



APPENDIX B

Southern Extension Areas Fauna Assessment

GINKGO MINERAL SANDS MINE
SOUTHERN EXTENSION MODIFICATION
SOUTHERN EXTENSION AREAS FAUNA ASSESSMENT



PREPARED BY
BIODIVERSITY MONITORING SERVICES

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EXECUTIVE SUMMARY

This fauna survey and impact assessment was conducted as part of the Environmental Assessment (EA) for the Ginkgo Mineral Sands Mine (Ginkgo Mine) Southern Extension Modification (the Modification). The Modification area is located approximately 85 kilometres (km) north-east of Wentworth and approximately 170 km to the south-east of Broken Hill in western New South Wales (NSW).

Fauna surveys were undertaken in a study area forming part of a south-eastern extension to the existing mine workings at the Ginkgo Mine. The study area is divided into two smaller areas (42.5 hectares [ha] and 53.5 ha, respectively) and four surface development areas are contained within the study area.

Fauna survey methods consisted of Elliott trapping, pit trapping, hair funnels, tree-mounted traps, cage trapping, remote cameras, harp traps, echo-location call analysis, reptile funnels, call broadcasting and recognition, spotlighting and general observations. Transects were walked through the study area and a number of trees were inspected for the presence of hollows. Logs were also counted within the study area.

A total of 84 species were located within the study area including 46 bird, 18 native mammal, five introduced mammal and 15 reptile species. The species richness (the value of different species) values for the study area are slightly lower than that found elsewhere in the Ginkgo area due to the smaller area of land surveyed.

Biodiversity Indices for bird and reptile populations from the study area were calculated and compared with that obtained from the Crayfish Deposit and Mallara Offset areas and the Crayfish Project area. This showed that there were no significant differences between the calculated indices in all the areas surveyed.

Five species listed as Vulnerable under the NSW *Threatened Species Conservation Act, 1995* (TSC Act) were located within the study area. These are Bolam's Mouse (*Pseudomys bolami*), Little Pied Bat (*Chalinolobus picatus*), Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*), Inland Forest Bat (*Vespadelus baverstocki*) and Hooded Robin (*Melanodryas cucullata*). An evaluation has been undertaken and it is considered that no threatened fauna species are likely to be significantly impacted by the Modification.

The Modification would result in the loss of 32 ha of habitat, comprising 27 ha of Black Oak Woodland Habitat Type and 5 ha of Grassland/Low Shrubland Habitat Type. The amount to be lost (32 ha) is small compared to that available in the surrounding region and its loss is not likely to significantly impact any local fauna populations. The cumulative adverse impacts on fauna and their habitat have been considered (i.e. combined clearance for the Ginkgo and Snapper Mines). Whilst the incremental impacts would result in a greater area of disturbance over time, the impacts would be mitigated (largely by progressive rehabilitation) and offset by enhancement of nearby habitats.

The existing mitigation measures implemented at the Ginkgo Mine would continue for the Modification. Cristal Mining has established two existing offset areas for the Ginkgo Mine, totalling approximately 2,603 ha. The existing offset would be expanded by 156 ha for the loss of 32 ha of habitat.

The Modification would also include additional offsets (covering 1,255 ha) for existing surface development that has not been accounted for in previous Ginkgo Mine biodiversity offset area calculations. In conclusion, the four offset areas proposed as part of the Modification are considered to meet the NSW Office of Environment and Heritage (OEH) (2014) *Principles for the Use of Biodiversity Offsets in NSW* and it is likely that fauna biodiversity values would be maintained or improved in the medium to long-term.

1 INTRODUCTION

1.1 BACKGROUND

This fauna assessment was conducted as part of the Ginkgo Mineral Sands Mine (Ginkgo Mine) Southern Extension Modification (the Modification). The Ginkgo Mine is located approximately 85 kilometres (km) north-east of Wentworth and approximately 170 km south-east of Broken Hill in western New South Wales (NSW) (Figure 1).

Cristal Mining Australia is preparing an Environmental Assessment (EA) to support applications to modify the Ginkgo Mine Development Consent (DA 251-09-01). The modification would include:

1. extensions to the existing/approved surface development area for additional development areas for the mine path, overburden emplacement, topsoil stockpile areas and other supporting infrastructure; and
2. an increase in the Ginkgo Mine biodiversity offset area to account for existing surface development that has not been accounted for in previous Ginkgo Mine biodiversity offset area calculations.

This report covers the first component, (i.e. the Southern Extension Modification), extensions to the existing/approved surface development area. A separate report, titled the *Ginkgo Mineral Sands Mine Southern Extension Modification - Offset Increase Fauna Report* (Biodiversity Monitoring Services, 2015), covers the fauna assessment for increase in the Ginkgo Mine biodiversity offset area.

The existing/approved general arrangement is shown on Figures 2a and 2b (including both processing options approved as part of the *Ginkgo Mineral Sands Mine November 2012 Modification Modified Request* [Cristal Mining, 2013]).

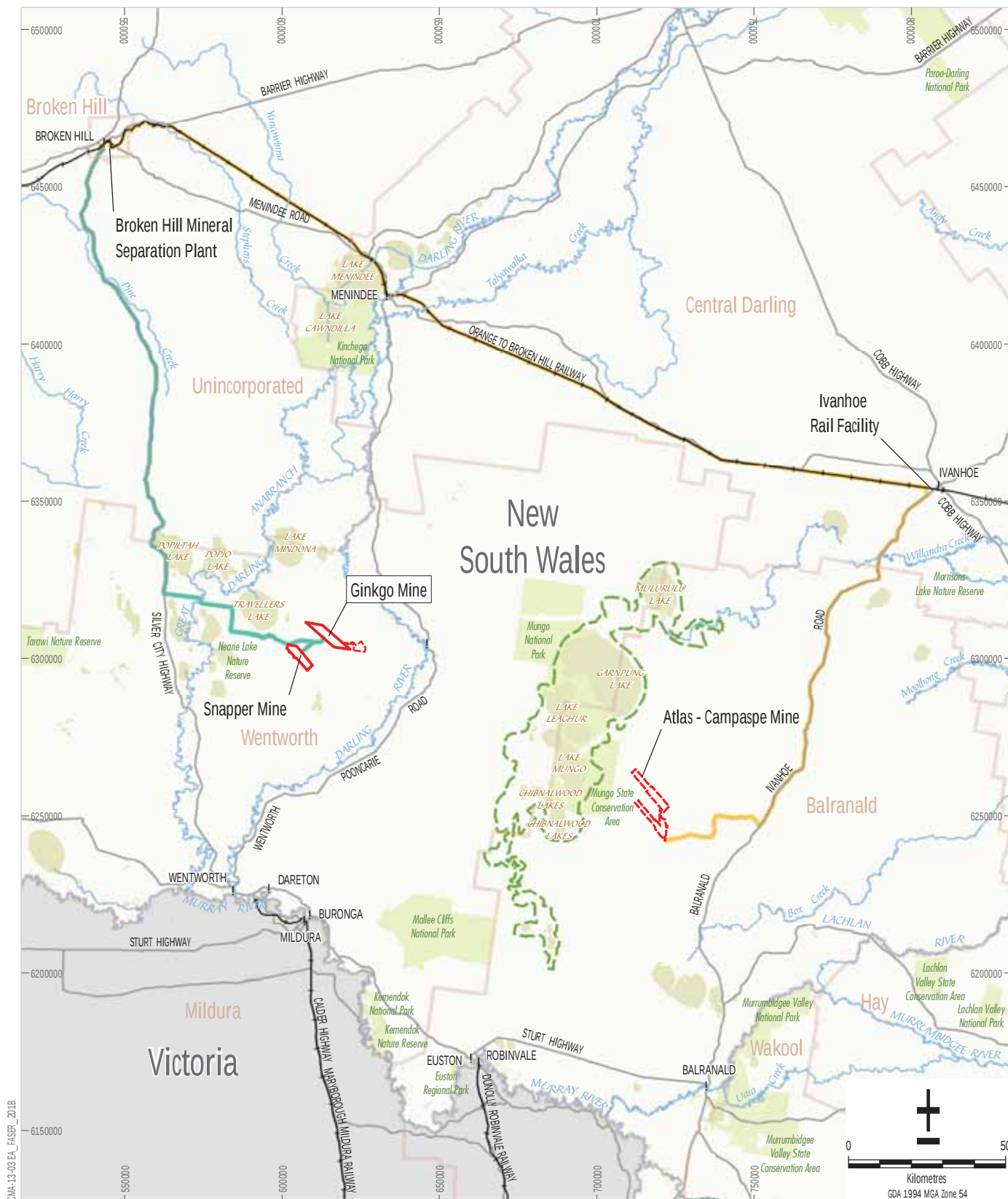
It is proposed that a modification to the existing Ginkgo Mine Development Consent under section 75W of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) would be required for the Modification.

1.2 SCOPE OF THIS REPORT

The scope of this report covers the preparation of a fauna assessment for the Southern Extension. This assessment includes:

- A habitat assessment which stratifies the study area and addresses the requirements in the NSW Office of Environment and Heritage (OEH) guidelines (e.g. estimate of tree hollow density per broad habitat type).
- Complete baseline fauna surveys, following sampling techniques outlined in the OEH and Department of the Environment (DotE) guidelines.
- Targeted searches for potentially occurring threatened fauna species, following sampling techniques outlined in the OEH and DotE guidelines.
- Assessment of the impacts on fauna (including threatened fauna species listed under the NSW *Threatened Species Conservation Act 1995* [TSC Act]) considering the *Draft Guidelines for Threatened Species Assessment* (NSW Department of Environment and Conservation [DEC] and Department of Primary Industries [DPI] 2005).
- Description of the proposed offset in relation to fauna considering the OEH (2014) *Principles for the Use of Biodiversity Offsets in NSW*.

Vegetation surveys of the study area were undertaken by FloraSearch (2015). This included an assessment of the condition, consistent with the BioMetric methodology (Gibbons *et al.*, 2005).



LEGEND

- National Park, Regional Park or State Conservation Area
- Mining Lease Boundary (ML)
- Mining Lease Application Boundary (MLA)
- Local Government Area Boundary
- Willandra Lakes Region World Heritage Area
- Mineral Concentrate Transport Route and MSP Process Waste Transport Route
- Atlas-Campaspe Mineral Sands Project Mineral Concentrate Transport Route and MSP Process Waste Transport Route*

* MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines

Source: DPI-C&L (CLD) (2011) and Cristal Mining (2013).



G I N K G O M I N E
Regional Location

Figure 1



QMA-13-03 EA, FISER 2020

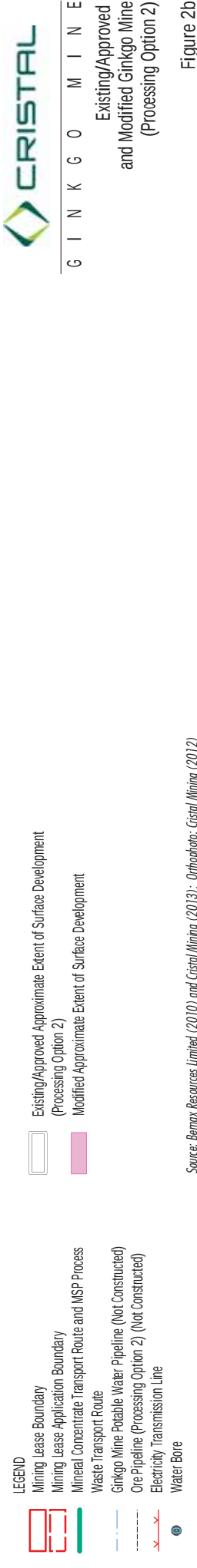


Source: Bemax Resources Limited (2010) and Cristal Mining (2013); Orthophoto: Cristal Mining (2012)

Figure 2a



QMA-13-03 EA, FASER, 2030



2 EXISTING ENVIRONMENT

2.1 STUDY AREA

The study area forms covers a south-eastern extension to the existing mine workings at the Ginkgo Mine. The study area is divided into two smaller areas (42.5 hectares [ha] and 53.5 ha, respectively) and four surface development areas are contained within the study area. These are shown as the modified approximate extent of surface development on Figure 3.

2.2 REGIONAL LOCATION

The study area is located in the Murray Darling Depression Interim Biogeographic Regionalisation for Australia Bioregion (Commonwealth Department of Sustainability, Environment, Water, Population and Communities [SEWPaC], 2013) and the Western Local Land Service Region.

2.3 CLIMATE

The closest Bureau of Meteorology (BOM) weather stations to the study area are located approximately 90 km south-southwest at Wentworth Post Office and approximately 110 km north-north-east at Menindee. The mean annual rainfall near the study area is between 245 millimetres (mm) (Menindee) and 285 mm (Wentworth) (BOM, 2013). Plate 1 shows that the rainfall deficiencies for study area between 1 July 2014 and 31 October 2015 and the region where the study area is located has not suffered any rainfall deficiency.

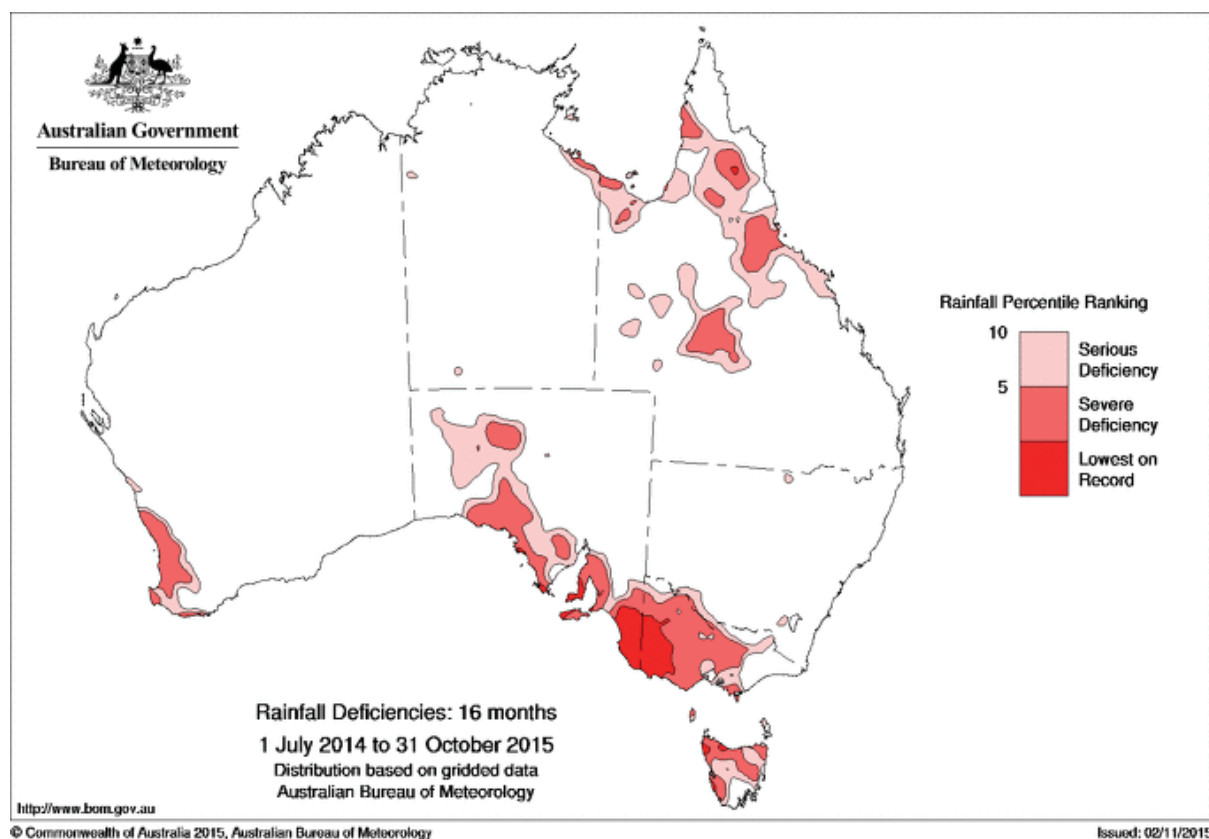


Plate 1: Rainfall Deficiency Map for Australia



Source: Bemax Resources Limited (2010) and Cristal Mining (2013); Orthophoto: Cristal Mining (2012)

Figure 3

2.4 LANDFORM AND HYDROLOGY

Topography of the surrounding region shows limited relief and comprises generally flat to undulating land covered by a combination of grasslands, low woodland and shrublands. The elevations within the study area range from 50 to 70 metres (m) Australian Height Datum.

The Darling River is a major hydrological feature of the local environment intersecting the Murray River at Wentworth. The Darling River Anabranch runs parallel to the Darling River and only flows under flood conditions. Numerous ephemeral lakes are associated with the Anabranch, which occasionally hold water (primarily during flood conditions). The study area does not contain any watercourses.

2.5 LAND USE

Surrounding land uses comprise of pastoral leasehold lands that are used predominantly for livestock grazing of native pastures by sheep, cattle and goats on Perpetual Western Land Leases.

2.6 VEGETATION

Within the vicinity of the study area a wide range of vegetation types occur. These include grassy and shrubby woodlands, shrublands and grasslands. Black Box (*Eucalyptus largiflorens*) Woodland and Black Oak (*Casuarina pauper*) – Western Rosewood and Pearl Saltbush Woodland communities occur within the study area surrounds along with Chenopod Mallee Woodland and Grassland/Low Shrubland.

2.7 THREATENED FAUNA

A total of 11 threatened fauna species listed under the TSC Act have been previously recorded at the Ginkgo Mine (within Mining Lease (ML)1504 and Mining Lease Application (MLA)437) (Table 1).

Table 1
Threatened Fauna Previously Recorded at the Ginkgo Mine

Scientific Name	Common Name	Conservation Status ¹		Description of the Records within ML1504 and MLA437
		TSC Act	EPBC Act	
Reptile				
<i>Delma australis</i>	Marble-faced Delma	E	-	Three Marble-faced Delmas were recorded in MLA 437 by Biodiversity Monitoring Services (2012).
<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard	V	-	A single Western Blue-tongued Lizard was recorded in ML 1504 by Mount King Ecological Services (2001) during the original surveys for the Ginkgo Mine.
Birds				
<i>Falco hypoleucos</i>	Grey Falcon	E	-	A single Grey Falcon was recorded by Mount King Ecological Services (2001) during the original surveys for the Ginkgo Mine.
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	A single Little Eagle was recorded in MLA 437 by Biodiversity Monitoring Services (2012).
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	V	-	Major Mitchell's Cockatoos have been recorded on a number of occasions within ML1504 and MLA437 and are relatively abundant in the locality (Biodiversity Monitoring Services, 2012; Mount King Ecological Services, 2001).

Table 1 (Continued)
Threatened Fauna Previously Recorded at the Ginkgo Mine

Scientific Name	Common Name	Conservation Status ¹		Description of the Records within ML1504 and MLA437
		TSC Act	EPBC Act	
Birds (Cont.)				
<i>Epthianura albifrons</i>	White-fronted Chat	V		White-fronted Chat were recorded by Mount King Ecological Services (2001) during the original surveys for the Ginkgo Mine, however an exact coordinate was not recorded as the species was not listed as threatened as that time.
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	-	Hooded Robin (south-eastern form) were recorded by Ogyris Ecological Research (2005-2015) in ML1504. This species was also recorded in MLA 437 by Biodiversity Monitoring Services (2012).
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	Varied Sittella were recorded in MLA 437 by Biodiversity Monitoring Services (2012).
Mammals				
<i>Pseudomys bolami</i>	Bolam's Mouse	E	-	The Bolam's Mouse was identified by the University of Ballarat (pers. comm.) during rehabilitation monitoring at the Ginkgo Mine but an exact coordinate was not recorded.
<i>Verpadelus baverstocki</i>	Inland Forest Bat	V	-	Inland Forest Bats have been recorded on a number of occasions within ML1504 and MLA437 and are relatively abundant in the locality (Biodiversity Monitoring Services, 2012; Mount King Ecological Services, 2001).
<i>Chalinolobus picatus</i>	Little Pied Bat	V	-	Little Pied Bats have been recorded on a number of occasions within ML1504 and MLA437 and are relatively abundant in the locality (Biodiversity Monitoring Services, 2012; Mount King Ecological Services, 2001).

¹ Threatened fauna species status under the TSC Act and/or Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) (current at December 2015).

V = Vulnerable; E = Endangered

Highlighted species = Species recorded within or immediately adjoining the Modification area.

3 METHODS

3.1 LITERATURE AND DATABASE SEARCHES

3.1.1 Fauna Surveys for the Ginkgo Mineral Sands Project Environmental Impact Statement

Fauna surveys of the Ginkgo Mine and associated infrastructure were undertaken by Mount King Ecological Surveys in 2000 and are described in Appendix H of the *Ginkgo Mineral Sands Project Environmental Impact Statement* (Mount King Ecological Surveys [MKES], 2001).

3.1.2 Pre-Clearance Surveys (2005-2015)

Pre-clearance surveys for flora and fauna were conducted on all land in the Subject area. A total of 17 pre-clearance surveys were conducted between 2005 and 2015 by Ogyris Ecological Research. As well as the surveys identifying and mapping the vegetation communities present, Ogyris Ecological Research also inspected a number of trees and identified any habitat trees (i.e. trees containing hollows, cracks and loose bark). Many of these trees were inspected during the clearing operations and any fauna located was documented. The pre-clearance survey reports are:

- *Vegetation Pre-clearance Flora and Fauna Surveys of Land at Bemax Resources NL Murray-Darling Basin sand mine sites. 1) Ginkgo Sand Mine, Autumn-Winter 2005.* Ogyris Ecological Research (2005).
- *Vegetation Pre-clearance Flora and Fauna Surveys of Land at Bemax Resources NL Murray-Darling Basin sand mine sites. 2) Ginkgo Sand Mine - February 2006.* Ogyris Ecological Research (2006a).
- *Vegetation Pre-clearance Flora and Fauna Surveys of Land at Bemax Resources NL Murray-Darling Basin sand mine sites. 3) Ginkgo Sand Mine - September 2006.* Ogyris Ecological Research (2006b).
- *Vegetation Pre-clearance Flora and Fauna Surveys of Land at Bemax Resources Ltd Murray-Darling Basin sand mine sites. 4) Ginkgo Sand Mine, February 2007.* Ogyris Ecological Research (2007a).
- *Vegetation Pre-clearance Flora and Fauna Surveys of Land at Bemax Resources Ltd Murray-Darling Basin sand mine sites. 5) Ginkgo Sand Mine Stage 2 Extension, May 2007.* Ogyris Ecological Research (2007b).
- *Vegetation Pre-clearance Flora and Fauna Surveys of Land at Bemax Resources Ltd Murray-Darling Basin sand mine sites. 6) Ginkgo Sand Mine Stage 3 Extension and northern boundary fenceline. February 2009.* Ogyris Ecological Research (2009a).
- *Vegetation Pre-clearance Flora and Fauna Surveys of Land at Bemax Resources Ltd Murray-Darling Basin sand mine sites. 8) Ginkgo Sand Mine Stage 4 Northern Extension and expansion of overburden stockpile OB2. May 2009.* Ogyris Ecological Research (2009b).
- *Vegetation Pre-clearance Flora and Fauna Surveys of Land at Bemax Resources Ltd Murray-Darling Basin sand mine sites. 9) Ginkgo Sand Mine Stage 4 Northern Extension. Winter 2009.* Ogyris Ecological Research (2010).
- *Vegetation Pre-clearance Flora and Fauna Surveys of Land at Bemax Resources NL Murray-Darling Basin sand mine sites. 13) Ginkgo Mine. August 2011.* Ogyris Ecological Research (2011).
- *Vegetation Pre-clearance Flora and Fauna Surveys of Land at Bemax Resources NL Murray-Darling Basin sand mine sites. 14) Ginkgo Mine. January 2012.* Ogyris Ecological Research (2012a).

- *Vegetation Pre-clearance Fauna Report of Land at Cristal Mining Australia Ltd Murray-Darling Basin sand mine sites. Ginkgo Mine - Winter 2012.* Ogyris Ecological Research (2012b).
- *Vegetation Pre-clearance Vegetation and Soils Report of Land at Cristal Mining Australia Ltd Murray-Darling Basin mineral sand mine sites. Ginkgo Mine - Winter 2012.* Ogyris Ecological Research (2012c).
- *Vegetation Pre-clearance Fauna Report of Land at Cristal Mining Australia Ltd Murray-Darling Basin mineral sand mine sites. Ginkgo Mine. February 2013.* Ogyris Ecological Research (2013).
- *Vegetation Pre-clearance Vegetation and Soils Report of Land at Cristal Mining Australia Ltd Murray-Darling Basin mineral sand mine sites. Ginkgo Mine – Winter 2014.* Ogyris Ecological Research (2014a).
- *Vegetation Pre-clearance Fauna Report of Land at Cristal Mining Australia Ltd Murray-Darling Basin mineral sand mine sites. Ginkgo Mine – Autumn – Winter 2014.* Ogyris Ecological Research (2014b).
- *Vegetation Pre-clearance Vegetation and Soils Report of Land at Cristal Mining Australia Ltd Murray-Darling Basin mineral sand mine sites. Ginkgo Mine – Autumn 2015.* Ogyris Ecological Research (2015a).
- *Vegetation Pre-clearance Fauna Report of Land at Cristal Mining Australia Ltd Murray-Darling Basin mineral sand mine sites. Ginkgo Mine. July 2015.* Ogyris Ecological Research (2015b).

3.1.3 Fauna Survey of Rehabilitation Areas within ML 1504

The University of Ballarat have been conducting fauna surveys within various stages of rehabilitation associated with the Ginkgo Mine.

3.1.4 Fauna Surveys for the Ginkgo Mine 2012 Modification

Surveys for fauna of the proposed Ginkgo Mine 2012 Modification were undertaken by Biodiversity Monitoring Services in 2012. Part of the area surveyed was within (ML 1504 on land to be traversed by the proposed route of the haul road from the Crayfish deposit to the processing area at the Ginkgo Mine. The relevant report is *Ginkgo Mineral Sands Mine – Crayfish Modification Fauna Assessment* (Biodiversity Monitoring Services, 2012).

3.1.5 Fauna Surveys for the Snapper Mineral Sands Project

Fauna surveys were undertaken by the Western Research Institute Ltd in 2006 of an area to the south of ML 1504. The results from these surveys are presented in *Snapper Mineral Sands Project Environmental Assessment Appendix D Fauna Assessment* (Western Research Institute and Resource Strategies, 2007).

3.1.6 Regional Distribution of Threatened Species Records

A desktop survey was undertaken to determine the threatened ecological communities, populations, species and critical habitat that are known to occur within the wider region. A list of threatened fauna that may potentially occur on the Subject area were compiled from searches of the following databases:

- Atlas of NSW Wildlife search for a 40 x 40 m area centred on the Subject area (accessed through BioNet, 25 November 2015) (OEH, 2015).
- The EPBC Act Protected Matters Search Tool (40 x 40 m area centred on the Subject area [accessed 25 November 2015]) (DotE, 2015).
- The results of fauna surveys in Dune Mallee woodlands in the Lower Murray Darling catchment of south-western NSW provide lists of species occurring near ML 1504 (Val *et al.*, 2012).
- Data from surveys undertaken by Biodiversity Monitoring Services within the proposed offset areas in 2012 and 2013. These are reported in the *Ginkgo Mineral Sands Mine – Crayfish Modification Fauna Assessment* (Biodiversity Monitoring Services, 2012) and the proposed offset areas survey report in this assessment, *Mallara Fauna Survey* (Biodiversity Monitoring Services, 2014).
- Species known or predicted to occur in the South Olary Plain, Murray Basin Sands [Part D] Catchment Management Authority (CMA) subregion (OEH, 2015).

3.2 FIELD SURVEYS

3.2.1 Survey Timing

The surveys were undertaken by Andrew Lothian and Will Brown within a survey area covering the Modification area at Ginkgo Mine between 29 October and 6 November 2015.

The weather conditions recorded at Pooncarie Post Office (station number 047029) during the survey period are given in Table 2. The conditions during the surveys were hot and wet.

Table 2
Weather Conditions during Survey Period (records from Pooncarie Post Office)

Date	Minimum Temperature (°C)	Maximum Temperature (°C)	Rainfall (mm)
29/10/2015	16	36	0
30/10/2015	19.4	37.3	0
31/10/2015	18.8	37	4.8
1/11/2015	20.4	31.7	5
2/11/2015	14.6	29.2	0.2
3/11/2015	16.9	28.5	0
4/11/2015	17.7	31	2.8
5/11/2015	16.8	27.8	26.8
6/11/2015	17.6	27.2	0

3.2.2 Survey Sites

Although the entire study area was surveyed by observation, a series of sites were established. A total of six survey sites were established that sampled the study area. A description of each site is given in Table 3 and their locations are shown on Figure 3. A photograph of each survey site is given in Plate 2.

Table 3
Survey Sites within the Study Area

Site Name	Easting	Northing	Vegetation Community (FloraSearch, 2015)
D1a	614791	6307346	Black Oak – Pearl Bluebush Woodland
D1b	615066	6307001	Black Oak – Pearl Bluebush Woodland
D1c	615252	6306714	Black Oak – Pearl Bluebush Woodland
D2a	614797	6306356	Black Oak – Western Rosewood Woodland
D3a	616144	6305451	Black Oak – Western Rosewood Woodland
D3b	615906	6305544	Black Oak – Western Rosewood Woodland

3.2.3 Fauna Survey Techniques

A range of survey techniques were used within the three survey areas to target native fauna. There is the potential of the presence of the Bolam's Mouse (*Pseudomys bolami*) within the study area as it was located within nearby rehabilitation areas (Table 1) and there is preferred habitat in the survey areas (this proved to be correct as two individuals were captured). Consequently, trapping techniques included Elliott trapping as well as pit traps, cage traps and reptile funnels. The presence of micro-bat species was determined using both harp traps and recording of ultrasonic calls with Anabat recorders. Each site was also sampled using remote cameras and hair funnels. Although the likelihood of any arboreal mammals was low, tree mounted Elliott traps were used and cage traps were placed on the ground in case any middle-sized fauna was present.

Ground Elliott Trapping

Five small (8 x 10 x 33 centimetre [cm]) Elliott traps were laid in straight lines at the ends of pit trap and reptile funnel trap lines at five of the survey sites (D1a, D1b, D2a, D3a and D3b). The traps were set for six days, giving a trap effort of 30 trap days at each site. The traps were baited with a mixture of rolled oats, peanut butter and bacon fat, and a small piece of dacron was placed within each trap (as protection against the cold). A freezer bag was placed over the end of each trap to prevent the contents becoming wet from the rain.



Site D1a



Site D1b with Harp Trap



Site D1c



Site D2a



Site 3a with Harp Trap



Site 3b with Harp Trap

Plate 2: Views of the Six Survey Sites***Tree Elliott Trapping***

To sample any small arboreal mammals, five small Elliott traps were mounted on trees at sites D1b, D2a and D3a for five nights. Aluminium tree mounts were attached to trees and a baited Elliott trap attached to the mount. The tree trunk and trap were sprayed with a honey-water mixture to assist in attracting any nectar or sap feeding arboreal mammals. Again, dacron and freezer bags were used to combat the cold and wet conditions. A total of 90 trap days were expended in the study area.

Cage Traps

Six Tomahawk cage traps and six large cage traps were placed on the ground at sites D1b, D2a and D3a. These were baited with muesli bars, apple and dog food.

Spotlighting

Two forms of spotlighting transect were undertaken. Tracks within the survey area were spotlighted from a moving vehicle. In addition, spotlighting on foot was undertaken where targeted searching was considered important.

Hair Funnels

Five hair funnels (from Faunatech) were used at three sites for six nights and baited with a mixture of rolled oats, peanut butter and bacon fat.

Remote Cameras

Remote cameras (Digital Scouting Camera 5.0 MP and Reconyx HC600) were used at Sites D1a, D1b, D2a and D3a to capture images of any animal using the area, particularly near the traps. A small container of bait was placed in front of a camera to attract animals. Remote Cameras were left for six days per site (48 trap days total).

Bird Surveys

In addition to the results obtained from general observations and spotlighting, listening and observing periods were undertaken at all sites. Taking into consideration the discussion in the draft on methods to survey diurnal birds (DEC, 2004) an area search method was used at each site. A 30 minute search was used where the observer walked around each site, as well as observing and listening for calls from a single point. At each site up to four periods of observation were undertaken (two in the morning and two in the late afternoon) (a total of least 36 hours of bird surveys).

Call Broadcasting

Calls of several species of nocturnal bird were broadcast during the night in the general area. Calls were broadcast through a megaphone for approximately five minutes, with a 10 minute listening time. Calls from the Tawny Frogmouth (*Podargus strigoides*), Barking Owl (*Ninox connivens*), Barn Owl (*Tyto alba*), Masked Owl (*T. novaehollandiae*), Grass Owl (*T. capensis*), Southern Boobook (*Ninox boobook*), White-throated Nightjar (*Eurostopodus mystacalis*), Australian Owlet-Nightjar (*Aegotheles cristatus*), Bush Stone-curlew (*Burhinus grallarius*) and Spotted Nightjar (*Eurostopodus argus*) were broadcast.

Pit Fall Traps

Pit fall traps were established at five of the survey sites (D1a, D1b, D2a, D3a and D3b). Either 20 litre buckets or 1 m long tubes were used, together with drift fencing made from wire gauze. At all sites buckets and tubes were dug into the ground at 5 m intervals and a 20 cm high wire mesh fence run between each hole. A total of 19 pit traps were placed for five nights for a total of 114 trap days at each site.

Reptile Funnel Traps

Reptile funnel traps are basically an enlarged rectangular fish trap (about 75 cm long and 18 cm wide) made from plastic netting over a wire frame with a funnel at each end. Each trap uses a screen of sunshade cloth to protect any captures.

The traps were laid out in association with a drift fence and were placed alongside the drift fence. It is usual to place a funnel on each side of the fence, thus ensuring a greater catch (not necessarily a more diverse catch) than if having a funnel placed within the drift fence. Reptile funnel traps were used at Sites D1a, D1b, D2a, D3a and D3b. A total of 16 reptile funnels were used over six days (96 trap-days).

Herpetological Searches

Systematic searches for reptiles and amphibians were undertaken within each habitat type at each survey site. Litter was raked and logs and loose tin turned over. Loose bark was prised from the trunks of dead trees. Each search took approximately 30 minutes and was repeated at each site. Searches for amphibians took place at night using spotlights and recognition of characteristic calls, but there was little water to search for amphibians. Spotlighting searches were also attempted for reptiles.

Sand Plots

Areas of sand on tracks were smoothed over and inspected for evidence of animal movement. Paw prints and other animal signs were identified and recorded. Sandplots were conducted at each survey site for five days (five trap days each).

Anabat Recorder

An Anabat II Bat Detector with a Compact Flash Storage ZCAIM was placed at Sites D1a, D1c, D3a and D3b for one night each and recorded any bat calls. The results from these detectors together with that from the harp traps were considered adequate to provide a picture of use of the study area by bats. Bat calls were analysed by Andrew Lothian, Biodiversity Monitoring Services and Glenn Hoye, FBN Bat Surveys PL.

Harp Traps

Harp traps consist of a 1.8 m square frame made of aluminium mounted on adjustable legs. Monofilament fishing line is strung vertically in the frame in two banks, with the lines c. 2.5 cm apart and the banks separated by c. 10 cm, and with the lines of each bank offset. Below the bottom of the frame is a canvas catch bag lined with plastic. Traps are usually placed in vegetation corridors, over water tanks, and at cave or mine entrances. Bats fly into the fishing lines and slide down into the catch bag from which they cannot escape. Four harp traps were in Sites D1b, D1c, D3a and D3b for one night.

Inspection Camera

An inspection camera was used (DeWalt DCT410 Inspection Camera with a three foot cable). A total of 225 trees (including stags) were inspected at the four sites.

Observation Sessions

At all sites time was set aside to record the presence of any fauna. The period of time for the observation sessions was one hour. During the session, traverses through each site occurred and any bird, mammal and reptile species observed was documented. In addition, logs and rocks were turned over and the underneath of any loose bark inspected. Signs of any species (e.g. scats, diggings, nests, scratching and burrows) were also recorded.

3.2.4 Survey Effort

Table 4 provides the survey effort undertaken at each site within the study area excluding observational techniques which were conducted throughout the study area.

Table 4
Survey Effort within the Study Area

Site	Ground Elliott trap days	Tree Elliott trap days	Ground Cage trap days	Hair Funnel trap days	Remote Camera trap days	Pit Trap trap days	Reptile Funnel trap days	Sand Plot trap days	Anabat Recorder trap days	Harp Trap trap days
D1a	30	-	-	-	2	24	18	6	1	-
D1b	30	30	18	30	2	24	18	6	-	1
D1c	-	-	-	-	-	-	-	-	1	2
D2a	30	30	36	30	2	24	18	6	-	-
D3a	30	30	18	30	2	18	24	6	1	1
D3b	30	-	-	-	-	24	18	6	1	1
Total	150	90	72	90	8	114	96	30	4	5

3.3 TARGETED SURVEYS FOR THREATENED SPECIES

Threatened fauna species listed under the TSC Act and/or EPBC Act which are known from database search results from the general region containing the study area (as well as the species known or predicted to occur in the South Olary Plain, Murray Basin Sands [Part D] CMA subregion [OEHL, 2015]) are listed in Table 5. Table 5 also includes the survey techniques to target each species, although some species listed in Table 5 are considered very unlikely to occur in the study area. Threatened fauna species recorded in the locality are shown on Figure 4.

The techniques used to target the threatened fauna species in Table 5 are in accordance with the guidelines produced by the OEHL (DEC, 2004) and DotE (DEWHA, 2010a and b and SEWPAC, 2011a and b).

Table 5
Threatened Species Known from the Locality Containing the Study Area

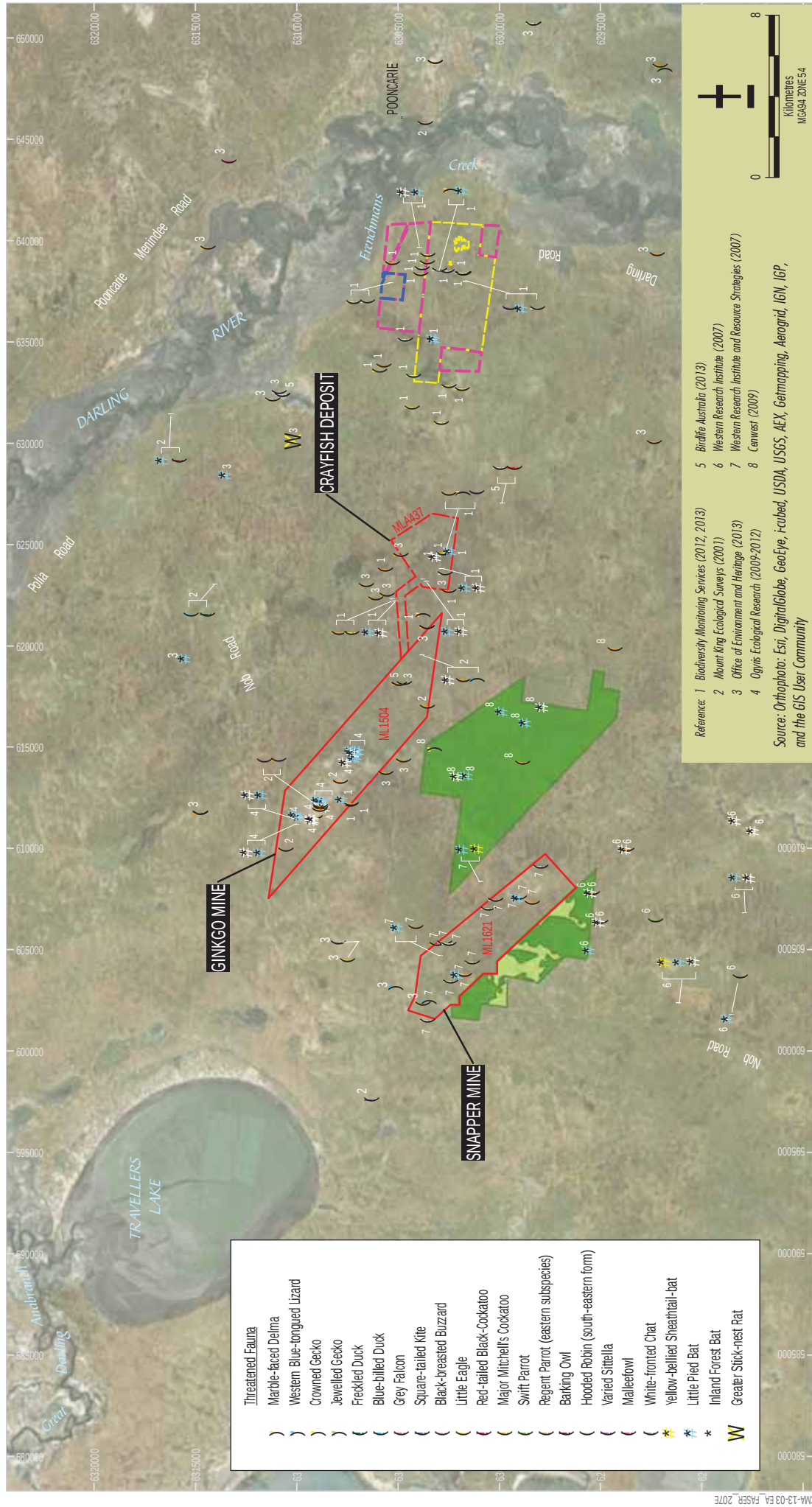
Scientific Name	Common Name	Conservation Status ¹		Survey Methods
		TSC Act	EPBC Act	
Amphibians				
Neobatrachus pictus	Painted Burrowing Frog	E	-	Call identification, Pit Trapping
Reptiles				
Lucasium stenodactylum	Crowned Gecko	V	-	Searching, Pit Trapping, Reptile Funnels
Strophurus elderi	Jewelled Gecko	V	-	Searching, Pit Trapping, Reptile Funnels
Aprasia inaurita	Mallee Worm-Lizard	E	-	Searching, Pit Trapping, Reptile Funnels
Delma australis	Marbled-faced Delma	E	-	Searching, Pit Trapping, Reptile Funnels
Cyclodomorphus melanops elongates	Mallee Slender Blue-tongue Lizard	V	-	Searching, Pit Trapping, Reptile Funnels
Lerista xanthura	Yellow-tailed Plain Slider	V	-	Searching, Pit Trapping, Reptile Funnels
Tiliqua occipitalis	Western Blue-tongued Lizard	V	-	Searching, Pit Trapping, Reptile Funnels
Birds				
Leipoa ocellata	Malleefowl	E	V	Bird Surveys, Observational Sessions, Call Identification
Stictonetta naevosa	Freckled Duck	V	-	Bird Surveys, Observational Sessions, Call Identification
Oxyura australis	Blue-billed Duck	V	-	Bird Surveys, Observational Sessions, Call Identification
Lophoictinia isura	Square-tailed Kite	V	-	Bird Surveys, Observational Sessions, Call Identification
Hamirostra melanosternon	Black-breasted Buzzard	V	-	Bird Surveys, Observational Sessions, Call Identification

Table 5 (Continued)
Threatened Species Known from the Locality Containing the Study Area

Scientific Name	Common Name	Conservation Status ¹		Survey Methods
		TSC Act	EPBC Act	
Birds (Cont.)				
Circus assimilis	Spotted Harrier	V	-	Bird Surveys, Observational Sessions, Call Identification
Hieraaetus morphnoides	Little Eagle	V	-	Bird Surveys, Observational Sessions, Call Identification
Falco hypoleucos	Grey Falcon	E	-	Bird Surveys, Observational Sessions, Call Identification
Falco subniger	Black Falcon	V	-	Bird Surveys, Observational Sessions, Call Identification
Burhinus grallarius	Bush Stone-curlew	V	-	Bird Surveys, Observational Sessions, Call Identification
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	-	Bird Surveys, Observational Sessions, Call Identification
Calyptorhynchus banksii samueli	Red-tailed Black-Cockatoo	V	-	Bird Surveys, Observational Sessions, Call Identification
Lathamus discolor	Swift Parrot	E	E	Bird Surveys, Observational Sessions, Call Identification
Polytelis anthopeplus monarchoides	Regent Parrot (eastern sub-species)	E	V	Bird Surveys, Observational Sessions, Call Identification
Neophema splendida	Scarlet-chested Parrot	V	-	Bird Surveys, Observational Sessions, Call Identification
Ninox connivens	Barking Owl	V	-	Bird Surveys, Observational Sessions, Call Identification, Spotligthing, Call Broadcasting
Pyrrholaemus brunneus	Redthroat	V	-	Bird Surveys, Observational Sessions, Call Identification
Epthianura albifrons	White-fronted Chat	V	-	Bird Surveys, Observational Sessions, Call Identification
Lichenostomus cratitius	Purple-gaped Honeyeater	V	-	Bird Surveys, Observational Sessions, Call Identification
Certhionyx variegatus	Pied Honeyeater	V	-	Bird Surveys, Observational Sessions, Call Identification
Hylacola cautus	Shy Heathwren	V	-	Bird Surveys, Observational Sessions, Call Identification
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	Bird Surveys, Observational Sessions, Call Identification
Drymodes brunneopygia	Southern Scrub-robin	V	-	Bird Surveys, Observational Sessions, Call Identification
Cinclosoma castaneothorax	Chestnut-backed Quail-thrush	V	-	Bird Surveys, Observational Sessions, Call Identification
Daphoenositta chrysoptera	Varied Sittella	V	-	Bird Surveys, Observational Sessions, Call Identification
Pachycephala inornata	Gilbert's Whistler	V	-	Bird Surveys, Observational Sessions, Call Identification
Mammals				
Ningau i yvonneae	Southern Ningau i	V	-	Elliott Trapping, Pit Trapping
Pseudomys bolami	Bolam's Mouse	E	-	Elliott Trapping, Pit Trapping
Certhionyx concinnus	Western Pygmy Possum	E	-	Tree Elliott Trapping, Pit Trapping, Glider Tubes
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Harp Trapping, Anabat Recording
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Harp Trapping, Anabat Recording
Chalinolobus picatus	Little Pied Bat	V	-	Harp Trapping, Anabat Recording
Vespadelus baverstocki	Inland Forest Bat	V	-	Harp Trapping, Anabat Recording

¹ Threatened fauna species status under the TSC Act and/or EPBC Act (current at December 2015).

V = Vulnerable; E = Endangered



CRISTAL

G I N K G O M I N E

Threatened Species Recorded in the Ginkgo Mineral Sands Mine Area and Surrounds

Please note that Mount King Ecological Surveys (2001) recorded the Hooded Robin (south-eastern form) and White-fronted Chat, and Oryx Ecological Research (2009-2012) also recorded the Hooded Robin (south-eastern form) however exact locations were not recorded.

LEGEND

- Existing Ginkgo Mine - Crayfish Deposit Offset Area
- Proposed Additional Biodiversity Offset Area (1-3)
- Proposed Southern Extension Biodiversity Offset Area (4)

3.4 HABITAT ASSESSMENT

The study area was dominated by Black Oak Woodland habitat with some small patches of mallee and depression herb and grassland. Approximately half of the study area is Grassland/Low Shrubland supporting grassland. Habitat assessment was undertaken in four sites within the three survey areas. An assessment of the habitat present within the study area was also conducted by FloraSearch (2015).

Transects were walked through four sites (D1b, D1c, D2a and D3a), a number of trees were inspected and the following information was documented:

- tree species;
- tree height;
- diameter at breast height (DBH);
- presence of cracks and/or shedding bark;
- number of small (<10 cm), medium (10 to 20 cm) and large (>20 cm) hollows;
- if the hollow classed as a stag;
- GPS co-ordinates;
- presence of wildlife; and
- if the hollow classed as a habitat tree.

In addition, the number of logs located within a ten metre strip along the walking transects were recorded, together with their diameter.

3.5 STATISTICAL ANALYSIS OF FAUNA SURVEY RESULTS

Although not necessarily part of the assessment process some analysis of the data obtained from the surveys was undertaken to compare the characteristics of the survey areas with that from the general area. In regards fauna, the following indices were calculated: Species richness of faunal groups; Simpsons Index of Dominance; Evenness Score and Total Numbers located.

4 RESULTS

4.1 FAUNA LOCATED

A total of 84 species were located within the study area including 46 bird, 18 native mammal, five introduced mammal and 15 reptile species. The species richness (the value of different species) values for the study area are slightly lower than that found elsewhere in the Ginkgo area due to the smaller area of land surveyed. The results from the fauna surveys for the original Ginkgo Mineral Sands Project give species richness values for birds and reptiles of 54 and 19, respectively (MKES, 2001). Surveys for the Crayfish Modification area (Biodiversity Monitoring Services, 2012) give various bird species richness values ranging from 30 to 77 and reptile values from 4 to 19. Table 6 and Figure 5 show the species richness values for various areas surveyed for the Ginkgo Mine and fauna listings from the present survey of the study area are provided in Appendix A.

Table 6
Bird and Reptile Species Richness Values in the Ginkgo Area

Fauna Group	Source	Birds	Reptiles
Crayfish Modification Area	Biodiversity Monitoring Services (2012)	77	19
Crayfish Deposit Area	Biodiversity Monitoring Services (2012)	46	15
Crayfish Deposit Offset area	Biodiversity Monitoring Services (2012)	55	4
Haul Road Area	Biodiversity Monitoring Services (2012)	30	Na
Modification Area Overall	Biodiversity Monitoring Services (2012)	89	26
Ginkgo Mine Area	MKES (2001)	54	19
Ginkgo Overall	MKES (2001)	136	27
Mallara Offset Area	Biodiversity Monitoring Services (2014)	63	20
Southern Extension Modification Offset	This Report	46	15

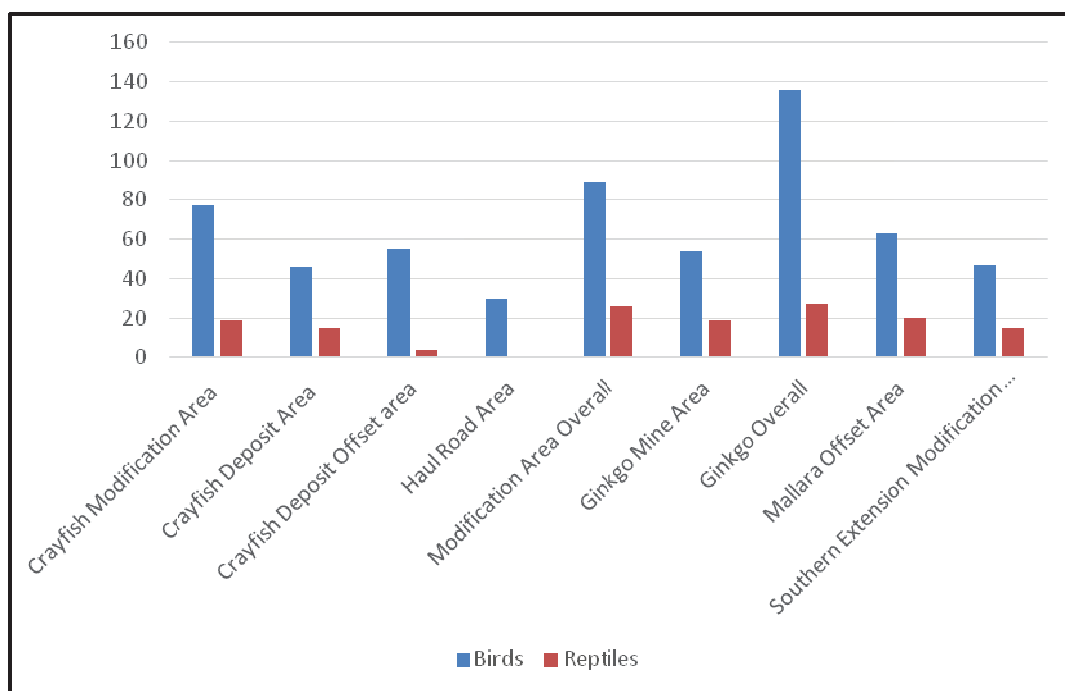


Figure 5: Bird and Reptile Species Richness Values in the Ginkgo Area

Although the Survey Area is relatively small (the entire study area is less than 100 ha) there were high numbers of bats captured as well as several common reptiles species that are new records for the Ginkgo area. The high number of bats captured (Plate 3) is possibly due to the ideal weather conditions for this fauna group (i.e. hot and moist). New reptile records included Border Beaked Gecko, Ranges Stone Gecko and Australian Coral Snake (Plate 4).



Plate 3: Harp Trap at Site D1b with Bats Collected Overnight
(photo by Andrew Lothian)



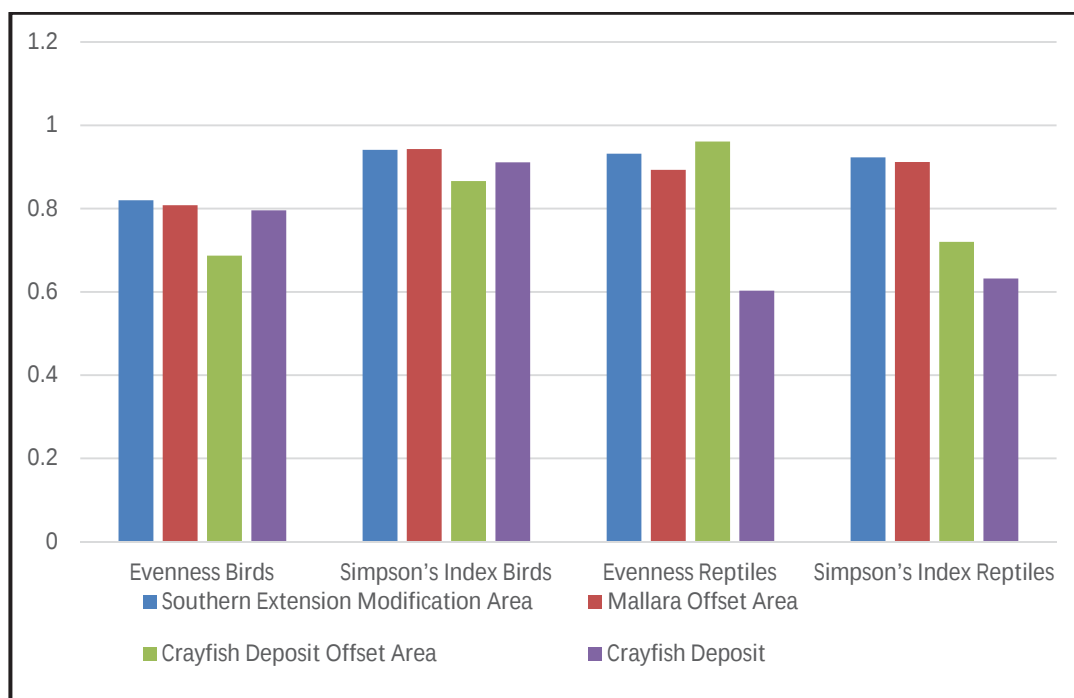
Plate 4: Australian Coral Snake captured at Site D2a

Total numbers and species richness (number of species per site) are the simplest measures used to determine biodiversity of a site. However, these indices miss the information that some species may be rare and others common. The Simpson's Index of Diversity takes into account both the abundance patterns and the species richness of a community. This index measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species).

An Evenness score was also calculated. Evenness is a measure of the relative abundance of different species making up the richness of an area. A low value for Evenness means that the sample is dominated by a large number of one or two species. A high Evenness value means that most species in the sample have a similar abundance. It was possible to calculate Simpson's Index of Diversity and Evenness score for bird and reptile populations from the study area and compare these with that obtained from the Crayfish Deposit and Mallara Offset areas and the Crayfish Project area. The results from the calculations are given in Table 7 and Figures 6a and 6b.

Table 7
Biodiversity Indices for Four Areas

Location	Evenness	Simpson's Index (D)	Number	Species Richness
Birds				
Southern Extension Modification Area	0.820	0.941	884	46
Mallara Offset Area	0.808	0.943	2,246	63
Crayfish Deposit Offset Area	0.687	0.866	2,034	55
Crayfish Deposit	0.796	0.911	869	46
Reptiles				
Southern Extension Modification Area	0.932	0.923	77	15
Mallara Offset Area	0.893	0.912	92	20
Crayfish Deposit Offset Area	0.961	0.720	5	4
Crayfish Deposit	0.603	0.632	70	15



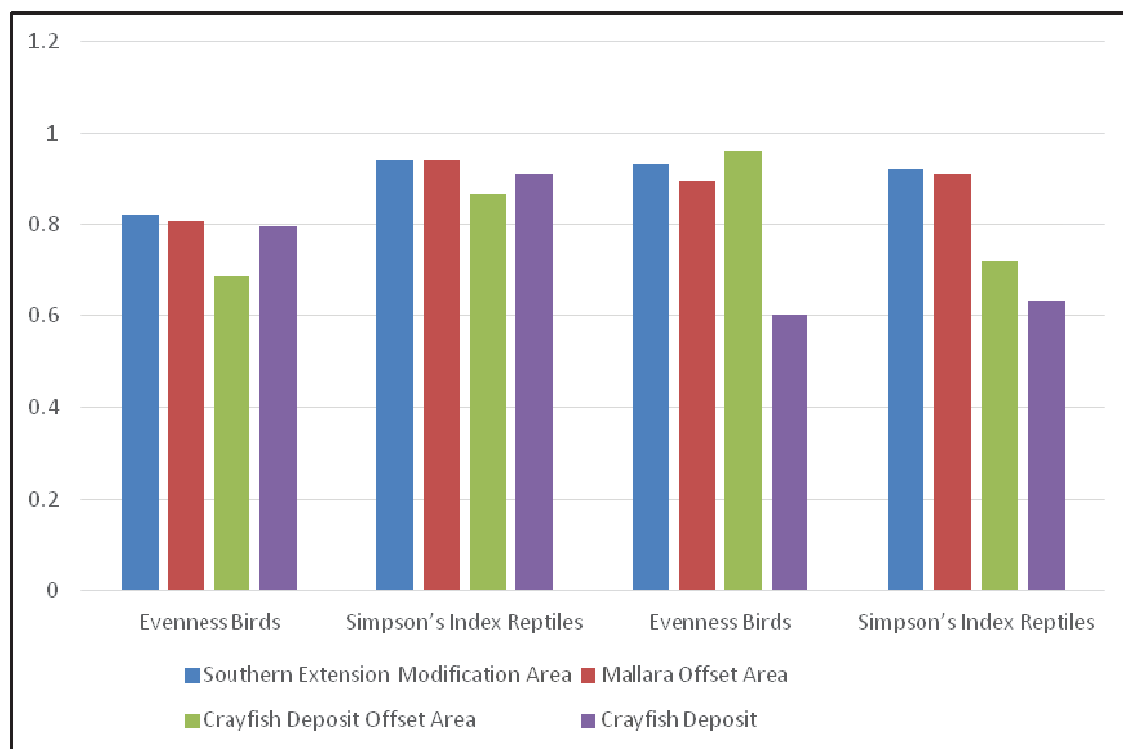


Figure 6a: Biodiversity Indices for Birds and Reptiles (1)

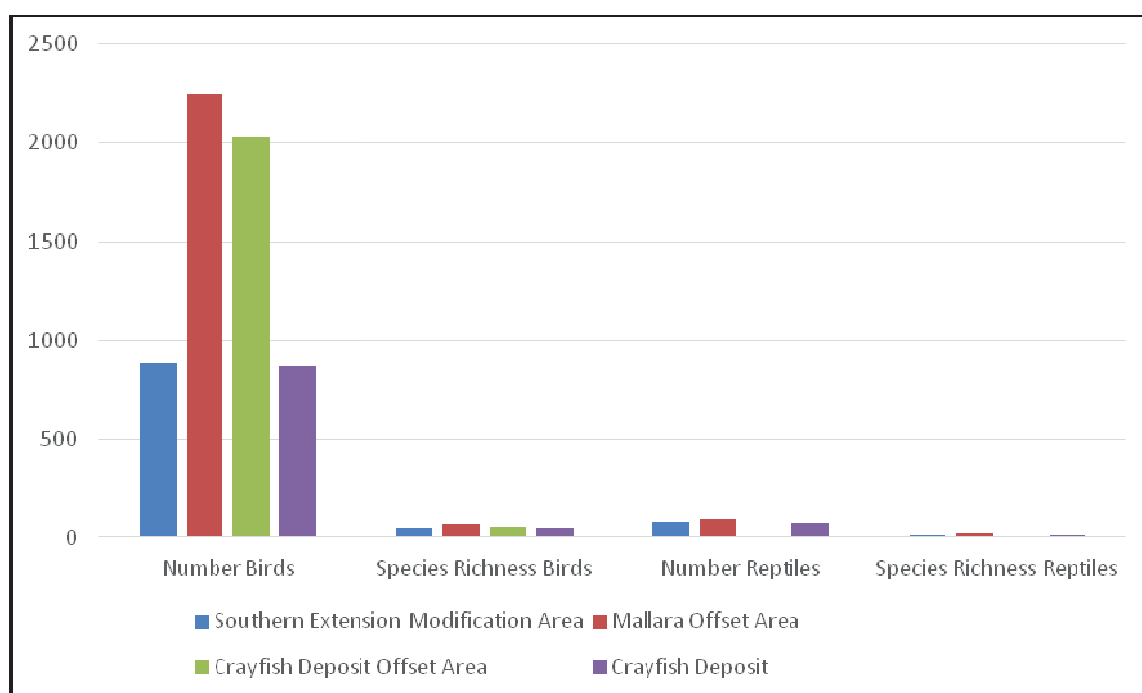


Figure 6b: Biodiversity Indices for Birds and Reptiles (2)

4.2 THREATENED FAUNA SPECIES

Five species listed as Vulnerable under the TSC Act were located within the study area. These are listed in Table 8 and their locations within the study area are given in Figure 7.

Table 8
Threatened Species Located within the Study Area

Date	Easting	Northing	Common Name	Scientific Name	No.	Method	Site
3/11/2015	615066	6307001	Hooded Robin (south-east form)	<i>Melanodryas cucullata</i>	3	Sight	D1b
3/11/2015	614797	6306356	Bolam's Mouse	<i>Pseudomys bolami</i>	1	Ground Elliot	D2a
4/11/2015	614797	6306356	Bolam's Mouse	<i>Pseudomys bolami</i>	1	Ground Elliot	D2a
31/10/2015	615066	6307001	Little Pied Bat	<i>Chalinolobus picatus</i>	2	Harp	D1b
1/11/2015	615252	6306714	Little Pied Bat	<i>Chalinolobus picatus</i>	1	Harp	D1c
30/10/2015	615252	6306714	Little Pied Bat	<i>Chalinolobus picatus</i>		Anabat	D1c
31/10/2015	614791	6307346	Little Pied Bat	<i>Chalinolobus picatus</i>		Anabat	D1a
1/11/2015	616144	6305451	Little Pied Bat	<i>Chalinolobus picatus</i>		Anabat	D3a
2/11/2015	615906	6305544	Little Pied Bat	<i>Chalinolobus picatus</i>		Anabat	D3b
30/10/2015	615252	6306714	Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>		Anabat	D1c
30/10/2015	615252	6306714	Inland Forest Bat	<i>Vespadelus baverstocki</i>		Anabat	D1c
31/10/2015	614791	6307346	Inland Forest Bat	<i>Vespadelus baverstocki</i>		Anabat	D1a
1/11/2015	616144	6305451	Inland Forest Bat	<i>Vespadelus baverstocki</i>		Anabat	D3a
2/11/2015	615906	6305544	Inland Forest Bat	<i>Vespadelus baverstocki</i>		Anabat	D3b

Two male Bolam's Mouse were captured in Survey Area D2a using Elliott traps (Plate 5). This species is listed as Endangered under the TSC Act but is not listed under the Commonwealth EPBC Act. The Bolam's Mouse is found in southern Western Australia and South Australia, extending east into the south-western corner of NSW. It is recorded in a wide variety of habitats, with a preference for chenopod shrubland plains or low mallee woodland. The two individuals were located within Black Oak – Western Rosewood Woodland with chenopod shrubland understorey. Bolam's Mouse has been recorded from within 2 km of Site D2a, within a rehabilitated area associated with previous mine workings.



Plate 5: Bolam's Mouse Captured at Survey Site D2a (photo by Will Brown)



LEGEND

- Mining Lease Boundary
- Ore Pipeline (Processing Option 2) (Not Constructed)
- Mineral Concentrate Transport Route and MSP Process Waste Transport Route (Not Constructed)
- Ginkgo Mine Potable Water Pipeline (Not Constructed)
- Electricity Transmission Line
- Water Bore

- Ginkgo Mine General Arrangement (2010)
- Subject Area
- Modified Approximate Extent of Surface Development

Threatened Fauna

- (Grey Falcon
- (Major Mitchell's Cockatoo
- (Hooded Robin (south eastern form)
-) Bolam's Mouse
- * Inland Forest Bat
- # Little Pied Bat
- Yellow-bellied Shearwater-Bat



G I N K G O M I N E

Threatened Species in the Modification Area

Please note that Mount King Ecological Surveys (2001) recorded the Hooded Robin (southeastern form) and White-fronted Chat, and Ogryis Ecological Research (2009-2012) also recorded the Hooded Robin (southeastern form) however exact locations were not recorded.

- Reference: 1 Biodiversity Monitoring Services (2012) 2 Mount King Ecological Surveys (2001) 4 Ogryis Ecological Research (2009-2012) 5 Biodiversity Monitoring Services (2015)

Source: Bernax Resources Limited (2010) and Cristal Mining (2013); Ornithophoto: Cristal Mining (2012)

Figure 7

4.3 BROAD FAUNA HABITAT TYPES

FloraSearch (2015) recorded six distinct vegetation communities in the Study area:

- Black Box Woodland;
- Black Oak – Western Rosewood Woodland;
- Black Oak – Pearl Bluebush Woodland;
- Chenopod Mallee Woodland/Shrubland;
- Austrostipa - Sida Grassland/Low Shrubland; and
- Eragrostis Depression Grassland.

The above vegetation communities equate to the following broad fauna habitat types (as mapped on Figure 8):

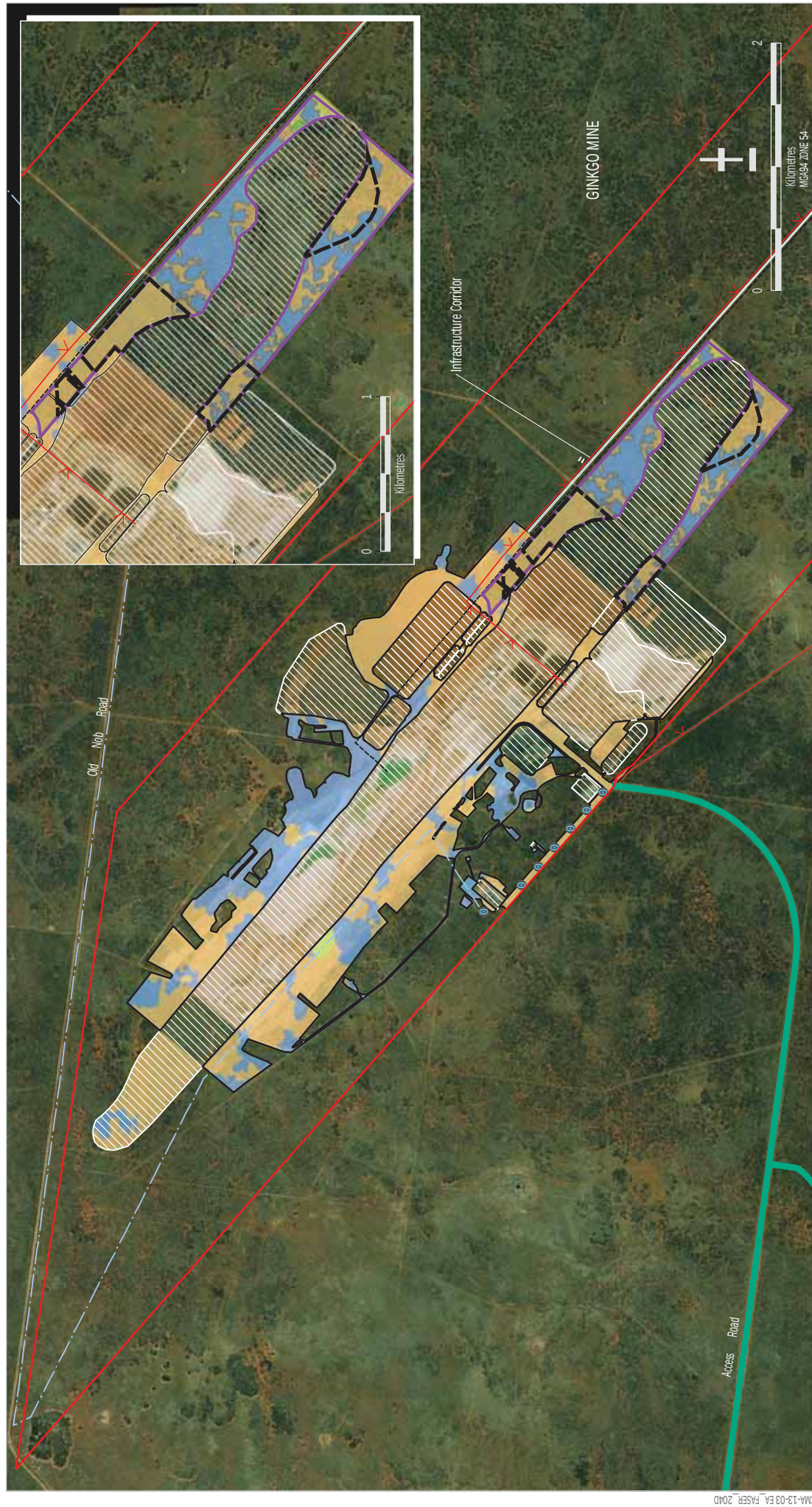
- Black Box Woodland Habitat Type;
- Black Oak Woodland Habitat Type (comprising Black Oak – Western Rosewood Woodland and Black Oak – Pearl Bluebush Woodland);
- Chenopod Mallee Habitat Type; and
- Grassland/Low Shrubland Habitat Type (comprising Austrostipa - Sida Grassland / Low Shrubland and Eragrostis Depression Grassland).

4.4 TREE HOLLOWS

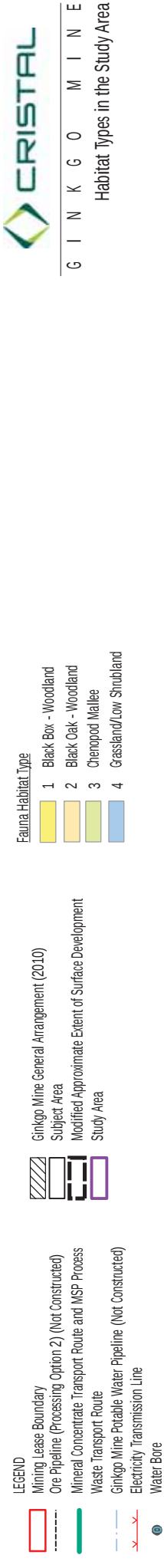
The survey within the study area showed that a proportion of the 225 trees inspected had some form of hollow and could be classed as 'habitat trees'. Table 9 gives a summary of the data obtained from the tree survey. Overall, the proportion of different tree species sampled was Mallee (9 percent [%]), Black Oak (67%), and Western Rosewood (24%).

Table 9
Characteristics of Trees within the Study Area

Site	Vegetation Community	Mean Tree Height (m)	Mean DBH (cm)	% Trees with Cracks	% Trees with Hollows			% Stags
					Small	Medium	Large	
D1b	Black Oak – Pearl Bluebush	6.4	21.6	48.1	19.2	-	-	15.4
D1c	Black Oak – Pearl Bluebush	4.8	18.5	71.1	26.9	5.8	-	40.4
D2a	Black Oak – Western Rosewood	4.4	15.0	46.7	21.7	-	-	8.3
D3a	Black Oak – Western Rosewood	4.8	15.8	22.9	1.6	3.2	-	16.4
Mean		5.1	17.7	47.2	17.3	2.2	-	20.1



CMA-13-03 EA, FRASER 2040



Source: Bemax Resources Limited (2010) and Cristal Mining (2013); Orthophoto: Cristal Mining (2012)

Figure 8

It can be seen that a proportion of the trees contain hollows of some size, with those trees with small hollows making up the majority. More trees showed cracks in the trunks and/or loose and cracking bark. There is some variation between the sites, with Site D2a showing the highest proportion of trees with hollows and cracks. However, there are no significant differences between the four sites (ANOVA). Unfortunately, the inspection of many tree hollows by the use of an inspection camera did not reveal much use by fauna. In most cases all that was found were insects. A small number of species were found associated with the trees inspected (*Cryptoblepharus carnabyi*, *Gehyra variegata*, *Pogona vitticeps* and *Tachyglossus aculeatus*).

4.5 LOGS

An estimate was made of the density of logs within four survey areas whilst the tree surveys were undertaken. Logs encountered within a two metre strip along the tree transect were counted and their diameter and presence of hollows noted. By multiplying the width of the strip by the distance of each transect it was possible to calculate log density in terms of logs per hectare. The results of this survey are given in Table 10.

Table 10
Logs Counted in Each Transect

Site	Diameter (cm)	% Logs with Cracks	% Logs with Hollows	Density Logs/ha
D1b	18.0	4.3	8.7	93
D1c	15.6	100	6.5	134
D2a	16.8	100	44.4	153
D3a	15.0	100	6.2	74
Mean	16.3	76	16.4	113

Survey Site D2a shows the highest density of logs and highest proportion of logs with hollows. However, there are no significant differences between any of sites in terms of log size, characteristics and density (non-parametric Kruskal-Wallis One Way Analysis of Variance on Ranks).

Statistically there are no significant differences between the biodiversity indices for the Mollara and Crayfish Deposit Offset Areas and that from the Modification area (non-parametric Kruskal-Wallis One Way Analysis of Variance on Ranks).

5 IMPACT EVALUATION

5.1 LAND CLEARANCE

5.1.1 Loss of Fauna Habitat

Less than half of the study area supports woodland habitat and only a proportion of this will be removed for the Modification. Overall, the amount to be lost (32 ha, Table 11) is small compared to that available in the surrounding region.

Table 11
Quantification of Broad Fauna Habitat Types

Broad Fauna Habitat Types		Ginkgo Mine Southern Extension Area (ha)
2	Black Oak Woodland Habitat Type	27
4	Grassland/Low Shrubland Habitat Type	5
Total		32

Any loss of fauna habitats would be compensated for by setting aside and managing an area of equivalent habitats to give an increase in biodiversity values over time. This would be achieved by the extension to the existing offset area (Section 7).

5.1.2 Loss of Hollow-bearing Trees, Removal of Dead Wood

Removal of dead wood and dead trees is listed as a Key Threatening Process on Schedule 3 of the TSC Act. Dead wood and dead trees provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems. The removal of dead wood can have a range of environmental consequences, including the loss of habitat (as they often contain hollows used for shelter by animals), disruption of ecosystem process and soil erosion.

About 20% of the trees counted within the study area were classed as 'Stags' i.e. dead trees. Hollow-bearing trees occur in the study area and current surveys (see Section 4.4) show that 17.3% of trees surveyed contained small hollows (<10cm diameter) and 2.2% had medium sized hollows (between 10 and 20 cm diameter). No large hollows (> 20cm diameter) were recorded. The relatively small population of hollow-bearing trees, including dead trees, within the study area would only be partly affected by the Modification and any impact could be considered as low.

Dead wood can be considered to be logs within the study area. A total of 102 logs were counted within the four survey areas giving an average density of 113 logs/ha within the transects. Some of these logs will be lost in the operations but the overall number is small compared to that available throughout the region.

Any loss of hollow-bearing trees, dead trees and dead wood would be compensated for by setting aside and managing an area of equivalent communities to ensure an increase in biodiversity values over time. This would be achieved by the extension to the existing offset area (Section 8).

5.1.3 Bushrock Removal

Bushrock Removal is the removal of natural surface deposits of rock from rock outcrops or from areas of native vegetation. The rocks may be loose rocks on rock surfaces or on the soil surface, or may have been removed from rock outcrops by excavation or blasting. Bushrock Removal removes and/or disturbs habitat of native species, which may find shelter in or under rocks, may use rocks for basking, or which grow in rocky areas (Bushrock removal - key threatening process listing NSW Scientific Committee - final determination). There is little to no bushrock within the study area.

5.1.4 Loss of Individual Animals

The majority of animals located within the study area are widely distributed throughout the region and are represented within the offset areas set aside for this development. Although Bolam's Mouse is listed as Endangered, it is found nearby to the Modification, in the rehabilitation areas. This species, like many within the *Pseudomys* genus, will successfully colonise disturbed land and it is likely that individuals in the Modification area would be able to move into the surrounding land during clearing operations. It is anticipated that any loss of individual animals will not significantly affect any populations in the general area.

5.1.5 Impacts on Habitat Connectivity

The study area is located next to an active open cut mine with associated infrastructure and other activities. It is considered that any activities within the study area will not significantly affect the already disturbed habitat continuity.

5.2 INDIRECT IMPACTS

5.2.1 Introduced Flora and Fauna

The creation of disturbed land could attract introduced species such as House Mice, Red Fox, Feral Pig, Rabbit and Cat to the area. However, measures to control feral pests would be continued (Section 7). Consequently the presence of introduced fauna should be low.

5.2.2 Noise

Studies have shown that excessive and sudden noise can affect the presence and breeding ability of certain fauna species. However, it is also found that many species adapt to human activities and readily habituate to noise. A range of fauna species are known to inhabit land within and surrounding the existing development and it is considered that the impact of noise generated by the Modification on vertebrate fauna adjacent to the area is likely to be minimal.

5.2.3 Artificial Lighting

Artificial lighting for the Modification has the potential to affect the behavioural patterns of some fauna species e.g. attracting birds and bats to feed at lights. Although such situations can result in increased predation there is no evidence of this phenomenon within the existing lighting set-up at Ginkgo Mine and it is unlikely that the impacts from artificial lighting at the Modification would be different.

5.2.4 Dust

Excessive dust generation can impact on the health and viability of surrounding vegetation and indirectly affect fauna populations. Such an impact would be limited and any dust effects would be mitigated by regular watering of roads and soil stockpiles.

5.3 CUMULATIVE IMPACTS ON BIODIVERSITY

The overall loss of vegetation and associated habitat types would be relatively low when compared to that known from the surrounding area. The Modification would result in a loss of 32 ha of native vegetation. This is in addition to the 1,630 ha of native vegetation clearance approved at the nearby Snapper Mine and 1,567 ha approved/existing surface disturbance at the Ginkgo Mine.

Nearie Lake Nature Reserve is the nearest protected area located approximately 160 km south of the Modification and the only protected area between the Great Darling Anabranh and Darling River. Nearie Lake Nature Reserve is 4,347 ha in size dominated by chenopod shrublands. The existing and proposed offset areas held by Cristal Mining between the Great Darling Anabranh and Darling River are 9,484 ha in size¹ (more than double the size of Nearie Lake Nature Reserve) and contain a range of vegetation communities and habitats not preserved within Nearie Lake Nature Reserve.

¹ The existing offset areas for the Snapper Mine are 5,470 ha in size.

6 THREATENED FAUNA SPECIES ASSESSMENT

6.1 THREATENED FAUNA SPECIES LISTED UNDER THE NSW TSC ACT

Table 12 provides a list of threatened fauna species listed under the TSC Act which have been recorded within the wider region as well as the species known or predicted to occur in the South Olary Plain, Murray Basin Sands [Part D] CMA subregion [OEH, 2015]. As the study area is within clay soils and does not contain any sandy soils with related spinifex and there are no areas of open water, several of the threatened species can be eliminated. Consequently, the list of potential threatened fauna species can be refined to those species with records and/or potential habitat within the study area or immediate surrounds, those species are highlighted in Table 12.

Table 12
Threatened Fauna Species that could Potentially be Impacted
by the Southern Extension Modification

Common Name	Habitat Preference	Species Previously Recorded within the Survey Area or Surrounds?	Likely to Occur
Amphibians			
Painted Burrowing Frog	Sandy soils	Not known from the area and surrounds	No
Reptiles			
Crowned Gecko	Sandy soils with spinifex	Not known to occur near the Modification area (Figure 7) but known to occur in the wider locality (Figure 4)	No
Jewelled Gecko	Sandy soils with spinifex		No
Mallee Worm-Lizard	Sandy soils with spinifex	Not known from the area and surrounds	No
Marbled-faced Delma*	Sandy soils with spinifex	Not known to occur near the Modification area (Figure 7) but known to occur in the wider locality (Figure 4)	No
Mallee Slender Blue-tongue Lizard	Mallee/spinifex	Not known from the area and surrounds	No
Yellow-tailed Plain Slider	Sand plains with spinifex	Not known from the area and surrounds	No
Western Blue-tongued Lizard*	Loamy or clayey/sandy soils with chenopod shrublands	Not known to occur near the Modification area (Figure 7) but known to occur in the wider locality (Figure 4)	Yes
Birds			
Malleefowl	Mainly mallee woodland	Not known to occur near the Modification area (Figure 7) but known to occur in the wider locality (Figure 4)	No
Freckled Duck	Open water		No
Blue-billed Duck	Open water		No
Grey Falcon*	Shrubland, grassland	Known to occur near the Modification area (Figure 7) and wider locality (Figure 4)	Yes
Square-tailed Kite	Woodlands, grasslands	Not known to occur near the Modification area (Figure 7) but known to occur in the wider locality (Figure 4)	Yes
Black-breasted Buzzard	Woodlands, grasslands		Yes
Spotted Harrier	Woodlands, grasslands	Not known from the area and surrounds	Possible
Little Eagle*	Woodlands, grasslands	Not known to occur near the Modification area (Figure 7) but known to occur in the wider locality (Figure 4)	Yes
Black Falcon	Woodlands, grasslands	Not known from the area and surrounds	Possible

Table 12 (Continued)
Threatened Fauna Species that could Potentially be Impacted
by the Southern Extension Modification

Common Name	Habitat Preference	Species Previously Recorded within the Survey Area or Surrounds?	Likely to Occur
Birds (Cont.)			
Bush Stone-curlew	Woodlands, grasslands	Not known from the area and surrounds	No
Major Mitchell's Cockatoo*	Woodlands, grasslands	Known to occur near the Modification area (Figure 7) and wider locality (Figure 4)	Yes
Red-tailed Black-Cockatoo	Woodlands, grasslands	Not known to occur near the Modification area (Figure 7) but known to occur in the wider locality (Figure 4)	Yes
Swift Parrot	Woodlands, grasslands		Yes
Regent Parrot (eastern sub-species)	Woodlands, grasslands		Yes
Scarlet-chested Parrot	Woodlands, grasslands	Not known from the area and surrounds	No
Barking Owl	Woodlands, grasslands	Not known to occur near the Modification area (Figure 7) but known to occur in the wider locality (Figure 4)	Yes
Redthroat	Chenopod shrublands		Yes
White-fronted Chat*	Chenopod shrublands		Yes
Purple-gaped Honeyeater	Mallee shrublands	Not known from the area and surrounds	No
Pied Honeyeater	Woodlands, grasslands		No
Shy Heathwren	Chenopod shrublands	Not known from the locality	Possible
Hooded Robin* (south-eastern form)	Woodlands	Known to occur within the Modification area (Figure 7) and wider locality (Figure 4)	Yes
Southern Scrub-robin	Woodlands, grasslands	Not known from the area and surrounds	No
Chestnut-backed Quail-thrush	Mallee with spinifex		No
Varied Sittella	Woodland	Not known to occur near the Modification area (Figure 7) but known to occur in the wider locality (Figure 4)	Yes
Gilbert's Whistler	Woodlands and shrublands	Not known from the area and surrounds	Possible
Mammals			
Southern Ningauai	Spinifex	Not known from the area and surrounds	No
Bolam's Mouse*	Chenopod shrublands	Known to occur within the Modification area (Figure 7)	Yes
Western Pygmy Possum	Woodlands,	Not known from the area and surrounds	No
Yellow-bellied Sheath-tail-bat*	Roosts in tree hollows	Known to occur near the Modification area (Figure 7) and wider locality (Figure 4)	Yes
Corben's Long-eared Bat	Roosts in tree hollows	Not known from the area and surrounds	Possible
Little Pied Bat*	Roosts in tree hollows	Known to occur within the Modification area (Figure 7) and wider locality (Figure 4)	Yes
Inland Forest Bat*	Roosts in tree hollows		Yes

* Species recorded at the Ginkgo Mine (Sections 2.7 and 4.2)

Those threatened species that are considered to potentially occur within the study area are highlighted in grey in Table 12 and are assessed under the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005) in the following sections.

Current Disturbance Regimes

In accordance with the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005), the potential effect of the Modification on current disturbance regimes applicable to threatened species has been considered. However, the Modification is unlikely to adversely change any current disturbance regimes applicable to the threatened flora and fauna species in Table 12, given the disturbance regimes in Modification area are largely human-induced (e.g. past livestock grazing).

Connectivity

In accordance with the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005), the potential effect of the Modification on connectivity of habitat for threatened species has been assessed. The Modification is unlikely to significantly reduce habitat connectivity for any threatened fauna species given the Modification is already largely surrounded by the existing/approved surface development (Figures 2a and 2b), and therefore unlikely to adversely impact any threatened species' population viability in this manner.

Critical Habitat

No critical fauna habitat occurs within the vicinity of Modification area.

6.2 THREATENED SPECIES ASSESSMENT FOR TSC ACT LISTED THREATENED FAUNA SPECIES

6.2.1 Western Blue-tongued Lizard

The Western Blue-tongued Lizard (*Tiliqua occipitalis*) is found throughout western NSW and inhabits plains, swales, ranges and sometimes dunes of loamy or clayey/sandy soils vegetated by woodlands, especially mallee, shrublands (including chenopods), heaths or hummock grasslands. Its preferred vegetation type appears to be mixed mallee/*Triodia* communities.

This species was not located within the Modification area but it has been found close by (Figure 4).

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

It is unlikely that the Modification would adversely affect the lifecycle of the Western Blue-tongued Lizard because of the small loss of woodland habitat (approximately 27 ha), combined with the ongoing management actions and the provision of offset areas (Section 7.3).

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

Only a small amount of woodland habitat would be removed (adjacent to existing approved disturbance areas) and no area of habitat will be isolated. There is a large amount of woodland habitat conserved in the surrounding area.

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

The Modification area is not at the limits of this species' distribution.

Summary

The Modification is unlikely to significantly impact the Western Blue-tongued Lizard due to the small loss of habitat, presence of suitable habitat in the surrounding area, and provision of offset areas.

6.2.2 Birds of Prey

Six birds of prey have the potential to be impacted by the Modification were they to use habitat in the Modification areas, namely the Square-tailed Kite (*Lophoictinia isura*), Little Eagle (*Hieraaetus morphnoides*), Grey Falcon (*Falco hypoleucos*), Black-breasted Buzzard (*Hamirostra melanosternon*), Black Falcon (*Falco subniger*) and Spotted Harrier (*Circus assimilis*) and are assessed below.

All these species are distributed through most of eastern Australia and are mainly found where open country intergrades with woodland and forest. All can be considered wide-ranging and utilize trees for nesting either on branches or in hollows. None of the six species were located within the study area.

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

It is unlikely that the Modification would adversely affect the lifecycle of any of the six birds of prey because of the small loss of woodland habitat (approximately 27 ha), combined with the on-going management actions and the provision of offset areas (Section 7.3).

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

Only a small amount of woodland which provides habitat for the birds of prey would be removed and no area of habitat would be isolated. There is a large amount of woodland habitat conserved in the surrounding area.

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

The Modification area is not at the limits of these species' distribution.

Summary

The Modification is unlikely to significantly impact these six birds of prey due to the small loss of habitat, presence of suitable habitat in the surrounding area, and provision of offset areas.

6.2.3 Barking Owl

The Barking Owl is not known to occur near the Modification area (Figure 7) but known to occur in the wider locality (Figure 4).

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

It is unlikely that the Modification would adversely affect the lifecycle of the Barking Owl because of the small loss of woodland which provides habitat for this species, combined with the on-going management actions and the provision of offset areas (Section 7.3).

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

Only a small amount of woodland providing habitat for this species would be removed and no area of habitat would be isolated. There is a large amount of woodland habitat conserved in the surrounding area.

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

The Modification area is not at the limits of this species' distribution.

Summary

The Modification is unlikely to significantly impact the Barking Owl due to the small loss of habitat, presence of suitable habitat in the surrounding area, and provision of offset areas.

6.2.4 Parrots

Four parrot species have the potential to be impacted by the Modification, namely the Major Mitchell's Cockatoo (*Lophochroa leadbeateri*), Red-tailed Black-cockatoo (*Calyptorhynchus banksii samueli*), Swift Parrot (*Lathamus discolor*) and Regent Parrot (eastern sub-species *Polytelis anthopeplus monarchoides*) and are assessed below.

All four species of parrot are widely distributed throughout eastern NSW and are found in the surrounding area. None were located within the study area but the Major Mitchell's Cockatoo was observed close by. All species are associated with woodland and grassland habitats.

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

It is unlikely that the Modification would adversely affect the lifecycle of either parrot species because of the small loss of woodland providing habitat for these species, combined with the on-going management actions and the provision of offset areas (Section 7.3).

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

Only a small amount of woodland providing habitat for these species would be removed and no area of habitat would be isolated. There is a large amount of woodland habitat conserved in the surrounding area.

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

The Modification area is at the limit of the known distributions of the Red-tailed Black-Cockatoo and Swift Parrot.

The Modification area is not at the limits of the known Major Mitchell's Cockatoo or Regent Parrot distribution.

Summary

Although the Study area is at the limit of the known distributions of the Red-tailed Black-Cockatoo and Swift Parrot, the Modification is unlikely to significantly impact these four parrot species due to the small loss of habitat, presence of suitable habitat in the surrounding area, and provision of offset areas.

6.2.5 Woodland Bird Species

Seven woodland bird species have the potential to be impacted by the Modification, namely Redthroat (*Pyrrholaemus brunneus*), White-fronted Chat (*Epthianura albifrons*), Shy Heathwren (*Hylacola cautus*), Hooded Robin (south-eastern form *Melanodryas cucullata cucullata*), Varied Sittella (*Daphoenositta chrysoptera*) and Gilbert's Whistler (*Pachycephala inornata*).

All the bird species are associated with woodland, shrubland and grassland habitats and are distributed throughout New South Wales. The Hooded Robin (south-eastern form) was observed within the study area.

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

It is unlikely that the Modification would adversely affect the lifecycle of the seven woodland bird species because of the small loss of woodland providing habitat for these species, combined with the on-going management actions and the provision of offset areas (Section 7.3).

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

Only a small amount of woodland providing habitat for these species would be removed and no area of habitat would be isolated. There is a large amount of woodland habitat conserved in the surrounding area.

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

The Modification area is at the southern limit of the known distributions of the Shy Heathwren distribution.

The Modification area is not at the limits of the known Redthroat, White-fronted Chat, Hooded Robin (south-eastern form), Grey-crowned Babbler (south-eastern sub-species), Varied Sittella or Gilbert's Whistler distribution.

Summary

Although the Study area is at the southern limit of the known distribution of the Shy Heathwren, this species is not known from the area and it is considered unlikely (although possible) that this species would occur within the Study area. Further, the Modification is unlikely to significantly impact these seven woodland species due to the small loss of habitat, presence of suitable habitat in the surrounding area, and provision of offset areas.

6.2.6 Bolam's Mouse

The Bolam's Mouse (*Pseudomys bolami*) is found in southern Western Australia and South Australia, extending east into the south-western corner of NSW. It prefers chenopod shrubland plains or low mallee woodland where there is a developed understorey of *Acacia*, *Dodonaea* or *Eremophila* species. It seems to especially favour plains areas, spillways and along valley bottoms where loam or clay soils occur. Two individuals (both male) were captured within the study area and it has been recorded from nearby rehabilitation areas.

This species was not located within the study area it has been found close by.

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

It is unlikely that the Modification would adversely affect the lifecycle of the Bolam's Mouse because of the small loss of preferred habitat and the species ability to colonize disturbed areas, combined with the on-going management actions and the provision of offset areas (Section 7.3).

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

Only a small amount of shrubland providing habitat for this species would be removed and no area of habitat would be isolated. There is a large amount of shrubland habitat conserved in the surrounding area.

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

The Modification area is at the southern limit of the known distributions of the Bolam's Mouse distribution.

Summary

Although the Study area is at the southern limit of the known distribution of the Bolam's Mouse, the Modification is unlikely to significantly impact this species due to the small loss of habitat, presence of suitable habitat in the surrounding area, and provision of offset areas.

6.2.7 Tree-roosting Bats

Four tree-dwelling bat species have the potential to be impacted by the Modification, namely the Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*), Little Pied Bat (*Chalinolobus picatus*), Corben's Long-eared Bat (*Nyctophilus corbeni*) and Inland Forest Bat (*Vespadelus baverstocki*) and are assessed below. All species are found within inland NSW and all utilize tree hollows for roosting. The Yellow-bellied Sheath-tail-bat, Little Pied Bat and Inland Forest Bat were recorded from the study area and in the surrounding area. Corben's Long-eared Bat has not been located at Ginkgo Mine.

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

It is unlikely that the Modification would adversely affect the lifecycle of the four tree-roosting bat species because of the small loss of woodland providing habitat for these species, combined with the on-going management actions and the provision of offset areas (Section 7.3).

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

Only a small amount of woodland providing habitat for these species would be removed and no area of habitat would be isolated. There is a large amount of woodland habitat conserved in the surrounding area.

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

The Modification area is at the southern limit of the known distributions of the Little Pied Bat and Inland Forest Bat distributions.

The Modification area is not at the limits of the known Yellow-bellied Sheath-tail-bat or Corben's Long-eared Bat distribution.

Summary

Although the Study area is at the southern limit of the known distributions of the Little Pied Bat and Inland Forest Bat, the Modification is unlikely to significantly impact these four tree-roosting species due to the small loss of habitat, presence of suitable habitat in the surrounding area, and provision of offset areas.

6.3 THREATENED FAUNA SPECIES LISTED UNDER THE COMMONWEALTH EPBC ACT

In regard to Commonwealth listed threatened fauna species, no threatened fauna species listed under the EPBC Act have been previously recorded in the Modification area or immediate surrounds. It is considered unlikely that the Modification would have a significant impact on any threatened fauna species.

7 MANAGEMENT, MITIGATION AND OFFSET MEASURES

7.1 CURRENT MANAGEMENT AND MITIGATION MEASURES

The overburden emplacement, topsoil stockpile areas and other supporting infrastructure are located adjacent to the existing surface disturbance areas thereby minimising the mine footprint. The Black Box Woodland Habitat, located to the south of the additional surface disturbance areas, would be avoided (Figures 2a and 2b).

Potential adverse impacts on flora and fauna from the Ginkgo Mine are managed under an existing *Ginkgo Mine Flora and Fauna Management Plan*. The existing plan was updated to include the Crayfish Deposit and submitted to Department of Planning and Environment (DP&E) for approval in December 2015.

The measures described in the *Ginkgo Mine Flora and Fauna Management Plan* that would be continued for the Modification are described in Table 13.

Table 13
Existing Mitigation Measures at the Ginkgo Mine

Measure	Description
Vegetation Clearance Protocol	The Vegetation Clearance Protocol includes: • clear delineation of remnant native vegetation outside of the approved disturbance areas immediately adjacent to proposed clearing (e.g. marked or fenced on the ground prior to clearing activities and restriction of clearing to within these areas); • sign posts to alert personnel not to enter vegetation outside of the disturbance areas; • mine staff and contractors will be made aware of clearing limits and restricted access areas; • targeted pre-clearance surveys for threatened flora and a review of appropriate management measures if species are found; • targeted pre-clearance surveys for fauna in areas supporting <i>Triodia</i> sp. or hollow bearing trees and implementation of appropriate clearing strategies; • select vegetation cleared at the mine will continue to be reused as part of the rehabilitation programme for habitat enhancement; and • select sources of seed will be collected and propagated as part of the rehabilitation programme.
Re-establishment of Native Vegetation and Habitat	The general objectives of the existing rehabilitation program are to: • provide stable landforms with suitable vegetation cover for the proposed post mining land uses being a combination of grazing and the preservation of native flora and fauna; and • retain and link existing viable remnants, where practicable. Management measures may include the placement of nesting boxes and bat roosting boxes in areas of suitable habitat for birds, bats and arboreal mammals and the inclusion of suitable ground cover species and forage resources in the rehabilitation program.
Threatened Species Management Measures	A Threatened Species Management Protocol has been prepared to facilitate the management and minimisation of potential impacts on threatened species. Key components of the Threatened Species Management Protocol which relate to fauna include site observations/surveys, threatened species management strategies and reporting.

Table 13 (Continued)
Existing Mitigation Measures at the Ginkgo Mine

Measure	Description
Marble-faced Delma Management Measures	The Marble-faced Delma (also known as the Marble-headed Snake-lizard) (<i>Delma australis</i>) is a reptile, listed as Endangered under the TSC Act, which was recorded in the Modified Request Project area. Cristal Mining will commission a suitably qualified person(s) to undertake further searches for the reptile in the disturbance and surrounding areas (e.g. the proposed Biodiversity Offset Area). The searches will aim to delineate the distribution of the Marble-faced Delma and its population numbers. This information will be used to demonstrate the wider occurrence of the local population of Marble-faced Delma. Prior to any vegetation and habitat removal, a slow, cool, fuel-reduction burn would be completed in autumn or spring to remove habitats for the Marble-faced Delma and encourage dispersal of this species out of the area. If timing and conditions do not allow this, other relocation techniques may be considered.
Measures to control weeds, feral pests and access	Control measures are implemented at the approved Ginkgo Mine to minimise the occurrence of weeds. Control measures include the mechanical removal of identified weeds and/or the application of approved herbicides in authorised areas. Control measures are implemented at the approved Ginkgo Mine to minimise the occurrence of feral goats and rabbits. Contractors are employed by Cristal Mining to complete pest controlling strategies. These can include poisoning, shooting and warren destruction (in the case of rabbits), in authorised areas. A clean, rubbish-free environment is kept 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 is prohibited. Domestic pets are not allowed at the mine site.
Salvage and Reuse of Material for Habitat Enhancement	Features identified for use in the rehabilitation program (e.g. habitat features, revegetation resources, soil erosion minimisation resources) will be salvaged (e.g. stumps, hollow branches) or collected (e.g. brush and seed stock) wherever possible.
Collection and Propagation of Seed	Seed will be collected, where practicable, from cleared vegetation for use in the rehabilitation program. Additionally, seasonal collection of seed on ML 1504 from remnant vegetation within proposed disturbance areas and other retained areas will be conducted where possible.
Grazing Management	Appropriate fencing has been used to prevent the uncontrolled entry of livestock within the progressive work and rehabilitation areas for the life of the mine.
Vegetation Monitoring	A photographic monitoring programme has been developed to assess the performance of the rehabilitation areas and monitor the health of the vegetation surrounding the existing Ginkgo Mine path and initial overburden emplacement.
Dust Suppression	Dust suppression is undertaken on the Ginkgo Mine roads within ML 1504.
Bushfire Risk Management	A BMP has been developed to manage risk of bushfires. This establishes bushfire management strategies to reduce the risk of bushfire outbreaks and to establish emergency responses.
Vehicular Traffic Management	The number of roads constructed for the Ginkgo Mine has been minimised, employees and contractors have been instructed to only use the Ginkgo Mine roads, speed limits have been imposed on vehicles using roads and tracks and signposting has been installed to remind personnel of the danger of vehicles to wildlife.
Site Induction	An environmental education programme will be included in employee and contractor inductions.

7.2 EXISTING BIODIVERSITY OFFSET STRATEGY

Cristal Mining currently has a number of existing offset areas in the surrounding locality. The existing Ginkgo Mine Biodiversity Offset Strategy is outlined in Table 14 from the Ginkgo Mine Development Consent (S00/01704) Consent Condition 18. These existing offset areas are shown on Figure 9. Cristal Mining has established two existing offset areas for the Ginkgo Mine, totalling approximately 2,603 ha. The Crayfish Deposit Offset was approved by DP&E as part of the Modification 9 in March 2015.

Table 14
Existing Biodiversity Offset Strategy

Area	Minimum Size/Amount (ha)	Source
Southern Mallee Offset	521	Modification 4 Offset
Crayfish Deposit Offset	2,082	Modification 9 Offset
Total	2,603	

Source: Ginkgo Mine Consent Condition 18.

Notes:

- *The Applicant may release 230 hectares of the Southern Mallee Offset if it can demonstrate the long-term success of woodland rehabilitation on the northern initial overburden emplacement, and those areas of the mine path subject to capping of less than five metres of non-slurried overburden, to the satisfaction of the Director-General.*
- *The success of native vegetation rehabilitation shall be based on agreed rehabilitation criteria to be included within the MOP and Flora and Fauna Management Plan. Criteria shall include vegetation condition and salinity.*

Table 15 provides a description of the main components of the existing Ginkgo Mine Biodiversity Offset Strategy, namely: management, long-term security and conservation bond.

Table 15
Components of the Existing Biodiversity Offset Strategy

Component	Southern Mallee Offset and Crayfish Deposit Offset
Management	Management of the Southern Mallee Offset began following approval of Modification 4 in 2006 under an Offset Management Plan. The existing Offset Management Plan was updated to include the Crayfish Deposit Offset and submitted to DP&E for approval in September 2015. The Offset Management Plan describes the following management measures: • fencing to exclude grazing; • incremental destocking; • removal of unnecessary fencing; • erosion control; • signage of the offset areas; • revegetation of unnecessary access tracks; • animal pest control; • weed management; • fire management; • threatened species management; • closure of artificial water sources such that they can no longer hold water; • vehicle access management; • an environmental induction for employees and contractors; and • auditing and monitoring.
Long-term Security	The existing offset areas are located on Western Land Leases held by Cristal Mining. The purpose of the Western Land Lease associated with the Southern Mallee Offset was changed to reflect its conservation purpose in January 2015. The purpose of the Western Land Lease associated with the Crayfish Deposit Offset would be changed to reflect its conservation purpose by 30 June 2016 or within a timeframe to the satisfaction of the NSW Secretary of DP&E.
Conservation Bond	Cristal Mining will lodge a conservation bond with DP&E for the existing offset areas by 20 March 2016, unless otherwise agreed with NSW Secretary of DP&E.

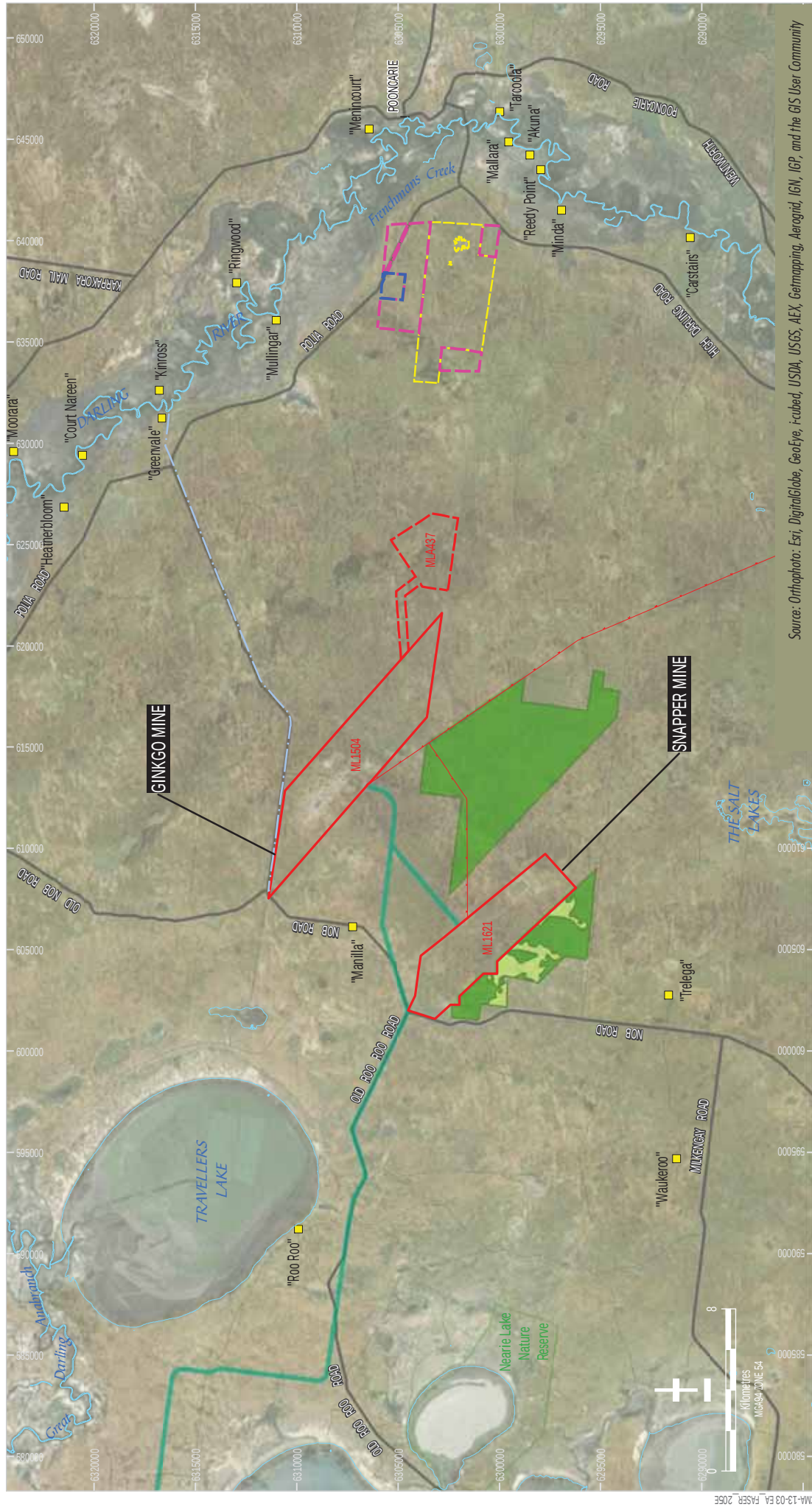


Figure 9

7.3 PROPOSED BIODIVERSITY OFFSET STRATEGY

The existing Ginkgo Mine Biodiversity Offset Strategy would be augmented with additional offset areas as part of the Modification. The proposed Ginkgo Mine Biodiversity Offset Strategy is outlined in Table 16 and shown on Figure 10.

Table 16
Existing and Proposed Biodiversity Offset Strategy

Area	Minimum Size/Amount (ha)	Source	Figure
Southern Mallee Offset	521	Modification 4 Offset	Figure 9
Crayfish Deposit Offset	2,082	Modification 9 Offset	Figure 9
Proposed Additional Biodiversity Offset Areas 1 to 3	1,255	This Modification	Figure 10
Proposed Southern Extension Biodiversity Offset Area (Area 4)	156	This Modification	Figure 10
Total	4,014		

It is proposed that the existing Crayfish Deposit Offset located on the Mollara Western Lands Lease held by Cristal Mining is expanded with four additional offset areas (Figure 9).

The additional Biodiversity Offset Areas 1 to 3 (Figure 10) are proposed to account for existing surface development that has not been accounted for in previous Ginkgo Mine Biodiversity Offset area calculations. The flora characteristics of the additional Biodiversity Offset Areas 1 to 3 (Figure 10) are described in a separate report titled: *Ginkgo Mineral Sands Mine Southern Extension Modification Offset Increase Flora Assessment* (FloraSearch, 2015).

The additional Biodiversity Offset Area 4 (Figure 10) is proposed to account for the proposed Southern Extension area (i.e. the subject of this report). The additional Biodiversity Offset Area 4 is further described below.

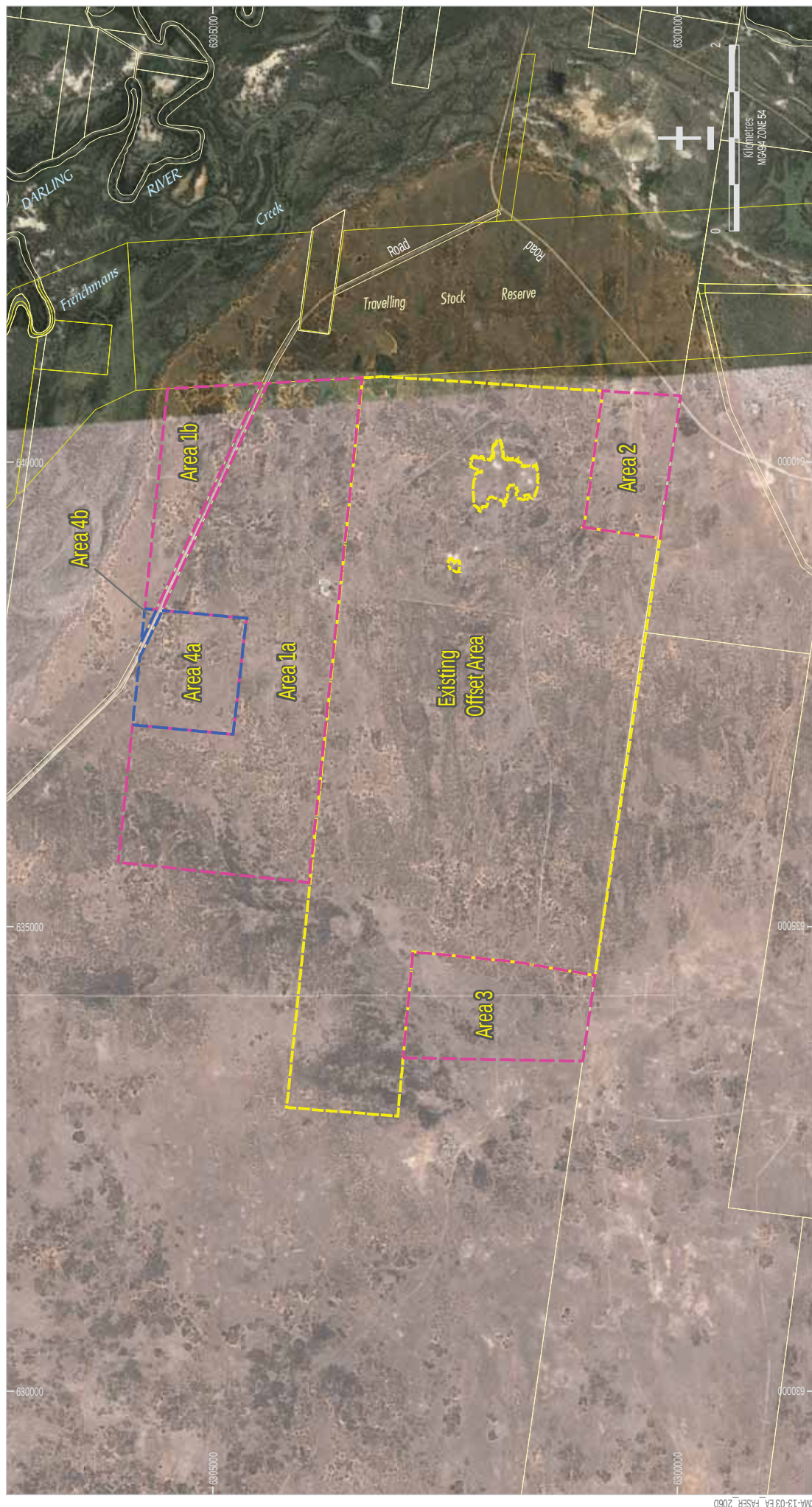
7.3.1 Broad Fauna Habitat Types

The broad fauna habitat types in the proposed Southern Extension area and the offset area are quantified in Table 17. The broad fauna habitat types in the offset area are shown on Figure 11.

Table 17
Quantification of Broad Fauna Habitat Types within the Offset Areas

Broad Fauna Habitat Types		Ginkgo Mine Southern Extension Area (ha)	Proposed Southern Extension Biodiversity Offset Area (Area 4) (ha)
1	Black Box Woodland Habitat Type	0	0
2	Black Oak Woodland Habitat Type	27	61
3	Mallee Habitat Type	0	18
4	Grassland/Low Shrubland Habitat Type	5	77
Total		32	156

Similar vegetation communities/fauna habitats to the Modification area would be conserved/enhanced in the proposed offset areas.



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LEGEND

-  Existing Ginkgo Mine - Crayfish Deposit Offset Area
-  Proposed Additional Biodiversity Offset Area (1-3)
-  Proposed Southern Extension Biodiversity Offset Area (4)

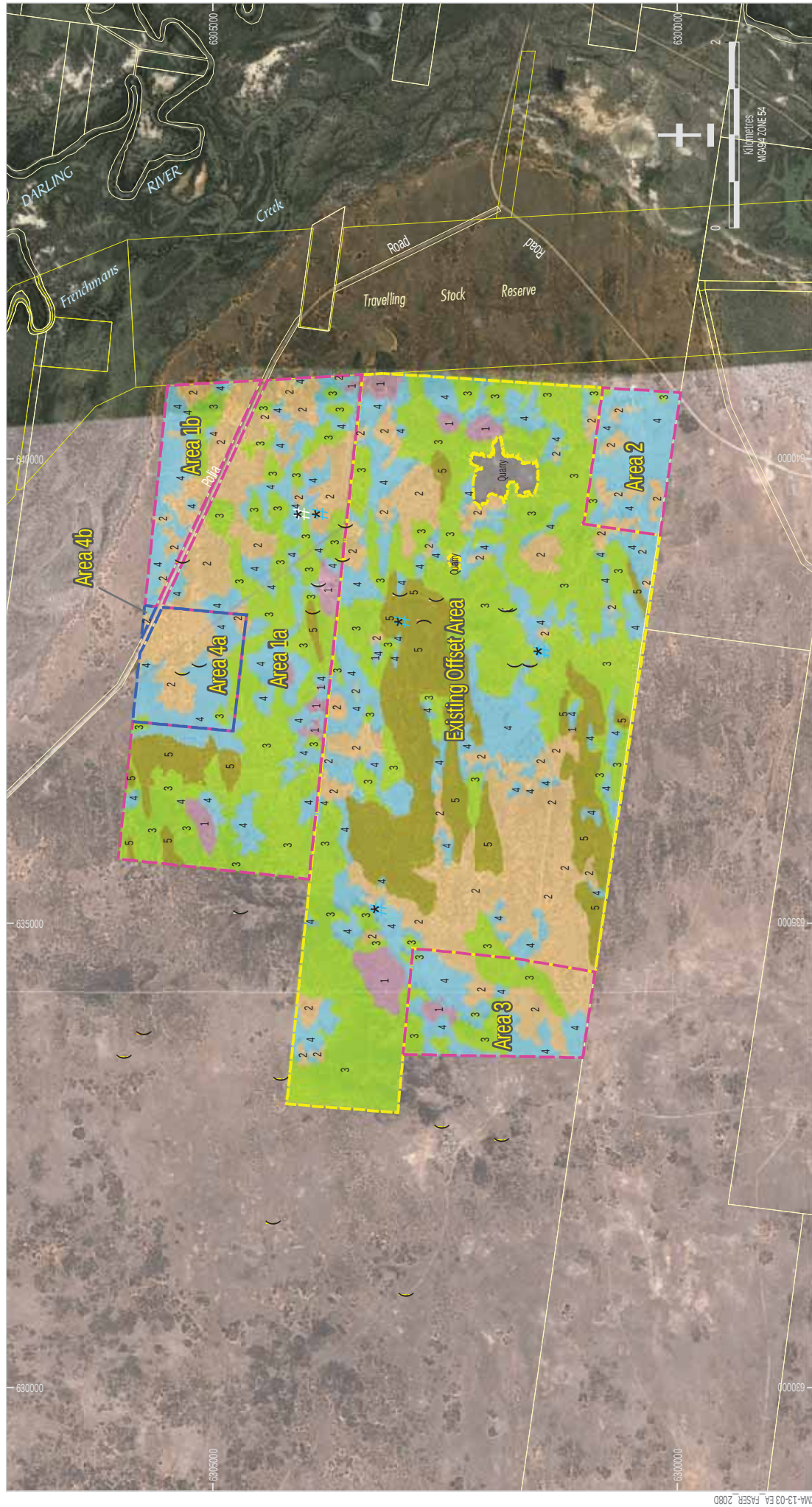


G I N K G O M I N E

Proposed Biodiversity Offset Areas

Source: NSW L & PI (2012) and Orthophoto: Google (2013)

Figure 10



Source: NSW L&PI (2012), Biodiversity Monitoring Services (2012, 2014) and Onophoro: Google (2013)

Figure 11

7.3.2 Threatened Fauna Species

Two threatened fauna species (the Little Eagle and Hooded Robin [south-eastern form]) have been recorded within the proposed offset areas (Figure 8). A total of seven threatened fauna species listed under the TSC Act have been recorded in the proposed offset areas and/or in the existing Ginkgo Mine Crayfish Deposit Offset area (Table 18; Figure 8). Table 18 provides a summary of habitat for threatened fauna species listed under the TSC Act within the Subject area and proposed offset areas.

Table 18
Threatened Fauna Habitat in the Modification area and Offset Areas

Scientific Name	Common Name	Conservation Status ¹		Habitat within the Modification Area	Habitat within the Offset Areas (Areas 1 to 3)
		TSC Act	EPBC Act		
Reptile					
<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard	V	-	5 ha of grassland/low shrubland	77 ha of grassland/low shrubland
Birds					
<i>Falco hypoleucos</i>	Grey Falcon	E	-	32 ha of habitat	156 ha of habitat.
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	32 ha of habitat	156 ha of habitat. This species was recorded in Offset Area 1 by Biodiversity Monitoring Services (2014) (Figure 11).
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	V	-	32 ha of habitat	156 ha of habitat. This species was recorded in Offset Area 1 by Biodiversity Monitoring Services (2014) (Figure 11).
<i>Epthianura albifrons</i>	White-fronted Chat	V	-	5 ha of grassland/low shrubland	77 ha of grassland/low shrubland
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	-	27 ha of woodland	79 ha of woodland and mallee habitat. This species was recorded in Offset Area 1 by Biodiversity Monitoring Services (2014) (Figure 11).
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	27 ha of woodland	79 ha of woodland and mallee habitat. This species was recorded in the existing Ginkgo Mine Crayfish Deposit Offset area by Biodiversity Monitoring Services (2014) (Figure 11).
Mammals					
<i>Pseudomys bolami</i>	Bolam's Mouse	E	-	5 ha of grassland/low shrubland	77 ha of grassland/low shrubland
<i>Verpadelus baverstocki</i>	Inland Forest Bat	V	-	27 ha of woodland	79 ha of woodland and mallee habitat. This species was recorded in Offset Area 1 by Biodiversity Monitoring Services (2014) (Figure 11).
<i>Chalinolobus picatus</i>	Little Pied Bat	V	-	27 ha of woodland	79 ha of woodland and mallee habitat. This species was recorded in Offset Area 1 and the existing offset area by Biodiversity Monitoring Services (2014) (Figure 11).
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V	-	27 ha of woodland	79 ha of woodland and mallee habitat.

¹ Threatened fauna species status under the TSC Act and/or EPBC Act (current at December 2015).

V = Vulnerable; E = Endangered

Highlighted species = Species recorded within or immediately adjoining the Modification area (Figure 7).

In summary, all threatened fauna species recorded within or immediately adjoining the Modification area have known or potential habitat in the offset areas, specifically:

- Of the eight threatened fauna species recorded within or immediately adjoining the Modification area:
 - four are known to occur within the proposed offset areas (Major Mitchell's Cockatoo [*Cacatua leadbeateri*], Hooded Robin [south-eastern form] [*Melanodryas cucullata cucullata*], Little Pied Bat [*Chalinolobus picatus*] and Inland Forest Bat [*Verpadelus baverstocki*]); and
 - four have the potential to occur in the offset areas based on suitable habitat (Grey Falcon [*Falco hypoleucos*], White-fronted Chat [*Epthianura albifrons*], Bolam's Mouse [*Pseudomys bolami*] and Yellow-bellied Sheath-tail-bat [*Saccolaimus flaviventris*]).
- Three additional threatened fauna species not recorded within or immediately adjoining the Modification area are known to occur within the proposed offset areas (Little Eagle [*Hieraaetus morphyoides*], Varied Sittella [*Daphoenositta chrysoptera*] and Marble-faced Delma [*Delma australis*]).
- One other threatened fauna species not recorded within or immediately adjoining the Modification area has the potential to occur in the offset areas based on suitable habitat (the Western Blue-tongued Lizard [*Tiliqua occipitalis*]).

All of the threatened fauna species that could potentially occur within the Modification area, could also potentially occur within the proposed offset areas.

7.3.3 Summary of the Key Ecological Gains Relevant to Fauna

Nearie Lake Nature Reserve is the nearest protected area located approximately 160 km south of the Modification and the only protected area between the Great Darling Anabranch and Darling River. Nearie Lake Nature Reserve is 4,347 ha in size dominated by chenopod shrublands. The existing and proposed offset areas held by Cristal Mining between the Great Darling Anabranch and Darling River are 9,484 ha in size² (more than double the size of Nearie Lake Nature Reserve) and contain a range of vegetation communities and habitats not preserved within Nearie Lake Nature Reserve.

The proposed offset areas expand the existing Crayfish Deposit Offset (Figure 10), thereby resulting in a larger conservation area.

Ecological gains from the proposed offset areas are listed below:

- Similar vegetation communities/fauna habitats to the Modification area would be conserved/enhanced in the proposed offset areas.
- The proposed biodiversity offset area is suitably located to benefit flora and fauna populations (biodiversity values) potentially impacted by the Modification.
- The proposed biodiversity offset area removes a substantial area of native vegetation from the deleterious effects of livestock grazing thereby allowing it to recover and improve over time.
- The proposed offset area is located adjacent to an existing biodiversity offset area (Crayfish Deposit Offset) and would complement the existing reserve system (Figure 10).
- Substantial areas of habitat for threatened fauna species occur within the proposed biodiversity offset area.

² The existing offset areas for the Snapper Mine are 5,470 ha in size.

- Two threatened fauna species (the Little Eagle and Hooded Robin [south-eastern form]) have been recorded within the proposed offset areas.
- There is capacity for the ecological function of the vegetation in the proposed offset areas to significantly improve with the removal of grazing by livestock, control of feral animals such as rabbits and foxes.

The proposed biodiversity offset area is therefore considered to be a suitable offset against the residual flora and fauna impacts associated with the Modification.

7.3.4 Biodiversity Offset Principles Reconciliation

The OEH has developed principles for the use of offsets for Projects other than those that are State significant (OEH, 2014). The proposed biodiversity offset strategy for the Modification provides for residual significant impacts to biodiversity resulting from approximately 333 ha which was disturbed outside of the currently approved surface development area, and the proposed extension (approximately 32 ha) to the currently approved surface development area. The offset strategy incorporates four potential offset areas (Offset Areas 1 to 4). A reconciliation of the Proposed Biodiversity Offset Strategy (Offset Areas 1 to 4) against the *Principles for the Use of Biodiversity Offsets in NSW* (OEH, 2014) is provided in Table 19.

Table 19
Reconciliation of the Proposed Biodiversity Offset Strategy against OEH Offset Principles

OEH Offset Principles (OEH, 2014)	How the Proposed Offset Addresses the OEH Offset Principles
1. <i>Impacts must be avoided first by using prevention and mitigation measures.</i>	The offset strategy addresses residual impacts associated with the Modification.
2. <i>All regulatory requirements must be met.</i>	Cristal Mining is required to meet all statutory requirements and the offset strategy is not proposed to substitute other licence/approval requirements.
3. <i>Offsets must never reward ongoing poor performance.</i>	The offset strategy addresses residual impacts associated with the Modification.
4. <i>Offsets would complement other government programs.</i>	The proposed offset areas (1-4) would complement other lands already conserved by the State government (resulting in a greater area of vegetation conserved in NSW).
5. <i>Offsets must be underpinned by sound ecological principles.</i>	The proposed offset areas (1-4) expand the existing Ginkgo Mine Crayfish Deposit Offset area (Figure 10), thereby resulting in a larger conservation area. The structure, function and compositional elements of biodiversity (including threatened species) have been considered in the selection of the proposed offset areas (Section 7.3.3). The proposed offset areas contain a similar suite of fauna species and fauna habitats to those in the Subject and Modification areas. Biodiversity is likely to be enhanced at a range of scales due to the proposed management measures, particularly the exclusion of livestock grazing and closure of artificial watering points such that they can no longer hold water. The proposed enhancement of the habitat would contribute towards protecting the long-term viability and functionality of local biodiversity.

Table 19 (Continued)
Reconciliation of the Proposed Biodiversity Offset Strategy against OEH Offset Principles

OEH Offset Principles (OEH, 2014)	How the Proposed Offset Addresses the OEH Offset Principles
6. <i>Offsets should aim to result in a net improvement in biodiversity over time.</i>	The offset strategy targets threatened fauna species and high conservation priorities in the Subject and Modification areas. A net improvement in biodiversity is likely because: • The proposed offset areas (1-4) adjoin and enhance the existing Ginkgo Mine Crayfish Deposit Offset area, improving its long term viability. • Management of the offset would include a series of measures likely to improve fauna habitat and reduce pressure on native fauna species, including removal of stock, ecological fire management and feral animal control. • The proposed offset area contains a similar suite of habitats to those in the Subject and Modification areas. In relation to Offset Area 4: • Both the Modification area and proposed offset area (Offset Area 4) contain comparable densities of old growth vegetation rich in tree hollows and with a large amount of fallen timber on the ground, which may be utilised by threatened fauna species.
7. <i>Offsets must be enduring. They must offset the impact of the development for the period that the impact occurs.</i>	The purpose of the Western Land Lease associated with the proposed offset areas (1-4) would be changed to reflect its conservation purpose at the same time as the existing Ginkgo Mine Crayfish Deposit Offset area (i.e. by 30 June 2016), or within a timeframe to the satisfaction of the NSW Secretary of DP&E.
8. <i>Offsets should be agreed prior to the impact occurring.</i>	The offset strategy addresses residual impacts associated with the Modification.
9. <i>Offsets must be quantifiable. The impacts and benefits must be reliably estimated.</i>	The impacts and benefits have been reliably assessed as follows: • The area of impact and proposed offset is quantified in Table 16 and shown on Figures 9 and 10. • The fauna species known or with potential to occur, and their conservation status are described, mapped and quantified, where relevant; • The potential gain in connectivity of woodland habitat from the proposed offset areas (1-4). • The management actions and security for the proposed offset area are discussed.
10. <i>Offsets must be targeted.</i>	The offset strategy addresses residual impacts associated with the Modification. The proposed offset areas contain a similar suite of fauna species and fauna habitats to those in the Subject and Modification areas. The proposed offset areas were selected in consideration of a range of factors, including: 1. Relationship to existing offset areas. 2. Proximity to the Subject and Modification areas. 3. Regional conservation priorities and vegetation most in need of conservation. 4. The vegetation composition of the Subject and Modification areas relative to the proposed offset areas; meeting the 'like for like' criterion. 5. The ecosystem resilience and condition of the proposed offset areas. 6. The presence of similar threatened species records and/or potential habitat to those within the Subject and Modification areas.
11. <i>Offsets must be located appropriately.</i>	The proposed offset area is located in the same region as the Ginkgo Mine in a similar topographic, climatic and geographic environment.
12. <i>Offsets must be supplementary.</i>	The implementation of the offset strategy is beyond existing requirements, in that it is not part of any conservation reserve system.
13. <i>Offsets and their actions must be enforceable through Development Consent conditions, licence conditions, conservation agreements or a contract.</i>	The offset requirement is likely to be a condition of Project approval.

8 CONCLUSION

Five species listed as Vulnerable under the TSC Act were located within the study area. These are Bolam's Mouse, Little Pied Bat, Yellow-bellied Sheath-tail Bat, Inland Forest Bat and Hooded Robin. An evaluation has been undertaken and it is considered that no threatened fauna species are likely to be significantly impacted by the Modification.

The Modification would result in the loss of 32 ha of habitat, comprising 27 ha of Black Oak Woodland Habitat Type and 5 ha of Grassland/Low Shrubland Habitat Type. The amount to be lost (32 ha) is small compared to that available in the surrounding region and its loss is not likely to significantly impact any local fauna populations. The cumulative adverse impacts on fauna and their habitat have been considered (i.e. combined clearance for the Ginkgo and Snapper Mines). Whilst the incremental impacts would result in a greater area of disturbance over time, the impacts would be mitigated (largely by progressive rehabilitation) and offset by enhancement of nearby habitats.

The existing mitigation measures implemented at the Ginkgo Mine would continue for the Modification. Cristal Mining has established two existing offset areas for the Ginkgo Mine, totalling approximately 2,603 ha. The existing offset would be expanded by 156 ha for the loss of 32 ha of habitat.

The Modification would also include additional offsets (covering 1,255 ha) for existing surface development that has not been accounted for in previous Ginkgo Mine biodiversity offset area calculations. In conclusion, the four offset areas proposed as part of the Modification are considered to meet the OEH (2014) *Principles for the Use of Biodiversity Offsets in NSW* and it is likely that fauna biodiversity values would be maintained or improved in the medium to long-term.

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APPENDIX A

FAUNA RECORDED FROM THE STUDY AREA

Scientific Name	Common Name	NSW Status ¹
BIRDS		
Dromaiidae		
<i>Dromaius novaehollandiae</i>	Emu	P
Accipitridae		
<i>Aquila audax</i>	Wedge-tailed Eagle	P
<i>Milvus migrans</i>	Black Kite	P
<i>Haliastur sphenurus</i>	Whistling Kite	P
Falconidae		
<i>Falco berigora</i>	Brown Falcon	P
<i>Falco cenchroides</i>	Nankeen Kestrel	P
Columbidae		
<i>Ocyphaps lophotes</i>	Crested Pigeon	P
<i>Phaps chalcoptera</i>	Common Bronzewing	P
Cacatuidae		
<i>Cacatua sanguinea</i>	Little Corella	P
<i>Eolophus roseicapillus</i>	Galah	P
Psittacidae		
<i>Barnardius zonarius</i>	Australian Ringneck	P
<i>Northiella haematogaster</i>	Bluebonnet	P
Halcyonidae		
<i>Todiramphus pyrrhophus</i>	Red-backed Kingfisher	P
Meropidae		
<i>Merops ornatus</i>	Rainbow Bee-eater	P
Climacteridae		
<i>Climacteris picumnus</i>	Brown Treecreeper	P
Pardalotidae		
<i>Pardalotus striatus</i>	Striated Pardalote	P
Acanthizidae		
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	P
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill	P
<i>Aphelocephala leucopsis</i>	Southern Whiteface	P
<i>Smicronis brevirostris</i>	Weebill	P
Meliphagidae		
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	P
<i>Lichenostomus virescens</i>	Singing Honeyeater	P
<i>Manorina flavigula</i>	Yellow-throated Miner	P
<i>Plectorhyncha lanceolata</i>	Striped Honeyeater	P
Petroicidae		
<i>Melanodryas cucullata</i>	Hooded Robin	V
<i>Microeca fascians</i>	Jacky Winter	P
<i>Petroica goodenovii</i>	Red-capped Robin	P

Scientific Name	Common Name	NSW Status ¹
BIRDS (Cont.)		
Pomatostomidae		
<i>Pomatostomus ruficeps</i>	Chestnut-crowned Babbler	P
Pachycephalidae		
<i>Oreoica gutturalis</i>	Crested Bellbird	P
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	P
<i>Falcunculus frontatus</i>	Eastern Shrike-tit	P
<i>Pachycephala pectoralis</i>	Golden Whistler	P
<i>Pachycephala rufiventris</i>	Rufous Whistler	P
Dicruridae		
<i>Grallina cyanoleuca</i>	Magpie-lark	P
<i>Rhipidura leucophrys</i>	Willie Wagtail	P
Artamidae		
<i>Cracticus nigrogularis</i>	Pied Butcherbird	P
<i>Cracticus torquatus</i>	Grey Butcherbird	P
<i>Gymnorhina tibicen</i>	Australian Magpie	P
Campephagidae		
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	P
Corvidae		
<i>Corvus coronoides</i>	Australian Raven	P
<i>Corvus bennetti</i>	Little Crow	P
<i>Corvus mellori</i>	Little Raven	P
Corcoracidae		
<i>Struthidea cinerea</i>	Apostlebird	P
<i>Corcorax melanorhamphos</i>	White-winged Cough	P
Hirundinae		
<i>Hirundo neoxena</i>	Welcome Swallow	P
<i>Petrochelidon nigricans</i>	Tree Martin	P
<i>Cheramoeca leucosternus</i>	White-backed Swallow	P
Motacillidae		
<i>Anthus australis</i>	Australasian Pipit	P
MAMMALS		
Tachyglossidae		
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	P
Macropodidae		
<i>Macropus rufus</i>	Red Kangaroo	P
<i>Macropus fuliginosus</i>	Western Grey Kangaroo	P
Muridae		
<i>Mus musculus</i>	House Mouse	U
<i>Pseudomys bolami</i>	Bolam's Mouse	E
Molossidae		
<i>Ozimops planiceps</i>	Southern Freetail Bat	P
<i>Ozimops petersi</i>	Mastiff Bat	P

Scientific Name	Common Name	NSW Status ¹
MAMMALS (Cont.)		
Vespertilionidae		
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	P
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	P
<i>Chalinolobus picatus</i>	Little Pied Bat	V
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	P
<i>Nyctophilus sp.</i>	Long-eared Bat	P
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat	V
<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat	P
<i>Scotorepens greyii</i>	Little Broad-nosed Bat	P
<i>Austronomus australis</i>	White-striped Mastiff Bat	P
<i>Vespadelus baverstocki</i>	Inland Forest Bat	V
<i>Vespadelus vulturnus</i>	Little Forest Bat	P
Canidae		
<i>Vulpes vulpes</i>	Red Fox	U
Felidae		
<i>Felis catus</i>	Cat	U
Bovidae		
<i>Capra hircus</i>	Goat	U
Leporidae		
<i>Oryctolagus cuniculus</i>	Rabbit	U
REPTILES		
Agamidae		
<i>Pogona vitticeps</i>	Central Bearded Dragon	P
Gekkonidae		
<i>Gehyra variegata</i>	Tree Dtella	P
<i>Lucasium damaeum</i>	Beaded Gecko	P
<i>Rhynchoedura angusta</i>	Border Beaked Gecko	P
<i>Diplodactylus furcosus</i>	Ranges Stone Gecko	P
<i>Heteronotia binoei</i>	Bynoe's Prickly Gecko	P
Scincidae		
<i>Lerista punctatovittata</i>	Eastern Robust Slider	P
<i>Morethia boulengeri</i>	South-eastern Morethia Skink	P
<i>Cryptoblepharus carnabyi</i>	Snake-eyed Skink	P
<i>Ctenotus regius</i>	Pale-rumped Ctenotus	P
<i>Ctenotus schomburgkii</i>	Schomburgk's Ctenotus	P
<i>Menetia greyii</i>	Common Dwarf Skink	P
<i>Tiliqua rugosa</i>	Shingle-back	P
Elapidae		
<i>Pseudonaja textilis</i>	Eastern Brown Snake	P
<i>Brachyuropsis australis</i>	Australian Coral Snake	P

¹ Fauna species status under the TSC Act (current at December 2015).

V = Vulnerable; E = Endangered; P=Protected, U=Unprotected