Mineral Sands Project Fauna Assessment*. Prepared for BEMAX Pty Ltd.
- <sup>3</sup> Birds Australia (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the Study area. Data received May 2006.
- <sup>4</sup> Australian Museum (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the Study area. Data received May 2006.
- <sup>5</sup> Species recorded during the fauna survey conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006.

Scientific Name	Common Name	Status <sup>1</sup>		Source of Record					Detailed Results of the Fauna Survey Conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006														Opportunistic Observation (Grid No)				
		TSC Act	EPBC Act	1	2	3	4	5	Site						Transect												
									S1	S2	S3	S4	S5	S6	TA	TB	TC	TD	TE	TF	TG	TH		TI	TJ		
<b>AVES (Cont.)</b>																											
<i>Vanellus miles</i>	Masked Lapwing	P	-	✓	✓	-	-	-																			
<i>Vanellus tricolor</i>	Banded Lapwing	P	-	✓	-	-	-	-																			
<b>Climacteridae</b>																											
<i>Climacteris affinis</i>	White-browed Treecreeper	P	-	✓	-	✓	-	✓		H							X							X		12, 17	
<i>Climacteris picumnus</i> <sup>1</sup>	Brown Treecreeper	P	-	✓	✓	✓	-	✓			2			1-O	1-O	X							X		X	9, 10, 23	
<b>Columbidae</b>																											
<i>Geopelia cuneata</i>	Diamond Dove	P	-	-	✓	✓	-	-																			
<i>Geopelia placida</i>	Peaceful Dove	P	-	✓	✓	-	-	-																			
<i>Geopelia strata</i>	Squatter Pigeon	P	-	-	-	✓	-	-																			
<i>Ocyphaps lophotes</i>	Crested Pigeon	P	-	✓	✓	✓	-	✓	1-O				2		1-O										X	5, 6, 7, 11, 12, 31, 32, north of grid 7	
<i>Phaps chalcoptera</i>	Common Bronzewing	P	-	✓	✓	-	-	✓		2					1 AC										X	Site1, 21, 26	
<b>Corcoracidae</b>																											
<i>Corcorax melanorhamphos</i>	White-winged Chough	P	-	✓	✓	-	-	✓	OS	8																	31, 32
<i>Struthidea cinerea</i>	Apostlebird	P	-	✓	✓	✓	-	✓					20										X			6, 10, 11, 12, 31, 32	
<b>Corvidae</b>																											
<i>Corvus bennetti</i>	Little Crow	P	-	-	✓	✓	-	-																			
<i>Corvus coronoides</i>	Australian Raven	P	-	✓	✓	✓	-	✓		1+H	H-O			1-O	H-O	X				X			X		X		
<i>Corvus mellori</i>	Little Raven	P	-	-	✓	✓	-	✓	OS	5	H-O			1-O								X	X			12, 31, 32	
<b>Cuculidae</b>																											
<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo	P	-	✓	-	✓	-	-																			

<sup>1</sup> The distribution of the threatened sub-species of the Brown Treecreeper (*Climacteris picumnus victoriae*) is not considered to occur within of the study area.

**Table DB-1 (Continued)**  
**Vertebrate Fauna Species within the study area and the Surrounds**

**Source of Record**

- <sup>1</sup> Department of Environment and Conservation (2006) *BIONET- User Defined Grid of Lat/Long - 141.57,-33.63,142.2,-33.12*. Accessed 20/3/06.
- <sup>2</sup> Mount King Ecological Surveys (2001) *Ginkgo Mineral Sands Project Fauna Assessment*. Prepared for BEMAX Pty Ltd.
- <sup>3</sup> Birds Australia (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the Study area. Data received May 2006.
- <sup>4</sup> Australian Museum (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the study area. Data received May 2006.
- <sup>5</sup> Species recorded during the fauna survey conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006.

Scientific Name	Common Name	Status <sup>1</sup>		Source of Record					Detailed Results of the Fauna Survey Conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006														Opportunistic Observation (Grid No)														
		TSC Act	EPBC Act	1	2	3	4	5	Site						Transect																						
									S1	S2	S3	S4	S5	S6	TA	TB	TC	TD	TE	TF	TG	TH		TI	TJ												
<b>AVES (Cont.)</b>																																					
<i>Chrysococcyx osculans</i>	Black-eared Cuckoo	P	-	-	✓	✓	-	-																													
<i>Cuculus pallidus</i>	Pallid Cuckoo	P	-	-	✓	-	-	-																													
<b>Cinclosomatidae</b>																																					
<i>Psophodes cristatus</i>	Chirruping Wedgebill	P	-	-	✓	-	-	-																													
<b>Dicaeidae</b>																																					
<i>Dicaeum hirundinaceum</i>	Mistletoebird	P	-	✓	-	✓	-	✓																												11, 12	
<b>Dicruridae</b>																																					
<i>Grallina cyanoleuca</i>	Magpie-lark	P	-	✓	✓	✓	-	✓																											X	31, 32, 36	
<i>Myiagra inquieta</i>	Restless Flycatcher	P	-	✓	✓	✓	-	-																													
<i>Rhipidura leucophrys</i>	Willie Wagtail	P	-	✓	✓	✓	-	✓																												10, 12, 28, north of grid 7	
<i>Rhipidura fuliginosa</i>	Grey Fantail	P	-	-	✓	✓	-	-																													
<b>Estrildidae</b>																																					
<i>Taeniopygia guttata</i>	Zebra Finch	P	-	-	✓	✓	-	-																													
<b>Falconidae</b>																																					
<i>Falco berigora</i>	Brown Falcon	P	-	-	✓	-	-	✓																												4, N	
<i>Falco cenchroides</i>	Nankeen Kestrel	P	-	✓	✓	✓	-	✓																												X	39
<i>Falco hypoleucos</i>	Grey Falcon	V	-	-	✓	-	-	-																													
<i>Falco longipennis</i>	Australian Hobby	P	-	-	✓	-	-	-																													
<i>Falco peregrinus</i>	Peregrine Falcon	P	-	-	✓	-	-	✓																													
<b>Halcyonidae</b>																																					
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	P	-	✓	✓	✓	-	-																													
<i>Todiramphus sanctus</i>	Sacred Kingfisher	P	-	✓	✓	✓	-	-																													
<i>Todiramphus pyrrhopygia</i>	Red-backed Kingfisher	P	-	-	✓	✓	-	-																													



**Table DB-1 (Continued)**  
**Vertebrate Fauna Species within the study area and the Surrounds**

**Source of Record**

- <sup>1</sup> Department of Environment and Conservation (2006) *BIONET- User Defined Grid of Lat/Long - 141.57,-33.63,142.2,-33.12*. Accessed 20/3/06.  
<sup>2</sup> Mount King Ecological Surveys (2001) *Ginkgo Mineral Sands Project Fauna Assessment*. Prepared for BEMAX Pty Ltd.  
<sup>3</sup> Birds Australia (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the study area. Data received May 2006.  
<sup>4</sup> Australian Museum (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the study area. Data received May 2006.  
<sup>5</sup> Species recorded during the fauna survey conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006.

Scientific Name	Common Name	Status <sup>1</sup>		Source of Record					Detailed Results of the Fauna Survey Conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006														Opportunistic Observation (Grid No)						
		TSC Act	EPBC Act	1	2	3	4	5	Site						Transect														
									S1	S2	S3	S4	S5	S6	TA	TB	TC	TD	TE	TF	TG	TH		TI	TJ				
<b>AVES (Cont.)</b>																													
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	P	-	-	-	-	-	✓																		X			
<i>Manorina flavigula</i>	Yellow-throated Miner	P	-	✓	✓	✓	-	✓																	X		5, 6, 11		
<i>Philemon citreogularis</i>	Little Friarbird	P	-	✓	✓	-	-	-																					
<i>Phylidonyris albiglans</i>	White-fronted Honeyeater	P	-	✓	-	✓	-	-																					
<i>Plectorhyncha lanceolata</i>	Striped Honeyeater	P	-	✓	-	✓	-	✓		1			1	1-O											X		10, 12, 26		
<b>Meropidae</b>																													
<i>Merops ornatus</i>	Rainbow Bee-eater	P	M	✓	-	✓	-	✓																	X				
<b>Motacillidae</b>																													
<i>Anthus australis</i>	Australian Pipit	P	-	✓	✓	-	-	✓																				2, 9	
<b>Neosittidae</b>																													
<i>Daphoenositta chrysoptera</i>	Varied Sittella	P	-	-	-	-	-	✓																				27	
<b>Pachycephalidae</b>																													
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	P	-	✓	✓	✓	-	✓	1				1													X	X	21	
<i>Oreoica gutturalis</i>	Crested Bellbird	P	-	✓	✓	✓	-	✓	OS		1	H	H-O	H-O					X		X	X				X		12, 17, 23, 31	
<i>Pachycephala rufiventris</i>	Rufous Whistler	P	-	✓	✓	✓	-	✓																	X	X		12	
<b>Pardalotidae</b>																													
<i>Pardalotus punctatus</i>	Spotted Pardalote	P	-	-	✓	-	-	-																					
<i>Pardalotus striatus</i>	Striated Pardalote	P	-	✓	✓	✓	-	-																					
<b>Passeridae</b>																													
<i>Passer domesticus</i>	House Sparrow	P	-	-	-	✓	-	-																					
<b>Pelicanidae</b>																													
<i>Pelicanus conspicillatus</i>	Australian Pelican	P	-	-	✓	✓	-	-																					

**Table DB-1 (Continued)**  
**Vertebrate Fauna Species within the study area and the Surrounds**

**Source of Record**

- 1 Department of Environment and Conservation (2006) *BIONET- User Defined Grid of Lat/Long - 141.57,-33.63,142.2,-33.12*. Accessed 20/3/06.
- 2 Mount King Ecological Surveys (2001) *Ginkgo Mineral Sands Project Fauna Assessment*. Prepared for BEMAX Pty Ltd.
- 3 Birds Australia (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the study area. Data received May 2006.
- 4 Australian Museum (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the study area. Data received May 2006.
- 5 Species recorded during the fauna survey conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006.

Scientific Name	Common Name	Status <sup>1</sup>		Source of Record					Detailed Results of the Fauna Survey Conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006														Opportunistic Observation (Grid No)	
		TSC Act	EPBC Act	1	2	3	4	5	Site						Transect									
									S1	S2	S3	S4	S5	S6	TA	TB	TC	TD	TE	TF	TG	TH		TI
<b>AVES (Cont.)</b>																								
<b>Petroicidae</b>																								
<i>Melanodryas cucullata cucullata</i>	Hooded Robin	V	-	✓	✓	✓	-	✓		2	1			1						X			X	3, 12, 17, 23, 27, 28
<i>Microeca fascians</i>	Jacky Winter	P	-	✓	✓	-	-	-																
<i>Petroica goodenovii</i>	Red-capped Robin	P	-	✓	✓	✓	-	✓	1	2	2	1	1	2	X	x	X	X		X	X	X	X	5, 7, 10, 11, 12, 23, 28, 31
<b>Phalacrocoracidae</b>																								
<i>Phalacrocorax carbo</i>	Great Cormorant	P	-	✓	✓	✓	-	-																
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	P	-	-	✓	✓	-	-																
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	P	-	✓	✓	-	-	-																
<i>Phalacrocorax varius</i>	Pied Cormorant	P	-	✓	✓	✓	-	-																
<b>Podargidae</b>																								
<i>Podargus strigoides</i>	Tawny Frogmouth	P	-	✓	✓	-	-	✓	1					1										6, 12, 13, 15/16, 27
<b>Podicipedidae</b>																								
<i>Polyocephalus polyocephalus</i>	Hoary-headed Grebe	P	-	✓	✓	-	-	-																
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	P	-	✓	✓	-	-	-																
<b>Pomatostomidae</b>																								
<i>Pomatostomus ruficeps</i>	Chestnut-crowned Babbler	P	-	-	✓	✓	-	✓			OS	X		8-O					X			X		4-N, 6, 7, 9, 11, 12, 13, 25, 31
<i>Pomatostomus superciliosus</i>	White-browed Babbler	P	-	✓	✓	-	-	-																
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	V	-	-	✓	-	-	-																

**Table DB-1 (Continued)**  
**Vertebrate Fauna Species within the study area and the Surrounds**

**Source of Record**

- <sup>1</sup> Department of Environment and Conservation (2006) *BIONET- User Defined Grid of Lat/Long - 141.57,-33.63,142.2,-33.12*. Accessed 20/3/06.  
<sup>2</sup> Mount King Ecological Surveys (2001) *Ginkgo Mineral Sands Project Fauna Assessment*. Prepared for BEMAX Pty Ltd.  
<sup>3</sup> Birds Australia (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the study area. Data received May 2006.  
<sup>4</sup> Australian Museum (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the study area. Data received May 2006.  
<sup>5</sup> Species recorded during the fauna survey conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006.

Scientific Name	Common Name	Status <sup>1</sup>		Source of Record					Detailed Results of the Fauna Survey Conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006														Opportunistic Observation (Grid No)		
		TSC Act	EPBC Act	1	2	3	4	5	Site						Transect										
									S1	S2	S3	S4	S5	S6	TA	TB	TC	TD	TE	TF	TG	TH		TI	TJ
<b>AVES (Cont.)</b>																									
<b>Psittacidae</b>																									
<i>Barnardius zonarius barnardi</i>	Mallee Ringneck	P	-	✓	✓	✓	-	✓	25+	35	3+	13	8	H-O						X			X	X	15, 22, 26, 27, 31
<i>Calyptorhynchus banksii</i>	Red-tailed Black-cockatoo	V	-	-	-	✓	-	-																	
<i>Melopsittacus undulatus</i>	Budgerigar	P	-	-	✓	-	-	-																	
<i>Neophema chrysostoma</i>	Blue-winged Parrot	P	-	-	✓	✓	-	-																	
<i>Northiella haematogaster</i>	Blue Bonnet	P	-	✓	✓	✓	-	✓		X	1 + 2AC	2		1								X			6, 9, 11, 31, 32
<i>Platycercus elegans flaveolus</i>	Yellow Rosella	P	-	✓	✓	-	-	-																	
<i>Polytelis anthopeplus monarchoides</i>	Regent Parrot	E	V	-	✓	-	-	-																	
<i>Psephotus haematonotus</i>	Red-rumped Parrot	P	-	✓	✓	✓	-	-																	
<i>Psephotus varius</i>	Mulga Parrot	P	-	✓	✓	✓	-	✓	X	X	2 AC		1										X		6, 11, 12, 21, 23
<b>Rallidae</b>																									
<i>Fulica atrio</i>	Eurasian Coot	P	-	-	✓	-	-	-																	
<i>Gallinula ventralis</i>	Black-tailed Native-hen	P	-	✓	-	✓	-	-																	
<i>Porphyrio porphyrio</i>	Purple Swamphen	P	-	-	✓	-	-	-																	
<b>Recurvirostridae</b>																									
<i>Himantopus himantopus</i>	Black-winged Stilt	P	-	✓	-	✓	-	-																	
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet	P	-	-	✓	-	-	-																	
<b>Strigidae</b>																									
<i>Ninox connivens</i>	Barking Owl	V	-	-	✓	-	-	-																	
<i>Ninox novaeseelandiae</i>	Southern Boobook	P	-	✓	✓	-	-	-																	



**Table DB-1 (Continued)**  
**Vertebrate Fauna Species within the study area and the Surrounds**

**Source of Record**

- <sup>1</sup> Department of Environment and Conservation (2006) *BIONET- User Defined Grid of Lat/Long - 141.57,-33.63,142.2,-33.12*. Accessed 20/3/06.
- <sup>2</sup> Mount King Ecological Surveys (2001) *Ginkgo Mineral Sands Project Fauna Assessment*. Prepared for BEMAX Pty Ltd.
- <sup>3</sup> Birds Australia (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the study area. Data received May 2006.
- <sup>4</sup> Australian Museum (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the study area. Data received May 2006.
- <sup>5</sup> Species recorded during the fauna survey conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006.

Scientific Name	Common Name	Status <sup>1</sup>		Source of Record					Detailed Results of the Fauna Survey Conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006														Opportunistic Observation (Grid No)				
		TSC Act	EPBC Act	1	2	3	4	5	Site						Transect												
									S1	S2	S3	S4	S5	S6	TA	TB	TC	TD	TE	TF	TG	TH		TI	TJ		
<b>MAMMALIA (Cont.)</b>																											
<i>Vulpes vulpes</i>	Red Fox	U	-	-	✓	-	-	✓				X			S												4, 6 (urinated on traps), 10, 15/16
<b>Dasyuridae</b>																											
<i>Sminthopsis murina</i>	Common Dunnart	P	-	✓	✓	-	-	-																			
<b>Emballonuridae</b>																											
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V	-	-	✓	-	-	✓	3																		
<b>Felidae</b>																											
<i>Felis catus</i>	Cat	U	-	✓	✓	-	-	-																			
<b>Leporidae</b>																											
<i>Oryctylagus cuniculus</i>	Rabbit	U	-	-	✓	-	-	✓		S														X S		4, 5, 6, 7, 9, 10, 11, 12, 13, 13A, 15/16, 31	
<b>Macropodidae</b>																											
<i>Macropus giganteus</i>	Eastern Grey Kangaroo	P	-	-	-	-	-	✓																		31	
<i>Macropus fuliginosus</i>	Western Grey Kangaroo	P	-	✓	✓	-	-	✓		S	Several			S	S								X	X S	S	10, 12, 13, 15/16, 17, 26	
<i>Macropus rufus</i>	Red Kangaroo	P	-	✓	✓	-	-	✓	1+S	S	Several			X	S	S							X	S		6, 10, 11, 12, 15, 23, 26, 28, 31, 32	
<b>Molossidae</b>																											
<i>Mormopterus sp. (little penis)</i>	-	P	-	✓	-	-	-	-																			
<i>Nyctinomus/Tadarida australis</i>	White-striped Mastiff Bat	P	-	-	✓	-	-	✓	2																		
<i>Mormopterus sp</i>	Inland Mastiff Bat	P	-	-	✓	-	-	-																			
<i>Mormopterus sp 3</i>	-	P	-	-	-	-	-	✓	3				4														

**Table DB-1 (Continued)**  
**Vertebrate Fauna Species within the study area and the Surrounds**

**Source of Record**

- <sup>1</sup> Department of Environment and Conservation (2006) *BIONET- User Defined Grid of Lat/Long - 141.57,-33.63,142.2,-33.12*. Accessed 20/3/06.  
<sup>2</sup> Mount King Ecological Surveys (2001) *Ginkgo Mineral Sands Project Fauna Assessment*. Prepared for BEMAX Pty Ltd.  
<sup>3</sup> Birds Australia (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the study area. Data received May 2006.  
<sup>4</sup> Australian Museum (2006) Database records within a search area of approximately 400 km<sup>2</sup> surrounding the study area. Data received May 2006.  
<sup>5</sup> Species recorded during the fauna survey conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006.

Scientific Name	Common Name	Status <sup>1</sup>		Source of Record					Detailed Results of the Fauna Survey Conducted for the Snapper Mineral Sands Project by Western Research Institute in 2006																	
		TSC Act	EPBC Act	1	2	3	4	5	Site						Transect								Opportunistic Observation (Grid No)			
									S1	S2	S3	S4	S5	S6	TA	TB	TC	TD	TE	TF	TG	TH		TI	TJ	
<b>MAMMALIA (Cont.)</b>																										
<i>Mormopterus sp 4</i>	-	P	-	-	-	-	-	✓	104	37/400			82	10	6											
<b>Muridae</b>																										
<i>Hydromys chrysogaster</i>	Water Rat	P	-	-	✓	-	-	-																		
<i>Leporillus conditor</i>	Greater Stick-nest Rat	PE	V	✓	-	-	-	-																		
<i>Mus musculus</i>	House Mouse	U	-	✓	✓	-	-	✓	12	5	23	15	13	19												
<b>Tachyglossidae</b>																										
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	P	-	✓	✓	-	-	✓		S				S												4-S and 6-S
<b>Vespertilionidae</b>																										
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	P	-	✓	✓	-	-	✓	2	50/400			4	11	10											
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	P	-	-	✓	-	-	✓							13											
<i>Chalinolobus picatus</i>	Little Pied Bat	V	-	✓	✓	-	-	✓	36	7/400			3	9												
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	P	-	✓	-	-	-	-																		
<i>Nyctophilus sp/spp</i>	Unidentified Long-eared Bat	P	-	-	✓	-	-	✓	16	35/400	X	14	12	11												
<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat	P	-	✓	✓	-	-	✓	3	12/230			1													
<i>Scotorepens greyii</i>	Little Broad-nosed Bat	P	-	✓	-	-	-	✓		2																
<i>Vespadelus spp.</i>	Unidentified Eptesicus	P	-	✓	-	-	-	✓	1	34/230			4													
<i>Vespadelus baverstocki</i>	Inland Forest Bat	V	-	-	✓	-	-	-																		
<i>Vespadelus vulturnus</i>	Little Forest Bat	P	-	✓	✓	-	-	-																		
<b>Totals</b>				125	183			3	95																	

- <sup>1</sup> Conservation Status  
 NSW *Threatened Species Conservation Act 1995*  
 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*  
 V = Vulnerable      E = Endangered      M = Migratory species      PE = Presumed Extinct      P = Protected      U=Introduced  
 X = Observed within the sampling site      O = Observed outside the sampling site      H = Heard only whilst in the sampling site      N = Nest      S = Scat      AC =Above Canopy      J = Juvenile

ATTACHMENT DC  
SPECIES RELATIVE ABUNDANCE  
MARCH 2006

**Table DC-1**  
**Fauna Species List, Relative Abundance, Snapper Survey March 2006**

	Observed or Trace Only	Uncommon	Common	Abundant
Amphibians	0	0	0	0
Reptiles	5	10	7	0
Birds	8	29	13	3
Mammals	2	15	3	0
<b>Total</b>	<b>15</b>	<b>54</b>	<b>23</b>	<b>3</b>

Scientific Name	Common Name	Observation <sup>1</sup>
<b>REPTILIA</b>		
<i>Amphibolurus nobbi</i>	Nobbi Dragon	U
<i>Pogona vitticeps</i>	Central Bearded Dragon	C
<i>Morelia spilota variegata</i>	Carpet Python	1 skeleton
<i>Pseudechis australis</i>	King Brown snake	1
<i>Pseudonaja textilis</i>	Eastern Brown Snake	1
<i>Suta nigriceps</i>	Short Tailed Snake	1
<i>Diplodactylus vittatus</i>	Eastern Stone Gecko	U
<i>Gehyra variegata</i>	Varied Dtella	C
<i>Heteronotia binoei</i>	Prickly Gecko	C
<i>Lucasium damaeum</i>	Beaded Gecko	U
<i>Rhynchoedura ornata</i>	Beaked Gecko	C
<i>Underwoodisaurus milii</i>	Thick-tailed Gecko	U
<i>Cryptoblepharus carnabyi</i>	Shiny-palmed Shinning-skink	U
<i>Ctenotus atlas</i>	Southern Mallee Ctenotus	U
<i>Ctenotus brachyonix</i>	-	U
<i>Ctenotus regius</i>	Pale-rumped Ctenotus	C
<i>Ctenotus schomburgkii</i>	Barred Wedge-snout Ctenotus	C
<i>Lerista punctatovittata</i>	Eastern Robust Slider	U
<i>Morethia boulengeri</i>	South-eastern Morethia Skink	C
<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard	1 skin
<i>Trachydosaurus rugosus</i>	Shingleback Lizard	U
<i>Varanus gouldii</i>	Sand Monitor	U
<b>AVES</b>		
<i>Acanthiza apicalis</i>	Inland Thornbill	U
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	U
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill	A
<i>Aphelocephala leucopsis</i>	Southern Whiteface	C
<i>Smicromis brevirostris</i>	Weebill	U
<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk	1
<i>Aquila audax</i>	Wedge-tailed Eagle	1 nest
<i>Hieraaetus morphnoides</i>	Little Eagle	1
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	C
<i>Anas gracilis</i>	Grey Teal	U
<i>Cracticus nigrogularis</i>	Pied Butcherbird	C
<i>Cracticus torquatus</i>	Grey Butcherbird	C
<i>Gymnorhina tibicen</i>	Australian Magpie	A
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	U
<i>Eolophus roseicapillus</i>	Galah	C
<i>Nymphicus hollandicus</i>	Cockatiel	U
<i>Dromaius novaehollandiae</i>	Emu	U

**Table DC-1 (Continued)**  
**Fauna Species List, Relative Abundance, Snapper Survey March 2006**

Scientific Name	Common Name	Observation1
<i>Climacteris affinis</i>	White-browed Treecreeper	U
<i>Climacteris picumnus</i>	Brown Treecreeper	C
<i>Ocyphaps lophotes</i>	Crested Pigeon	U
<i>Phaps chalcoptera</i>	Common Bronzewing	U
<i>Corcorax melanorhamphos</i>	White-winged Cough	U
<i>Struthidea cinerea</i>	Apostlebird	U
<i>Corvus coronoides</i>	Australian Raven	C
<i>Corvus mellori</i>	Little Raven	C
<i>Dicaeum hirundinaceum</i>	Mistletoebird	U
<i>Grallina cyanoleuca</i>	Maggie-lark	U
<i>Rhipidura leucophrys</i>	Willie Wagtail	U
<i>Falco berigora</i>	Brown Falcon	U
<i>Falco cenchroides</i>	Nankeen Kestrel	U
<i>Falco peregrinus</i>	Peregrine Falcon	1
<i>Hirundo ariel</i>	Fairy Martin	old nests
<i>Malurus leucopterus</i>	White-winged Fairy-wren	U
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	C
<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater	1
<i>Lichenostomus virescens</i>	Singing Honeyeater	C
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	1
<i>Manorina flavigula</i>	Yellow-throated Miner	U
<i>Plectorhyncha lanceolata</i>	Striped Honeyeater	U
<i>Merops ornatus</i>	Rainbow Bee-eater	U
<i>Anthus australis</i>	Australian Pipit	U
<i>Daphoenositta chrysoptera</i>	Varied Sitella	1
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	U
<i>Oreoica gutturalis</i>	Crested Bellbird	C
<i>Pachycephala rufiventris</i>	Rufous Whistler	U
<i>Melanodryas cucullata cucullata</i>	Hooded Robin	U
<i>Petroica goodenovii</i>	Red-capped Robin	A
<i>Podargus strigoides</i>	Tawny Frogmouth	U
<i>Pomatostomus ruficeps</i>	Chestnut-crowned Babbler	C
<i>Barnardius zonarius barnardi</i>	Mallee Ringneck	C
<i>Northiella haematogaster</i>	Blue Bonnet	U
<i>Psephotus varius</i>	Mulga Parrot	U
<i>Tyto alba</i>	Barn Owl	U
<b>MAMMALIA</b>		
<i>Capra hircus</i>	Feral Goat	C
<i>Ovis aries</i>	Sheep	U
<i>Vulpes vulpes</i>	Red Fox	U
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	U
<i>Oriental lagus cuniculus</i>	Rabbit	U
<i>Macropus giganteus</i>	Eastern Grey Kangaroo	1
<i>Macropus fuliginosus</i>	Western Grey Kangaroo	C
<i>Macropus rufus</i>	Red Kangaroo	C
<i>Nyctinomus/Tadarida australis</i>	White-striped Mastiff Bat	U
<i>Mormopterus</i> sp. 3		U
<i>Mormopterus</i> sp. 4		U
<i>Mus musculus</i>	House Mouse	U

**Table DC-1 (Continued)**  
**Fauna Species List, Relative Abundance, Snapper Survey March 2006**

Scientific Name	Common Name	Observation <sup>1</sup>
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	U
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	U
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	1 (?)
<i>Chalinolobus picatus</i>	Little Pied Bat	U
<i>Nyctophilus</i> sp./spp.	Unidentified Long-eared Bat	U
<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat	U
<i>Scotorepens greyii</i>	Little Broad-nosed Bat	U
<i>Vespadelus</i> spp.	Unidentified Eptesicus	U

<sup>1</sup> Observation

- 1 One sighting of the species, or at least one trace found.
- U Uncommon, 2-5 observations of the species, as well as an assessment of how widespread and persistent the species was.
- C Common, 6-30 observations of the species, as well as an assessment of how widespread and persistent the species was.
- A More than 30 observations of the species, as well as an assessment of how widespread and persistent the species was.
- ? Relative abundance cannot be estimated when a species presence is identified solely from tracks and traces.

PLATES



Plate D-1 Habitat Type 1 – Mixed Woodland



Plate D-2 Habitat Type 2 – Open Grassland/Shrubland with Scattered Trees



Plate D-3 Habitat Type 3 – Mallee Shrubland