Tronox Mining Australia Ltd

Murray Basin Mines Flora and Fauna Environmental Management Plan

September 2020

Revision History

Rev No.	Document No.	Description	Approval Details	Date
A	603740	Draft for Tronox Approval	GHD	20/08/2015
B	603740	Final for Tronox Approval	Tronox	15/09/2015
C	603791	Amended following BCD review		02/12/2015
D	603791	Amended final review by BCD	BCD	18/12/2015
E	-	Amended to capture relevant updates related to offset areas	GHD and Tronox	23/08/2018
F		Address DPIE comments	GHD and Tronox	28/06/2019

Abbreviations

Abbreviation	Full Title
AEMR	Annual Environmental Management Report
AR	Annual Return (as required by the EPL)
BC Act	*Biodiversity and Conservation* Act 2016
BCD	Biodiversity Conservation Division (DPIE)
BHCC	Broken Hill City Council
Tronox	Tronox Mining Australia Ltd
DA	Development Application
DECC	NSW Department of Environment and Climate Change
DPIE	NSW Department of Planning, Inductry and Environment
Director General	Director-General of the Department of Planning (see Secretary below)
DPI	NSW Department of Primary Industries
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMS	Tronox Murray Basin Environmental Management Strategy
EPA	NSW Environment Protection Authority (part of the BCD)
EP & A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environmental Protection Licence
ETL	Electricity transmission lines
FFMP	Murray Basin Mines Flora and Fauna Management Plan
GHD	GHD Pty Ltd
HAR	Highway Access Road
IMRP	Ginkgo Integrated Mining Rehabilitation Plan
LMP	Land Management Plan
LPMA	NSW Lands Property Management Authority (abolished April 2011)
Minister	Minister for Planning or delegate
MOP	Mining Operations Plan
MLA	Mining Lease Area
MREMP	Mining Rehabilitation and Environmental Management Plan

Abbreviation	Full Title
MSP	Mineral Separation Plant (Broken Hill)
NPWS	National Parks and Wildlife Service
NSW	New South Wales
POEO Act 1997	*Protection of the Environment Operations Act 1997*
Secretary	Secretary of the Department of Planning and Environment, or nominee
SEE	Statement of Environmental Effects
WESCP	Murray Basin Mines Water, Erosion and Sediment Control Plan
WSC	Wentworth Shire Council

Limitations

This report has been prepared by GHD Pty Ltd (GHD) for Tronox Mining Australia Ltd (Tronox) and may only be used and relied on by Tronox for the purpose agreed between GHD and Tronox as provided in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Tronox arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations provided in the report.

GHD's scope of works was limited to updating Tronox's environmental documentation into standardised templates that are consistent with ISO 14001 and addressing Tronox's most recent approval requirements. GHD has relied on information provided in existing plans, the specific requirements stated within licences, permits and approval conditions provided to GHD and advice provided by Tronox on the status of works and implementation of management measures for the pre-construction and construction phase works. GHD has updated documents based on advice from Tronox relating to their current operations and management practices; GHD has not proposed new mitigation or management measures. Where GHD has identified deficiencies or anomalies in the existing plans, these have been updated based on additional information provided by Tronox. It is not within GHD's scope of works to undertake a detailed risk assessment for environmental aspects or to provide specialist advice on the suitability of mitigation measures or to devise new mitigation measures.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

GHD has prepared this report on the basis of information provided by Tronox which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

Table of contents

Table index

Figure index

Appendices

1. Introduction

1.1 Purpose of the management plan

Tronox Mining Australia Ltd (Tronox) operates mineral sands mines in the Murray Basin and a mineral separation plant (MSP) at Broken Hill in NSW. This Flora and Fauna Management Plan (FFMP) has been created for the management of flora and fauna values at the Ginkgo mineral sands mine (Ginkgo), Snapper Mineral Sands Mine (Snapper) and the Crayfish Mineral Sands Mine (Crayfish) in the Murray Basin in south-west NSW. Tronox's mine sites in the Murray Darling basin have been collectively referred to as the 'Murray Basin mines' for the purpose of this document.

1.2 Scope of the management plan

The FFMP provides an overview of the environmental management and performance requirements related to flora and fauna management at the Murray Basin mines. This FFMP includes:

- the requirements for environmental management of flora and fauna values for operations at the Murray Basin mines as stipulated by regulatory approvals for the project;
- the responsibilities for implementing this FFMP;
- a description of the environmental controls and associated limits to meet objectives, targets and regulatory approval requirements; and
- an overview of the environmental monitoring programs and contingency plans associated with environmental controls and management actions.

Further details on the Environmental Management Framework for Tronox's operations at this site are provided in Section 3.

1.3 Document succession

This FFMP supersedes the following FFMPs:

- Gingko Flora and Fauna Management Plan, dated 16 May 2006.
- Snapper Mineral Sands Mine Flora and Fauna, dated December 2009.
- Murray Darling Basin Mine Flora and Fauna Management Plan, dated May 2013.
- Murray Darling Basin Mine Flora and Fauna Management Plan, dated December 2015

This FFMP supersedes the documents listed above, which are now obsolete.

The original management plans were developed in consultation with the NSW DPIE Biodiversity Conservation Division (BCD) and qualified ecologists that were involved in the preparation of documents for the environmental assessment required to obtain regulatory development/project approval (see Section 3.2).

The new FFMP (this document) has been prepared on the basis of information contained within the original management plans and advice received from Tronox and NSW Department of Planning and Environment (DPIE) regarding current activities and management measures. This revision of the FFMP captures relevant details of the following Notice of Modification(s) for Tronox's operations in the Murray Darling Basin, issued in December 2017 by the delegate for the Minister for Planning:

- ‘Notice of modification under Section 75W of the Environment Planning and Assessment Act 1979 – Ginkgo Mineral Sands Mine Extension Modification (DA 251-09-01), Modification 13

Tronox is required to submit management plans to the DPIE for approval.

2. Project description

The Environmental Management Strategy (EMS, see Section 3) provides details on the current operations at the Murray Basin mines. Flora and fauna is considered to be an environmental value that requires management to minimise impacts associated with activities for the project.

An Environmental Impact Statement (EIS) was completed for Ginkgo in 2001. An Environmental Assessment (EA) was completed for Snapper in 2007. A modification to the Environmental Assessment (EA) was completed for Crayfish was completed in 2012.

The EIS and EA documents were prepared in accordance with the requirements of the NSW *Environmental Planning and Assessment Act 1979* (EP & A Act), to accompany the Development Application (DA) submitted by Tronox for the Projects. These documents provide detailed information on the flora and fauna values at Ginkgo and Snapper present at the time the assessments were prepared.

The regional location for current Murray Basin mines is shown in Figure 1.

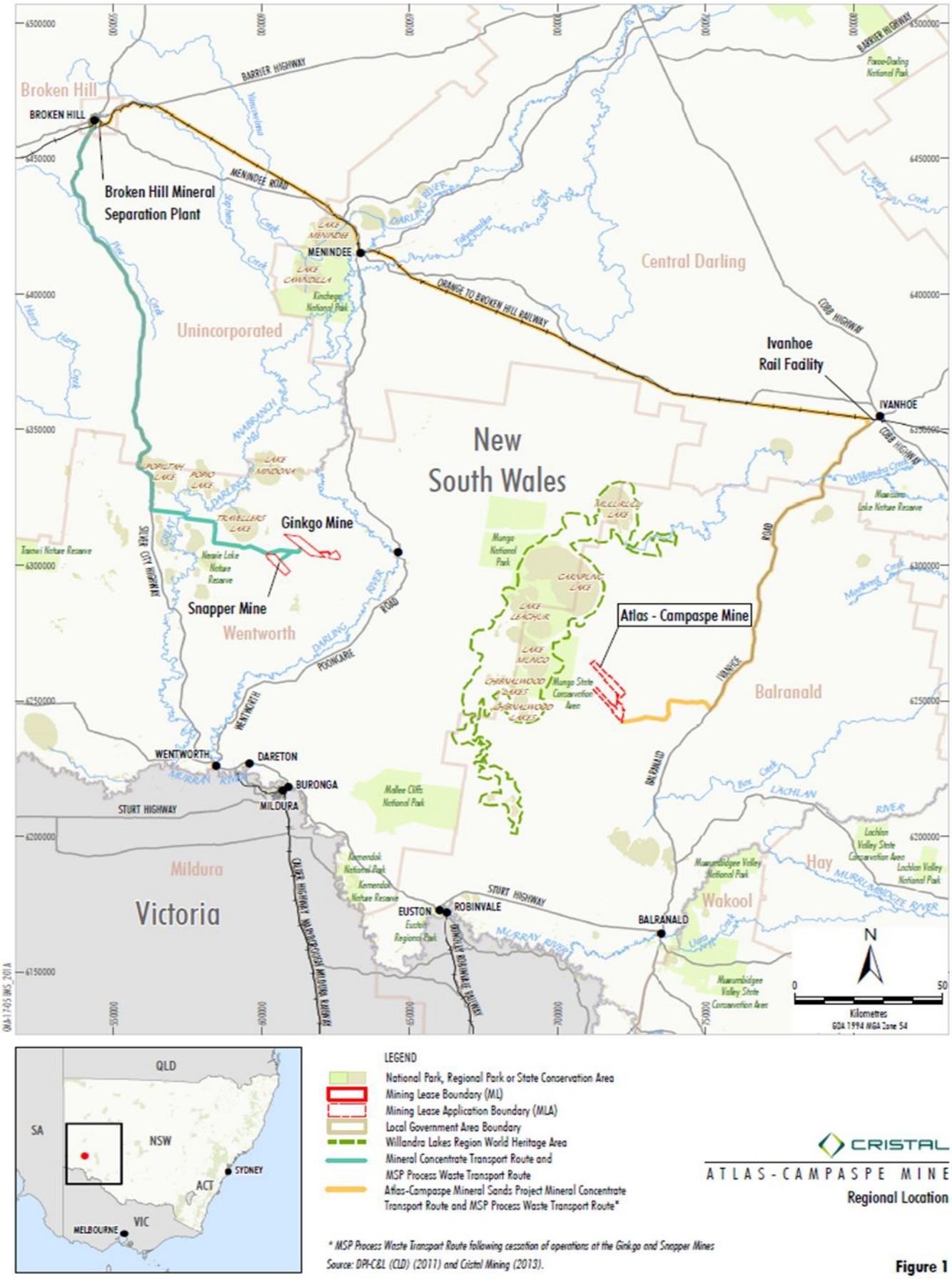

Figure 1 Murray Basin mines (Ginkgo, Snapper, Crayfish, and Atlas-Campaspe) regional location

2.1 Ginkgo

Ginkgo is located approximately 85 km north of Mildura and 40 km west of the township of Pooncarie in western New South Wales (NSW). A summary of the pre-mining environment at Ginkgo and surrounds is provided below with further details provided in Appendix A, Appendix D and Appendix E. The project area includes the Ginkgo mining lease area (Ginkgo MLA), highway access road (HAR) and electricity transmission line (ETL) (Figure 2). A detailed description of the existing environment is presented in the Ginkgo Mineral Sands Project Environmental Impact Statement (EIS) (Bemax 2001) and Ginkgo Mineral Sands Project Ancillary Infrastructure Modification Statement of Environmental Effects (SEE) (Bemax 2003).

2.1.1 Flora

Areas within the Ginkgo MLA not cleared for the mine comprise mostly native vegetation, albeit significantly altered by over 150 years of European settlement and pastoral activities. Flora surveys at Ginkgo MLA were conducted for the EIS and subsequent SEE for the modified ETL and HAR routes and lists of flora species recorded during these surveys are provided in Appendix D.

Overall, introduced species comprise a relatively small percentage of the species identified, reflecting the usage of natural ecosystems for low intensity grazing activities in the region.

Vegetation Communities

The EIS flora study (Bower and Porteners, 2001) described plant communities present in the Ginkgo MLA. The SEE supplementary flora study described vegetation associations present along the modified ETL and HAR routes (Resource Strategies 2003). As a result, 10 broad vegetation associations and a number of sub-communities have been identified at Ginkgo ().

Table 1 Vegetation communities identified within the Ginkgo MLA

	Original Community Name	Benson Vegetation Communities Equivalent
1	*Casuarina pauper,* Belah woodland	Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray- Darling Depression (Benson 58)
2	*E. largiflorens,* Black Box woodland	Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (Benson 15)
3	*E. socialis/ E. dumosa /E. gracilis,* Sandplain/Swale Mallee shrubland	Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (Benson 170)
3	*E. gracilis/E. dumosa/E. socialis/Triodia scariosa subsp. scariosa,* Dune Mallee shrubland	Deep sand mallee of irregular dunefields of the semi-arid (warm) zone (Benson 172)
4	*Maireana pyramidata /M. sedifolia* shrubland	Pearl Bluebush low open shrubland of the arid and semi-arid plains (Benson 154)
5	*Sclerolaena* spp., Chenopod Shrublands/ Grasslands - Copperburr low shrubland	Black Roly Poly low open shrubland of the Riverina and Murray-Daring Depression Bioregions (Benson 216)
6	Depression herblands	(Likely to be) Couch Grass grassland wetland on river banks and floodplians of inland river systems (Benson 50)
7	Disturbed herbland/grassland	Derived corkscrew grass grassland/forbland on sandplains and plains in the semi-arid (warm) climate zone (Benson 165)
8	*Eucalyptus camaldulensis,* Riverine Woodland	River Red Gum – Warrego Grass – Couch Grass riparian tall woodland wetland of the sermi-arid (warm) climate zone (Benson 8)

9	*Muehlenbeckia forulenta,* Dry swamp	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina and Murray Darling Depression Bioregions) (Benson 17)
10	*Acacia*/*Eremophila*/*Dodonaea,* Tall Shrubland	Narrow-leaved Hopbush-Scrub Turpentine-Senna shrubland on semi-arid and arid sandplains and dunes (Benson 143)
11	*Cleared/Grazing*	(Likely to be) Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW (Benson 166)

Introduced and Noxious Weeds

At Ginkgo, weeds predominantly occur on sites disturbed by clearing, stock trampling or road works. Previous surveys indicated that relatively few weeds appeared to penetrate and flourish within intact areas of native vegetation. The most prominent weed species recorded included Onion Weed (*Asphodelus fistulosus*), Wild Sage (*Salvia verbenaca*), Saffron Thistle (*Carthamus lanatus*), Maltese Cockspur (*Centaurea melitensis*), Stemless Thistle (*Onopordum acaulon*) and Common Heliotrope (*Heliotropium europaeum*). African Boxthorn (*Lycium ferocissimum*) was the only noxious weed species found, occurring on grey clay soils in the River Red Gum and Black Box communities. The dominant weed families were the Asteraceae (13 species), the Poaceae (5 species) and the Brassicaceae (4 species) out of a total of 42 weed species identified.

The following weeds are Class 4 declared noxious within Wentworth Shire Council (WSC) and the growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction (DPI 2012):

- African Boxthorn (*Lycium ferocissimum*)
- Onion Weed (*Asphodelus fistulosus*)
- Noogoora Burr (*Xanthium occidentale*);
- Bathurst Burr (*Xanthium spinosum*).
- Horehound (*Marrubium vulgare*)

Threatened Ecological Communities

No threatened ecological communities listed under the *Biodiversity and Conservation Act 2016* (BC Act) or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were found during the surveys conducted for the Ginkgo EIS (Bemax 2001) and Project Ancillary Infrastructure SEE (Bemax 2003).

Threatened Flora Species

Targeted surveys did not record any threatened flora species at Ginkgo (Orchid Research and Marianne Porteners Environmental Consulting, 2001). Potentially occurring threatened flora at Ginkgo are presented in Table 9 of Appendix A

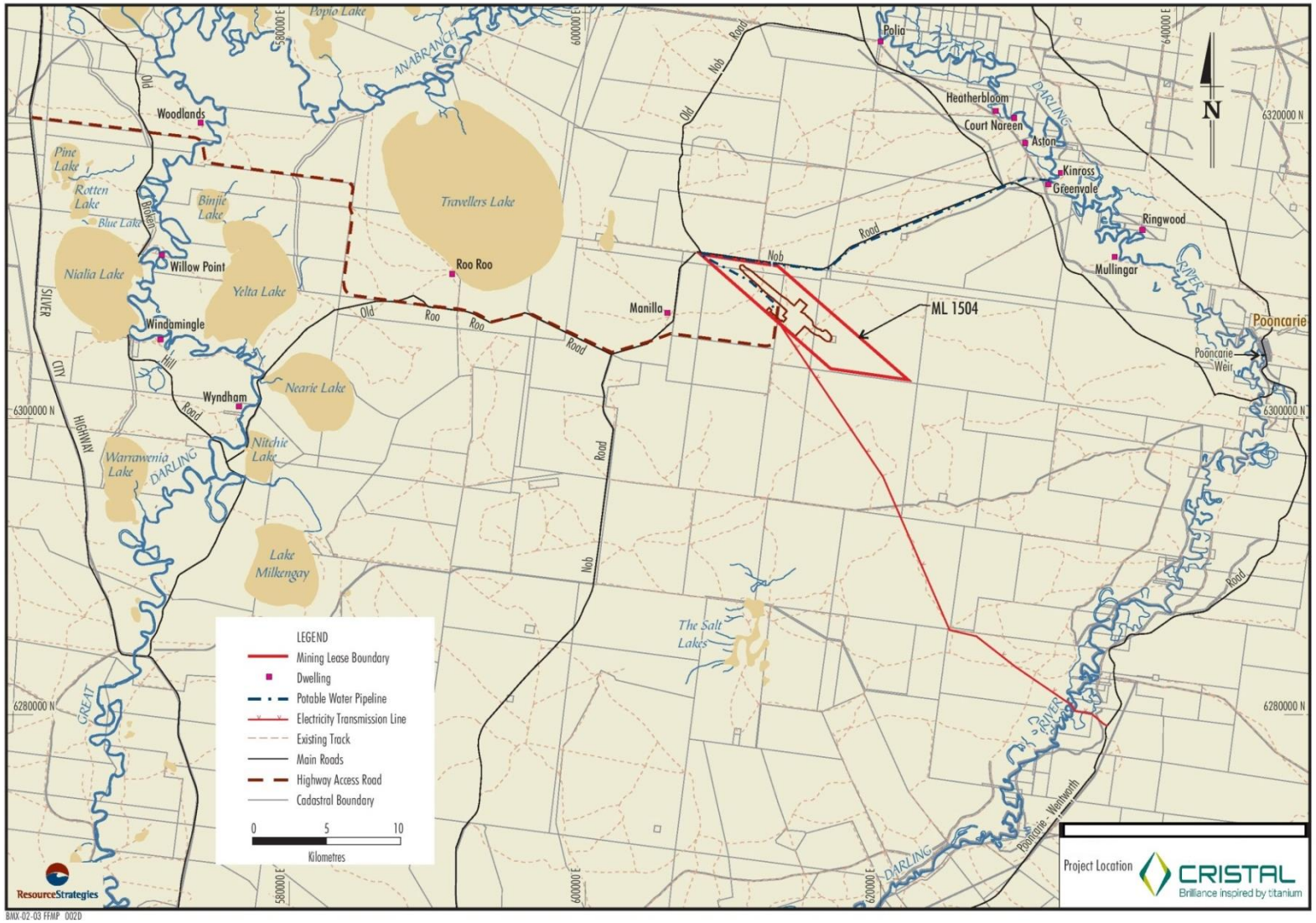

Figure 2 Ginkgo project location

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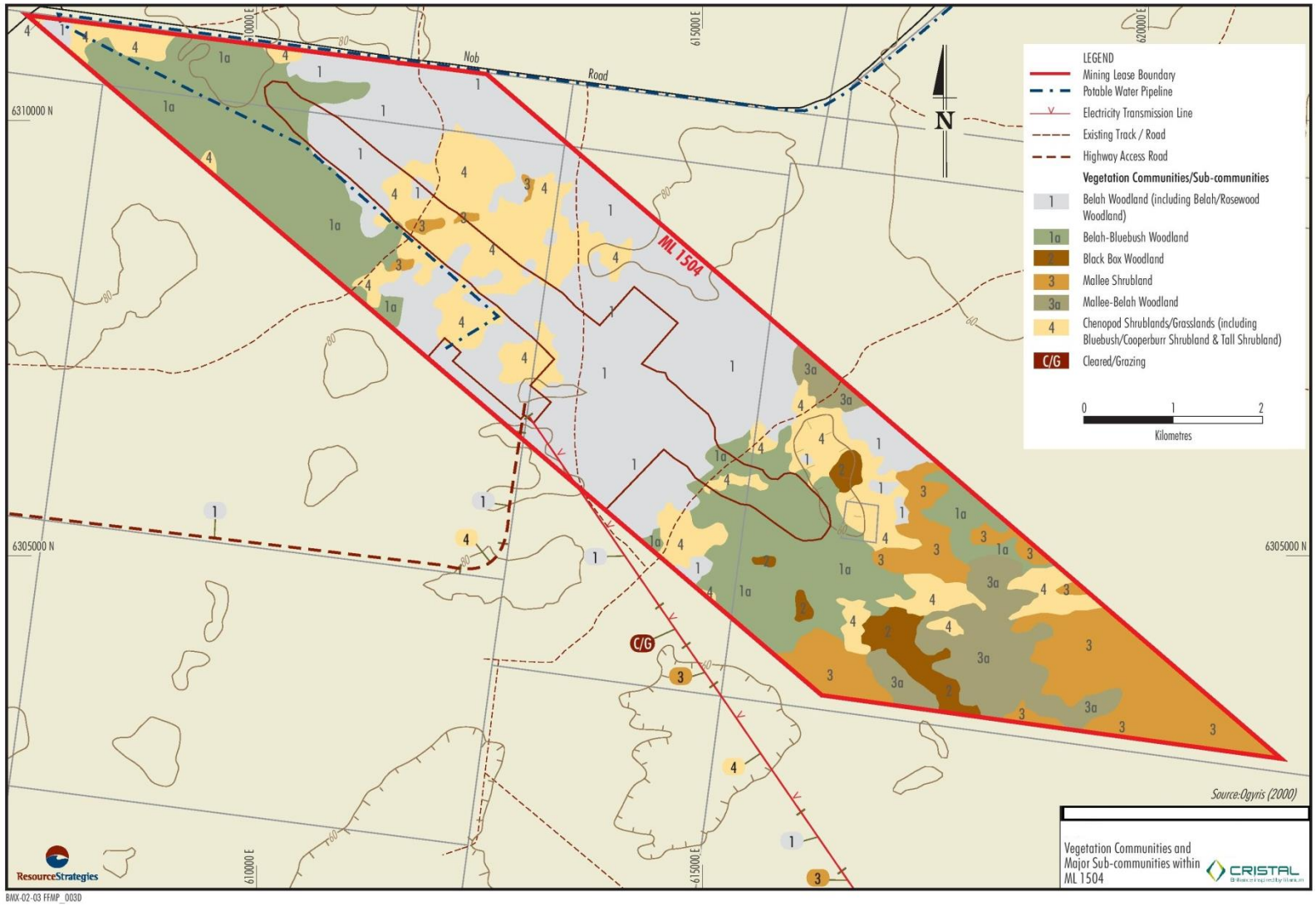


Figure 3 Ginkgo MLA vegetation communities

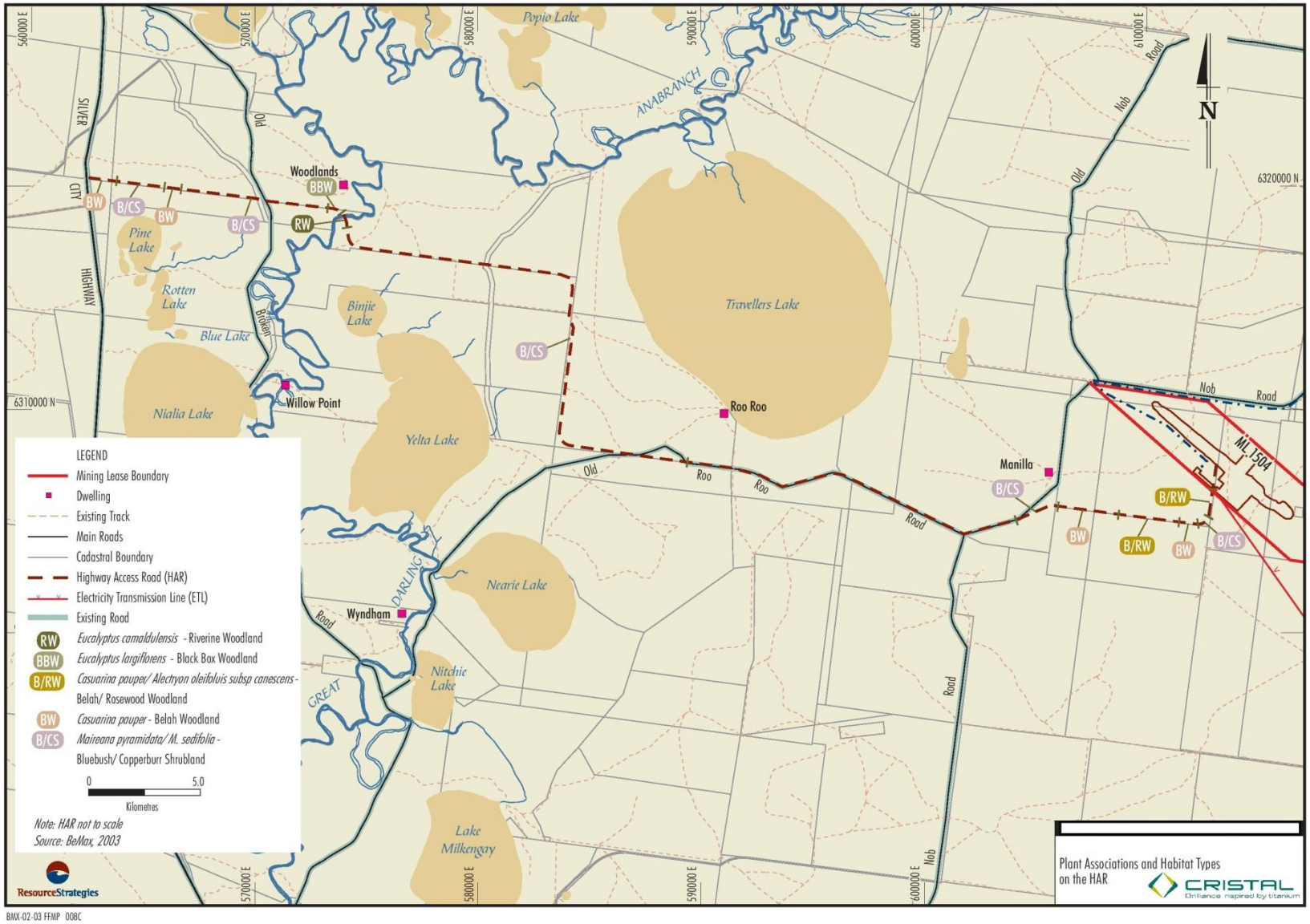


Figure 4 Ginkgo HAR vegetation communities

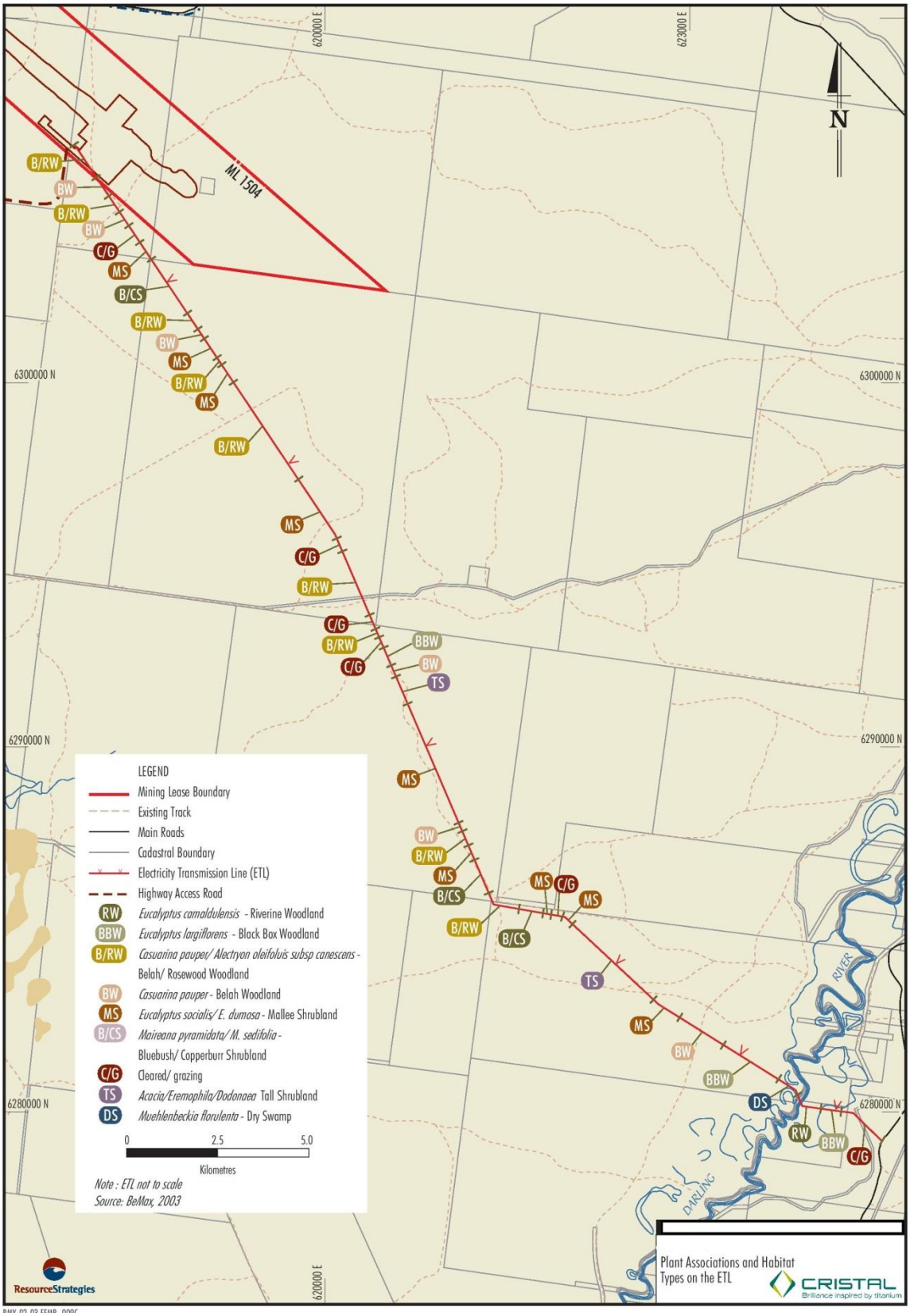


Figure 5 Ginkgo ETL vegetation communities

2.1.2 Fauna

Fauna Habitats

Ginkgo is located within the Southern Mallee Region (Mazzer *et. al*., 1998) which covers land within south-western NSW from the Victorian border to north of Pooncarie, and east to Balranald. Mazzer *et al*. (1998) describes the Southern Mallee Region as comprising four major landforms (dunefields, sandplains, playas and basins, and alluvial plains), and seven broad vegetation groups (Sandplain Mallee, Dunefield Mallee, Scotia Mallee, Remnant Mallee, Riverine Woodlands, Belah Woodland and Shrublands and Grasslands). Ginkgo contains all of the landforms and six of the vegetation groups (Sandplain Mallee, Dunefield Mallee, Remnant Mallee, Riverine Woodlands, Belah Woodland and Shrublands and Grasslands).

Further to the above, Mount King Ecological Surveys (2001) recognised three broad habitat types within the Ginkgo MLA, namely:

- Woodland of Belah, Wilga and Rosewood;
- Shrubland and grassland; and
- Mallee.

Species Composition

Fauna surveys of Ginkgo recorded some 188 fauna species including 136 birds, 21 mammals, 27 reptiles and 4 amphibians (Mount King Ecological Surveys, 2001). Fauna species known to occur within the Southern Mallee Region (Mazzer *et. al.,* 1998) include 202 birds, 47 mammals, 62 reptile and 10 amphibians. A list of fauna species recorded at Ginkgo is provided in Appendix D.

Threatened Fauna

Target surveys conducted for threatened fauna in the project area identified 12 threatened (3 mammals, 7 birds, 1 reptile and 1 amphibian) fauna species (Table 10 of Appendix A) (Mount King Ecological Surveys, 2001). The BCD database was assessed to determine threatened species which could potentially occur within Ginkgo. A total of 61 threatened fauna species (18 mammals, 38 birds, 3 reptiles and 1 amphibian) could potentially occur within the project area and surrounds. The potentially occurring threatened fauna species are provided in Table 11 of Appendix A.

2.2 Snapper

Snapper (Mining Lease (ML) 1621) is located approximately 85 km north of Mildura and 50 km west of the township of Pooncarie in western New South Wales (NSW) and approximately 10 km to the south-west of Ginkgo (Figure 6). A summary of the existing (i.e. pre-mining) environment at Snapper is provided in Appendix B. Snapper includes the Snapper MLA, and extensions to the HAR and ETL (Figure 8). A detailed description of the existing environment is presented in the Snapper Mineral Sands Project Environmental Assessment (Bemax 2007).

2.2.1 Flora

Overall, the region retains most of its remnant native vegetation cover, albeit significantly altered by over 150 years of European settlement and pastoral activities. Flora surveys of Snapper were conducted for the EA (2007). A list of flora species recorded at the Snapper site is provided in Appendix F.

Vegetation Communities

The EA flora study (FloraSearch 2007) described seven plant communities at Snapper ((**Error! Reference source not found.** and Figure 7 and Figure 8). Five of the vegetation communities (1 to 5) are considered to represent the original native vegetation communities of the South Olary Plain. The EA survey suggested that vegetation communities 6 and 7 were considered to be secondary (derived) vegetation communities resulting from removal of the original tree cover by landholders to promote grass and herb growth for stock grazing. This is probably unlikely for community 6 as bluebush shrubland is a generally treeless community found extensively through the broader locality.

Table 2 Vegetation communities identified within the Snapper MLA

Community Number	Original Community Name	Benson Vegetation Communities Equivalent
1	Black Box Woodland	Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (Benson 15)
2	Black Oak – Rosewood – Wilga Woodland	Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray- Darling Depression (Benson 58)
3	Chenopod Mallee Woodland/Shrubland	Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (Benson 170)
4	Irregular Dune Mallee Shrubland	Deep sand mallee of irregular dunefields of the semi-arid (warm) zone (Benson 172)
5	Turpentine Shrubland	Narrow-leaved Hopbush-Scrub Turpentine-Senna shrubland on semi-arid and arid sandplains and dunes (Benson 143)
6	Bluebush Shrubland	Pearl Bluebush low open shrubland of the arid and semi-arid plains (Benson 154)
7	Austrostipa Grassland	Derived corkscrew grass grassland/forbland on sandplains and plains in the semi-arid (warm) climate zone (Benson 165)

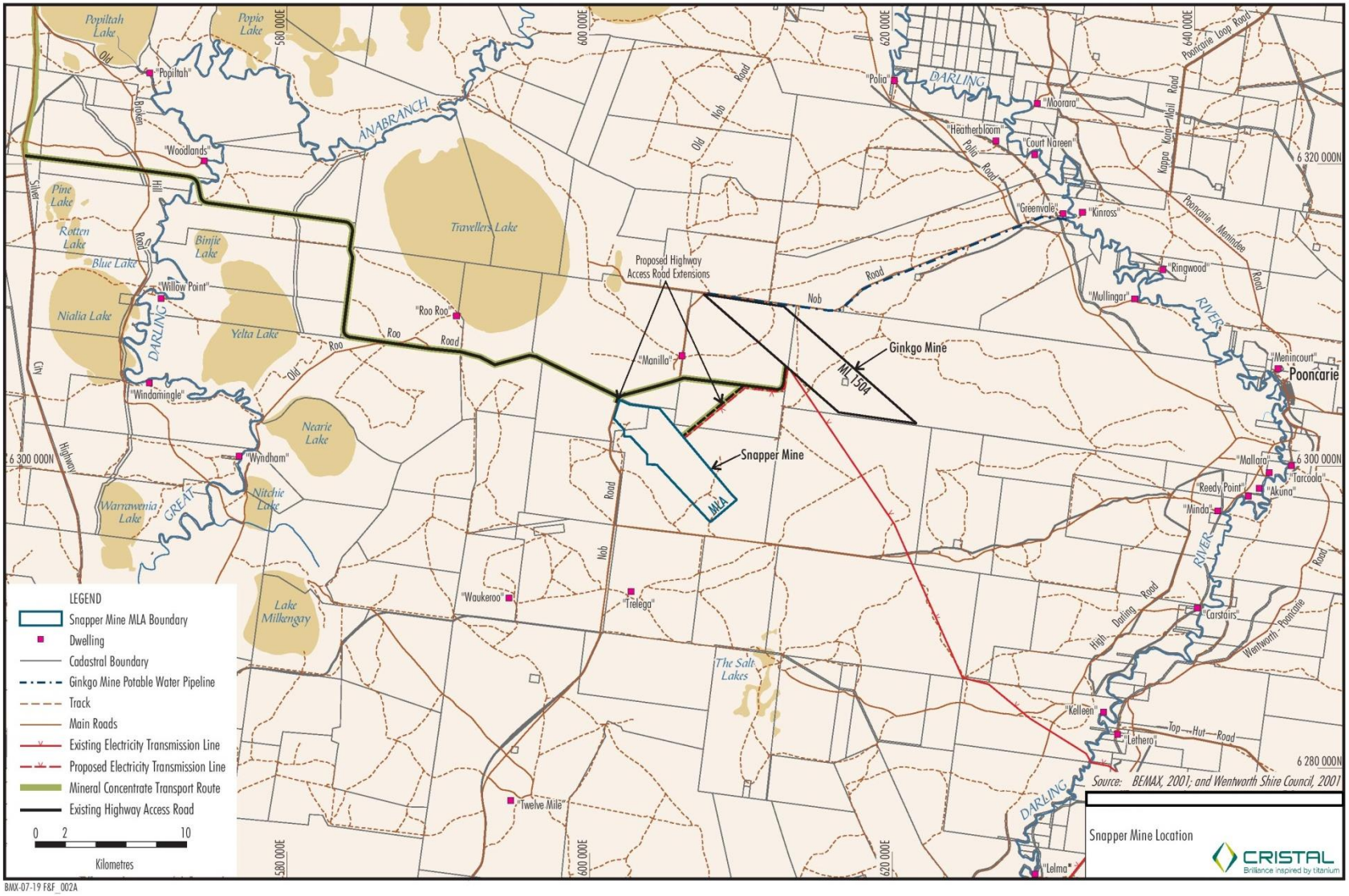


Figure 6 Snapper project location

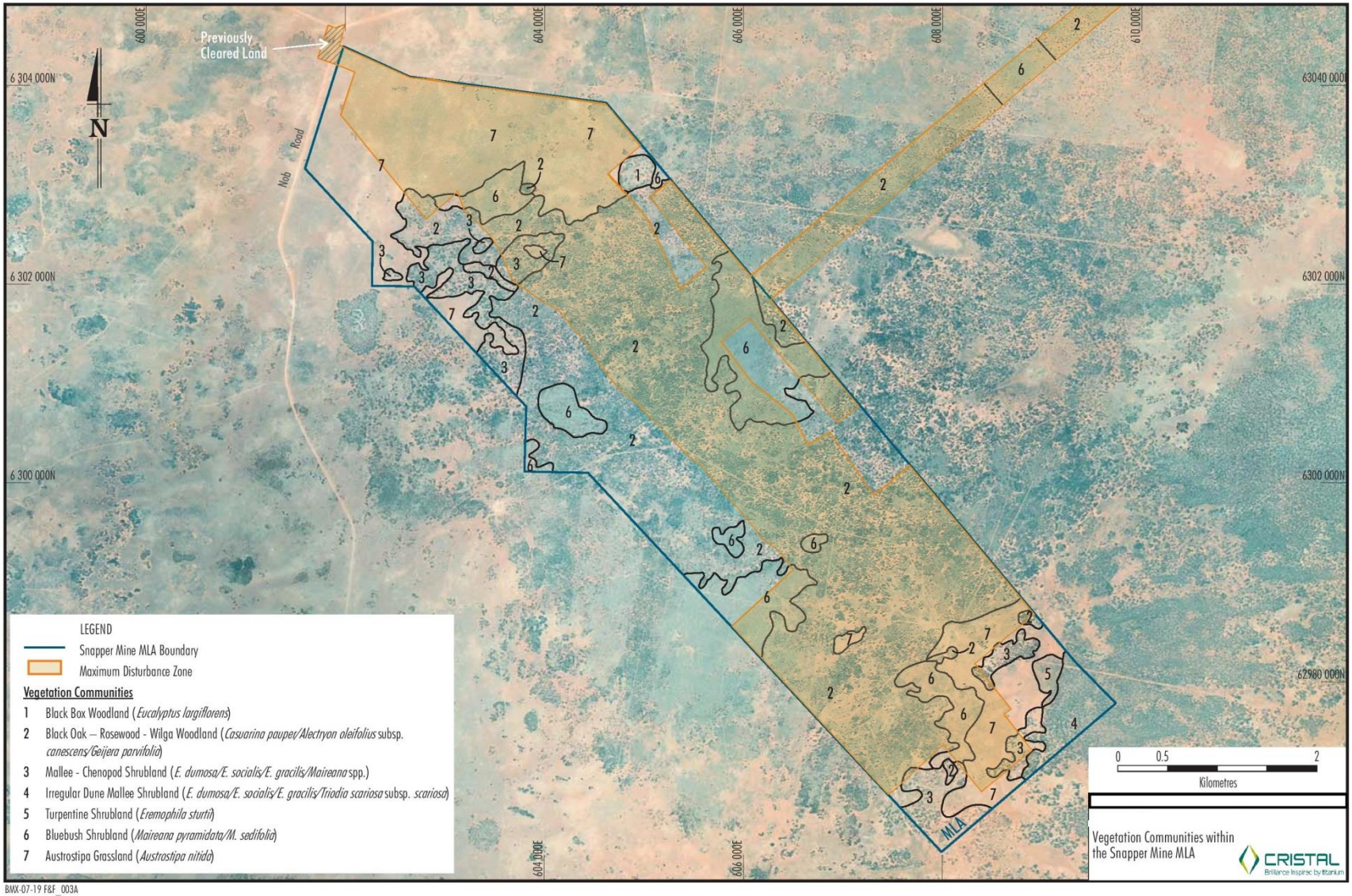


Figure 7 Snapper MLA vegetation communities

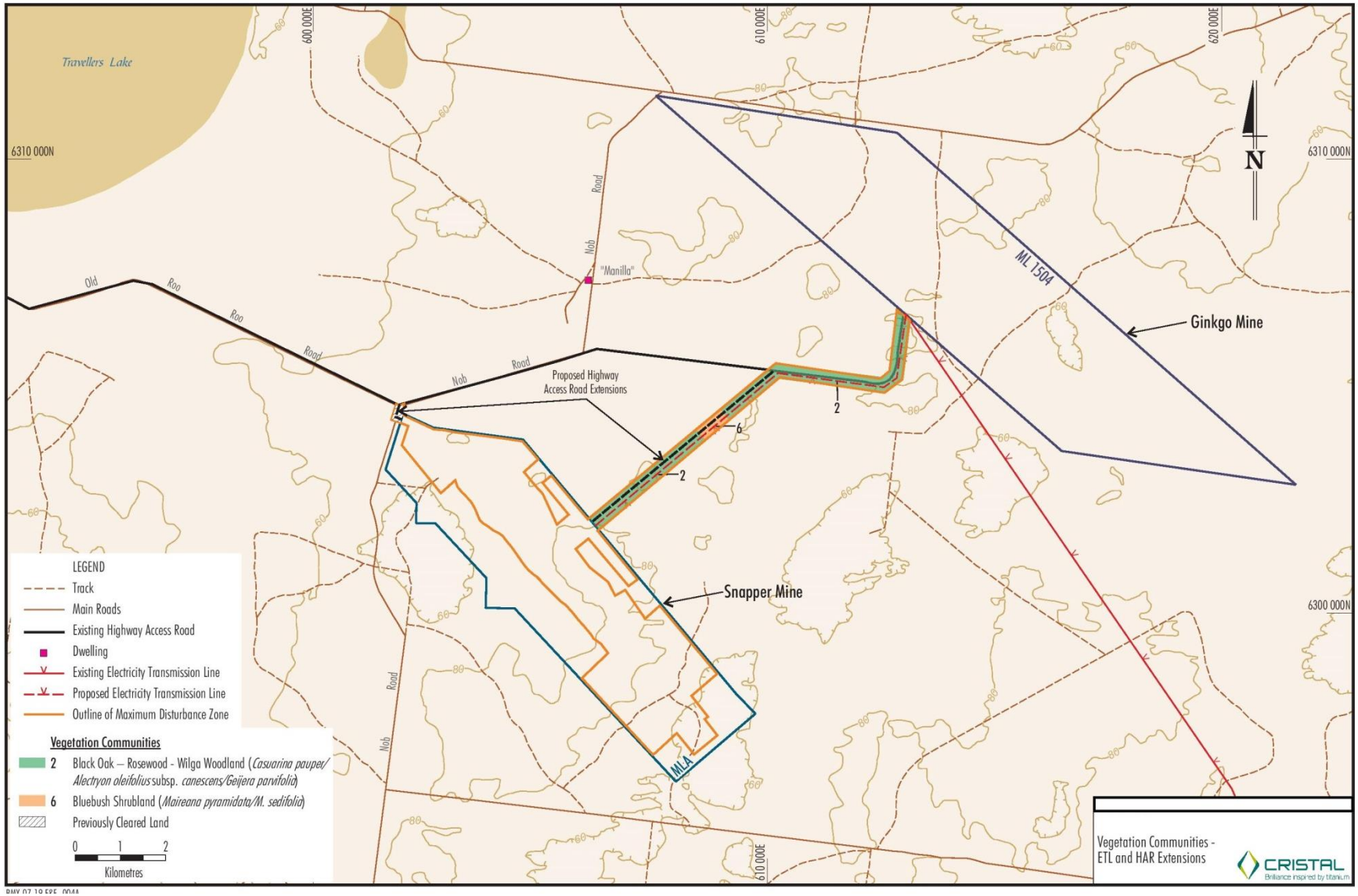


Figure 8 Snapper HAR and ETL vegetation communities

Introduced and Noxious Weeds

A total of 34 species of introduced plants were recorded in the study area comprising 23.4% of the total species observed. This relatively high level of introduced species indicates a high level of disturbance to the natural communities in the study area. One species, Horehound (Marrubium vulgare) is listed as noxious for WSC (DPI 2006a). It was found in only one location, the stock watering point at the eastern end of the study area. Horehound is listed as a Class 4 weed for which the growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction. The NSW Department of Primary Industries publishes a management guide for the control of noxious and environmental weed control that should be consulted for information on the management of horehound and other introduced and noxious weeds (Section 3.2.2).

Threatened Ecological Communities

No threatened ecological communities listed under the BC Act or the EPBC Act were found during the surveys at Snapper.

Threatened Flora Species

No flora species listed as threatened under the BC Act or the EPBC Act were found during the surveys at Snapper.

2.2.2 Fauna

Major Fauna Habitat Types

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

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

Fauna Species Composition

During the survey, a total of 95 species (22 Reptiles, 53 birds and 20 mammals) were identified at Snapper and in the immediate surrounds (Table 22 of Appendix F) including 90 native and five introduced species.

Threatened Fauna Species

Five fauna species listed as threatened within NSW were recorded at Snapper.

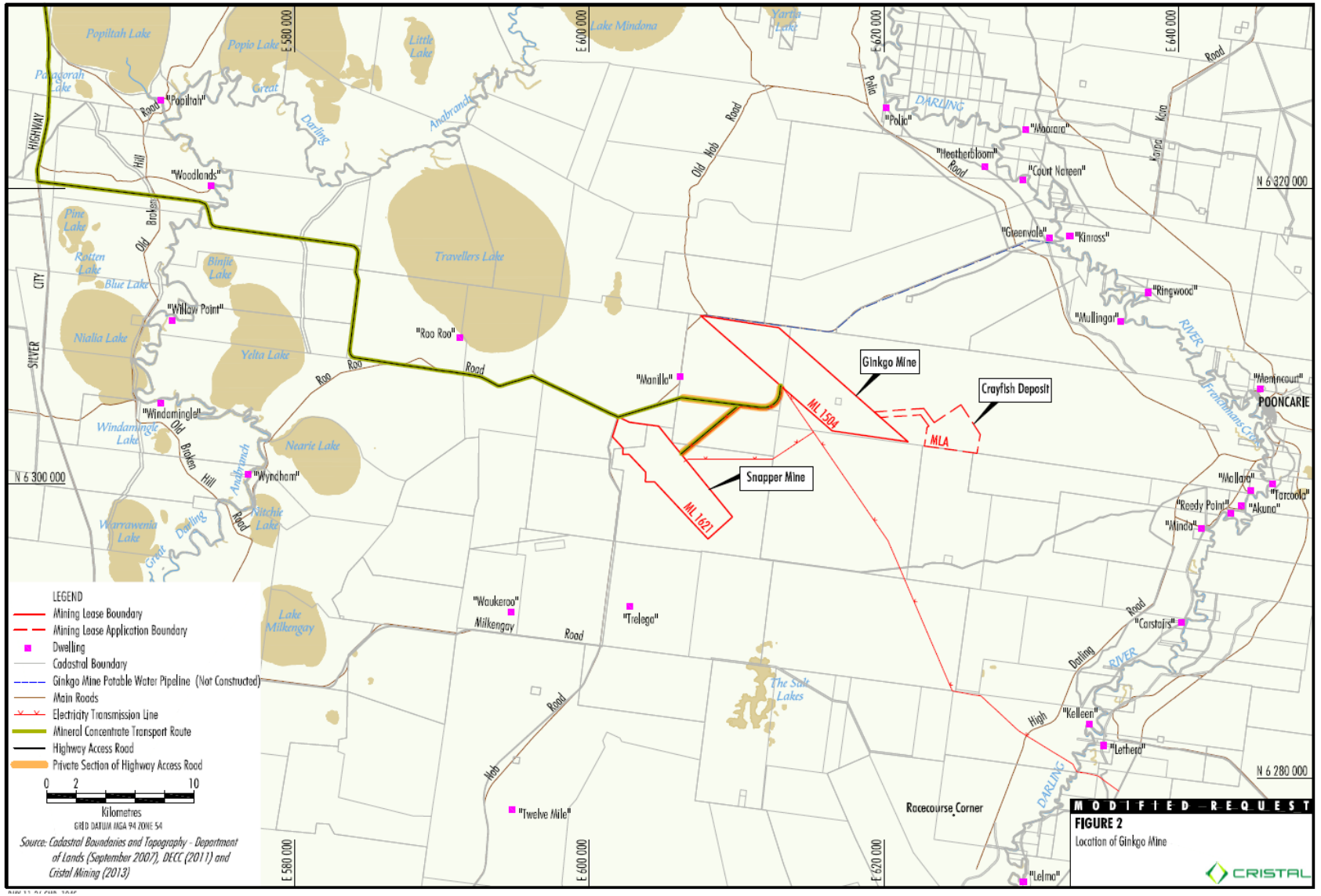
- Western Blue-tongued Lizard *Tiliqua occipitalis;*
- Major Mitchell's Cockatoo *Lophochroa leadbeateri;*
- Hooded Robin *Melanodryas cucullata;*
- Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris; and*
- Little Pied Bat *Chalinolobus picatus*

These species together with their respective location co-ordinates, and number of individuals observed are outlined in Table 13 in Appendix B. –A total of 24 threatened fauna species (one amphibian, six reptiles, 13 birds and four mammals) and/or their habitats could potentially occur within the project area and surrounds. The potentially occurring threatened fauna species are provided in Table 14 of Appendix B.

2.3 Crayfish

Crayfish is located approximately 85 km north of Mildura and 40 km west of the township of Pooncarie in western New South Wales, and is an extension of the existing Ginko MLA (Figure 9). A summary of the existing (i.e. pre-mining) environment at Crayfish and surrounds is provided below with further details provided in Appendix C, Appendix H and Appendix I. The project area includes the Crayfish mining lease area, part of the Ginko MLA and infrastructure corridor which includes the Haul Road Route and 22kV electricity transmission line (Figure 2). A detailed description of the existing environment is presented in the Ginko Mineral Sands Mine November 2012 Modification Environmental Assessment (Bemax 2012), Ginko Mineral Sands Project - Crayfish Modification Flora Assessment (Florasearch 2012) and Ginko Mine Modification – Crayfish Deposit Fauna Assessment (Biodiversity Monitoring Services 2012).

Figure 9 Crayfish project location



2.3.1 Flora

The Crayfish MLA retains most of its natural, native vegetation cover, albeit significantly altered by over 150 years of European settlement and pastoral activities. Flora surveys at Crayfish MLA were conducted for the EA within the modification area and infrastructure corridor, and lists of flora species recorded during these surveys are provided in Appendix I.

Overall, introduced species comprise a relatively small percentage of the species identified, reflecting the usage of natural ecosystems for low intensity grazing activities in the region.

Vegetation Communities

The EA flora study (Florasearch, 2012) described plant communities present in the Crayfish MLA and along the haul road. As a result, 9 vegetation communities have been identified at Crayfish (Table 3), and are mapped in Figure 10.

Table 3 Vegetation communities identified within the Crayfish MLA

	Original Community Name	Benson Vegetation Communities Equivalent
1	Black Box woodland	Black Box grassy open woodland of rarely flooded depressions in south western NSW (Benson 16)
2	Black Oak (Belah) – Western Rosewood woodland	Community has elements of two NSW VCA communities: Black Oak (Belah) – Western Rosewood open woodland on deep sandy loams of the Murray-Darling Depression and Riverina Bioregions (Benson 58) and Black Oak – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones (Benson 221).
3	Black Oak (Belah) – Pearl Bluebush Woodland	Black Oak (Belah) – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones (Benson 221)
4	Chenopod Mallee Woodland / Shrubland	Chenopod sand mallee woodland/shrubland of the arid and semi-arid (warm) zones (Benson 170)
5	Dune Mallee Shrubland	Spinifex linear dune mallee mainly of the Murray-Darling Depression Bioregion (Benson 170)
6	Pearl Bluebush Shrubland	Pearl Bluebush low open shrubland of the arid and semi-arid plains (Benson 154)
7	Derived Austrostipa Grassland	Corkscrew grass grassland/forbland on sandplains and plains in the semi-arid (warm) zone (Benson 165)
8	Derived Turpentine Tall Open Shrubland	Community 8 is not directly comparable to any NSWVCA community. However, it shares species with NSWVCA communities 58 (Black Oak (Belah) – Western Rosewood open woodland on deep sandy loams of the Murray-Darling Depression and Riverina Bioregions) and 170 (Chenopod sand mallee woodland/shrubland of the arid and semi-arid (warm) zones) from which it has been derived (Benson 58 and 170) (Benson 170)
9	Derived Depression Herbfield	Community 9 is not directly comparable to any NSWVCA community. However, its understory has most in common with NSWVCA community 16 (Black Box grassy open woodland of rarely flooded depressions in south western NSW). (Benson 16)

Introduced and Noxious Weeds

At Crayfish, thirty two species of introduced plants were recorded across the Study area, comprising 20 percent of the total species observed (Appendix H). Many of the introduced species were concentrated around a major stock watering point in the north eastern corner of

the Study area and were not found elsewhere. Relatively few species were widespread in the project area and generally only occurred in low numbers. None dominated any of the flora communities (FloraSearch 2012).

Two introduced species found in the survey, Horehound (*Marrubium vulgare*) and Bathurst Burr (*Xanthium spinosum*) are listed as Noxious for Wentworth Shire (DPI, 2012). Horehound was found in only two locations in low amounts and Bathurst Burr was found in low numbers near the watering point in the north east of the Study area. Both are listed as Category 4 weeds for which 'the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority'.

Threatened Ecological Communities

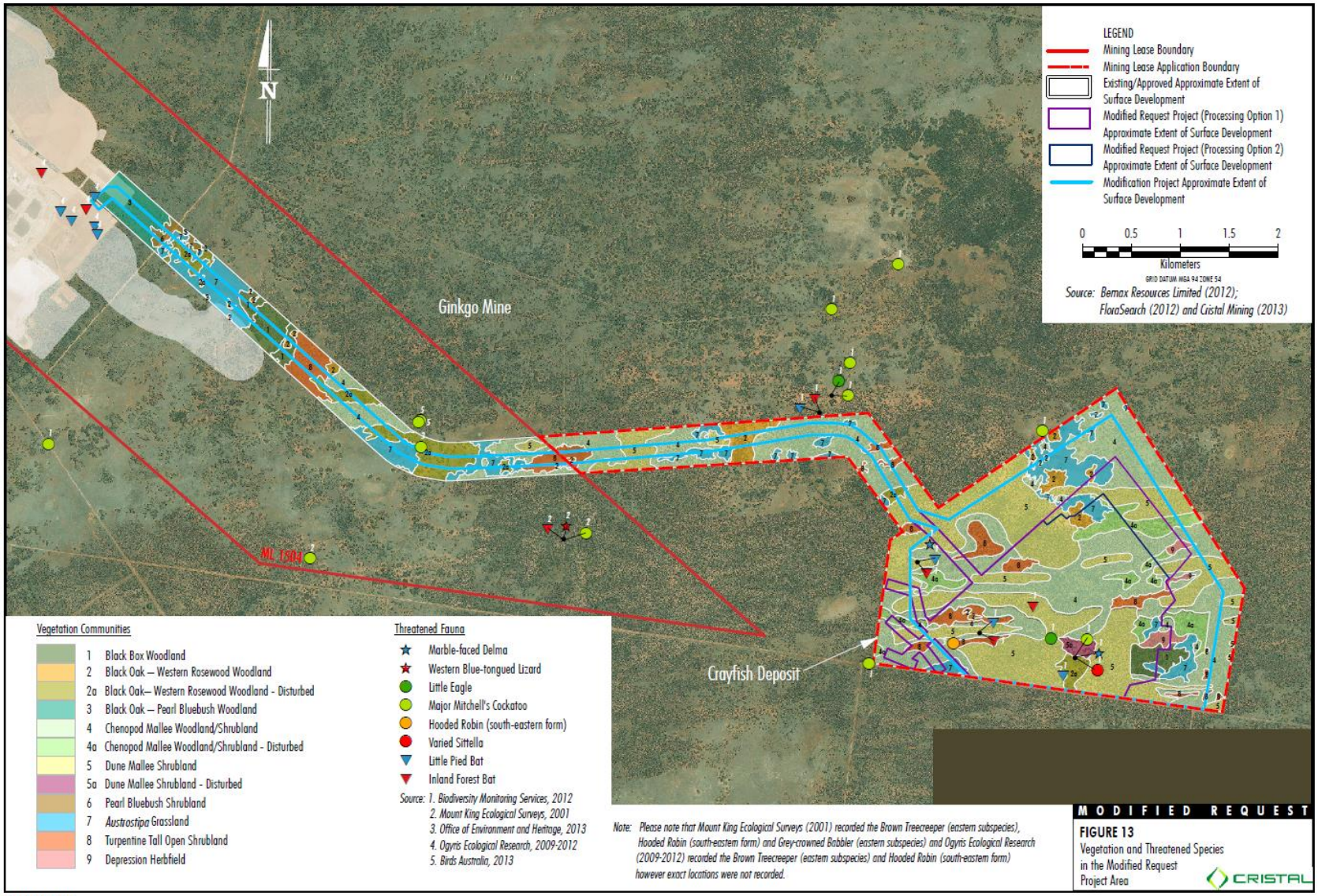
Seven ecological communities listed as endangered under the BC Act are known to occur in the Bioregion, two of which are also listed under the EPBC Act. An assessment of the likelihood of occurrence of these was found a very low likelihood that any of the seven ecological communities would occur in the Study area (FloraSearch 2012). Each was targeted during the study, but no listed communities were recorded during the surveys.

Threatened Flora Species

A total of 20 flora species listed under the BC Act, seven also listed under the EPBC Act, are known to occur or are considered to have potential to occur within the wider region. The list was compiled from database searches of the DPIE Biodiversity Conservation Division (BCD, 2012a) Atlas of NSW Wildlife for the Popiltah, Cuthero, Pooncarie, Bunnerungee, Para and Arumpo 1:100,000 map sheets; BCD BioNet-Atlas website for the South Olary Plain Parts B, C and D (BCD, 2012a), the BioNet website accesses databases held by NSW National Parks and Wildlife, Royal Botanic Gardens and Domain Trust and Forests NSW, and the EPBC Act Protected Matters Search Tool [6,000 km2 around the Study area (SEWPaC 2012b)] (FloraSearch 2012).

Surveys by FloraSearch did not record any threatened flora species at Crayfish (FloraSearch 2012).

Figure 10 Crayfish MLA vegetation communities



2.3.2 Fauna

Fauna Habitats

Crayfish is located within the Southern Mallee Region (Mazzer *et. al*., 1998) a region which covers land within south-western NSW from the Victorian border to north of Pooncarie, and east to Balranald. Mazzer *et al*. (1998) describes the Southern Mallee Region as comprising four major landforms (dunefields, sandplains, playas and basins, and alluvial plains), and seven broad vegetation groups (Sandplain Mallee, Dunefield Mallee, Scotia Mallee, Remnant Mallee, Riverine Woodlands, Belah Woodland and Shrublands and Grasslands). Crayfish contains all of the landforms and six of the vegetation groups (Sandplain Mallee, Dunefield Mallee, Remnant Mallee, Riverine Woodlands, Belah Woodland and Shrublands and Grasslands).

Further to the above, Biodiversity Monitoring Services (2012) recognised five broad habitat types within the Crayfish MLA, namely:

- Black Box Woodland;
- Grassland;
- Shrubland;
- Mallee-Spinifex Dunes; and
- Black Oak (Belah) Woodland.

Species Composition

Fauna surveys of Crayfish recorded some 124 fauna species including 76 birds, 22 mammals (8 exotic), 22 reptiles and 4 amphibians (Biodiversity Monitoring Services 2012). Fauna species known to occur within the Southern Mallee Region (Mazzer et. al., 1998) include 202 birds, 47 mammals, 62 reptile and 10 amphibians. A list of fauna species recorded at Crayfish is provided in Appendix H.

Threatened Fauna

Target surveys conducted by Biodiversity Monitoring Services for threatened fauna in the project area identified six threatened fauna species (2 mammals, 3 birds and 1 reptile) Appendix H, Table 24. The BCD Wildlife Atlas database was assessed to determine threatened species which could potentially occur within Crayfish. A total of 74 threatened fauna species (20 mammals, 44 birds, 8 reptile and 2 amphibians) were identified. The potentially occurring threatened fauna species are provided in Appendix H, Table 25.

2.4 Summary of mining activities that impact on flora and fauna values

Mining activities that impact on existing flora and fauna values include:

- Top soil and sub-soil stripping and clearing for mining and infrastructure;
- Mining;
- Stockpiling of soils and overburden;
- Stockpiling of mineral concentrates for further processing and transport;
- Construction and operation of water and sand residue dams and erosion and sediment control structures; and
- Construction of internal access roads and placement of supporting infrastructure (powerlines, set-down areas, mine camp and office facilities; ETLs; etc.)

2.5 Summary of potential environmental impacts

Significant impacts potentially associated with operations were assessed in the EIS and EA for each of the Murray Basin mines. Mitigation measures that regulatory authorities (such as the DPIE, BCD, NSW Environment Protection Authority (EPA) and local councils) deemed required to reduce potential risks to an acceptable level were identified and included in the Conditions of Approval and the EPL (Table 4 and Table 5) and any other permits and consents specifically applicable to this plan (Section 3.2.1).

A preliminary, high-level risk assessment for the Murray Basin mines was created as part of the update of the EMS and is appended to this revised FFMP. This high-level assessment was a subjective assessment based on Tronox's knowledge of site operations to date and the effectiveness of existing controls in reducing risks. Further details of the risk assessment are provided in the EMS.

A summary of the main potential environmental impacts for flora and fauna at the Murray Basin mines are summarised below.

- Removal of habitat for threatened flora and fauna species;
- Loss of native vegetation ranging in condition from good to poor and also secondary vegetation;
- Direct impacts to fauna (e.g. mortality during clearance, removal of nests);
- Disturbance of fauna during breeding or nesting;
- Loss of habitat for fauna species considered both threatened and common;
- Potential introduction of new weeds or spread of existing weeds; and
- Fragmentation of habitats.

The mitigation measures outlined in this document are based on the requirements of regulatory consent conditions (Table 4 and Table 5). The preliminary risk assessment (as appended to the EMS) identified the residual risk associated with flora and fauna following the implementation of the mitigation measures in this plan as medium. The mitigation measures outlined in this FFMP are designed to minimise the potential impacts of these above potential environmental impacts.

3. Environmental management framework

The environmental management framework for Tronox's operations in the Murray Basin is based on the requirements of AS/ISO 14001:2004 (the standard). Major elements of the environmental management framework include:

- Project risk identification and assessment;
- Environmental objectives and measurable performance targets;
- Legal and other requirements;
- Roles and responsibilities for environmental management;
- Staff training and induction processes;
- Responding to and managing complaints, non-compliances and incidents;
- Environmental reports and correspondence for the project;
- Audits of the FFMP; and
- Review and update of the FFMP.

This FFMP has been designed as a subordinate document to the EMS (2015), which provides the framework for all Tronox's operations at the Mineral Separation Plant (MSP) and the Murray Basin mines. Each of the main components of standard has been addressed in detail within the EMS. Information provided within this FFMP provides additional, specific details for flora and fauna management. The Environmental Management Framework in place for Tronox's current operations in the Murray Basin is illustrated in Figure 11.

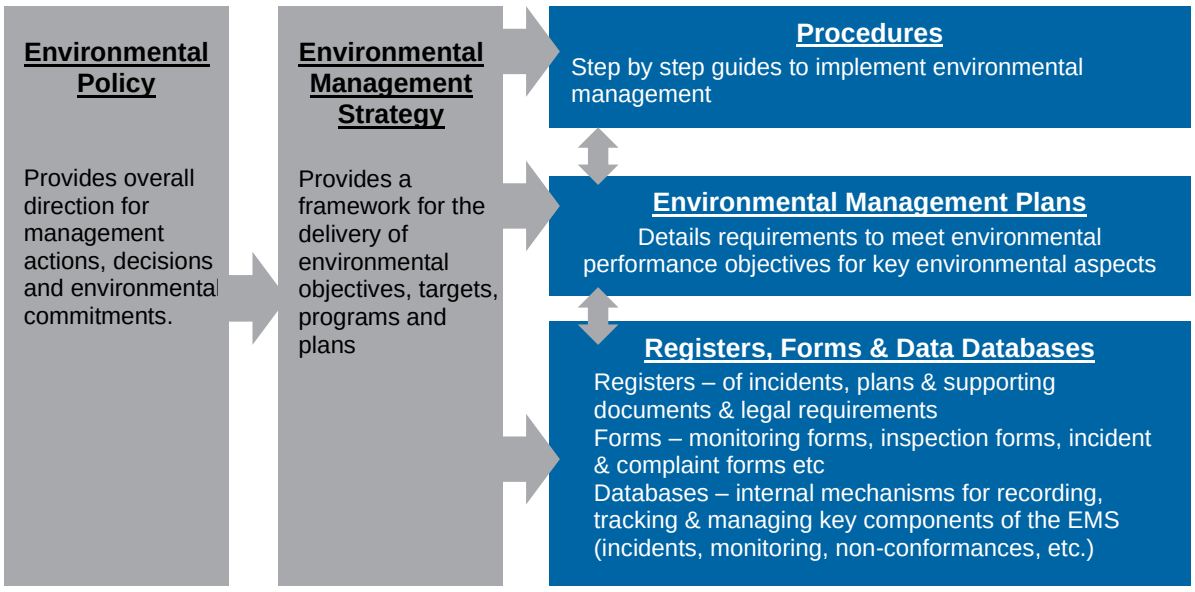


Figure 11 Tronox's Environmental management framework

3.1 Relationship to other Environmental Management Plans

The structure of the environmental management documentation is presented in Figure 12.

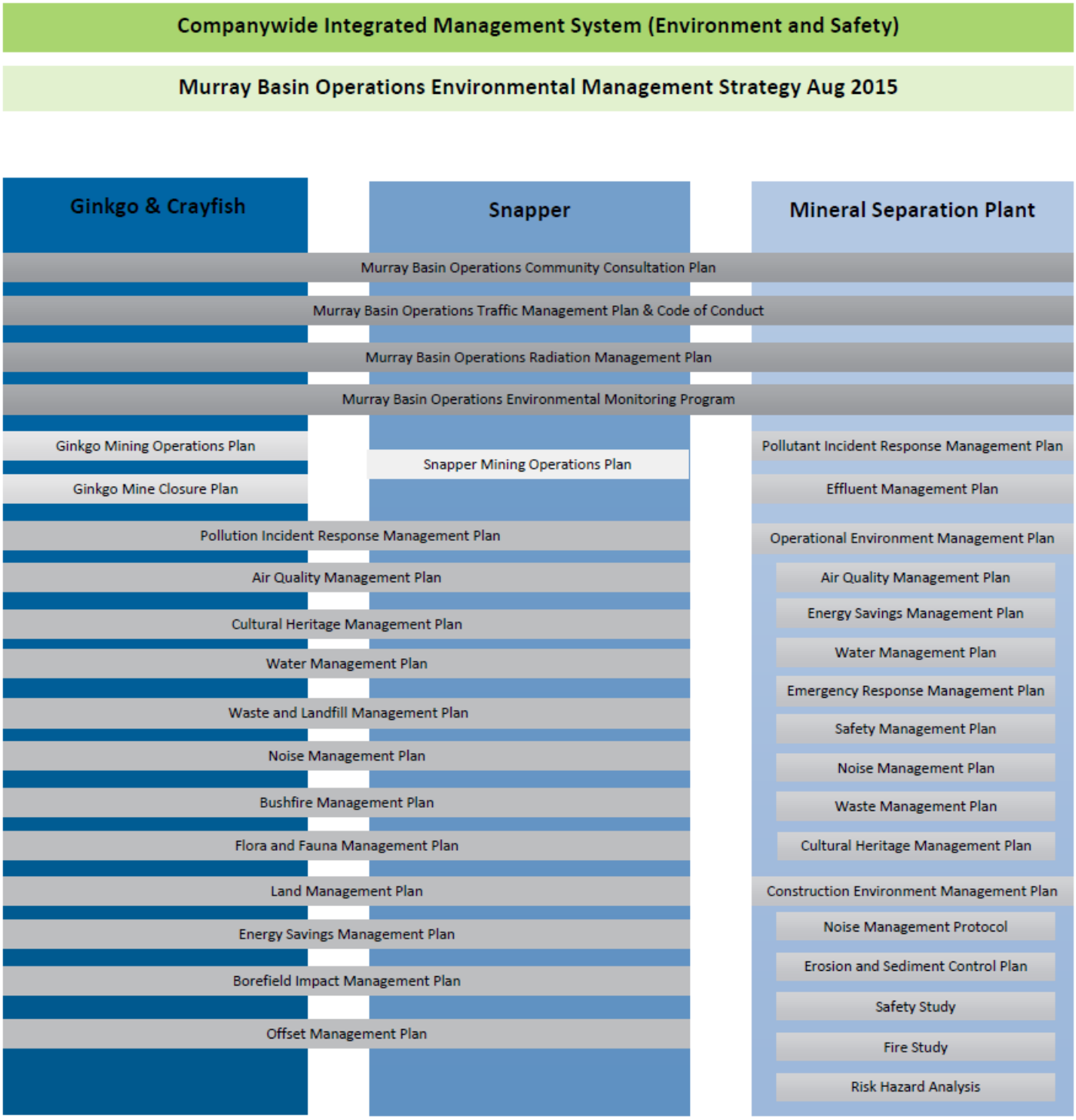


Figure 12 Environmental management documents for Tronox's operations in the Murray Basin in NSW

3.2 Legislative requirements and project environmental approvals

3.2.1 Project regulatory approvals

Tronox is required to create, maintain and implement EMPs in accordance with the approval conditions for the Murray Basin mines. There are a number of regulatory approval documents that contain conditions for environmental management that Tronox must adhere to for operations at these sites. This EMP has been created to address the specific requirements of the regulatory approval documents. The current regulatory approval documents for this project are provided in Table 4 below. The requirements of these regulatory approvals to be addressed in this FFMP are provided in Table 5.

With regards to Conditions of Approval granted for the Murray Basin Mines under the EP & A Act 1979 it is noted that:

- Development consent for Ginkgo was granted pursuant to Section 76(A)9 & 80 (Part 4) in January 2002;
- Project Approval for Snapper was granted pursuant to Section 75J (Part 3A) in August 2007;
- Development consent for Crayfish (Ginkgo modification) DA 251-09-01 was granted pursuant to Section 75W in March 2015.

Table 4 Approval documents for the Murray Basin mines

Approval Document	Document Number	Current revision date	Current modifcation
Ginkgo Mineral Sands Mine Development Consent Conditions	DA 251-09-01	14 December 2017	13
Ginkgo Mining Lease	ML No. 1504	6 March 2002	-
Ginkgo Mine Environmental Protection Licence	EPL 12264	18 December 2015	-
Snapper Mineral Sands Mine Conditions of Project Approval	DA 06-168	20 March 2015[1]	5
Snapper Mining Lease	ML No. 1621	10 July 2008	-
Snapper Mine Environmental Protection Licence	EPL 12799	10 July 2012	-

3.2.1 Regulatory approvals specific to flora and fauna management

EPBC Act

Ginkgo

A referral was submitted to the Commonwealth environment department for consideration of the project under the EPBC Act in February 2001. The project was considered not to require approval under the EPBC Act based on the provided documentation and the proposed action.

[1] Most recent modification – date on consolidated PA is October 2010

Snapper

A referral was submitted to the Commonwealth environment department for consideration of the project under the EPBC Act in June 2007. The project was considered not to require approval under the EPBC Act based on the provided documentation and the proposed action.

Crayfish

A referral was submitted to the Commonwealth environment department for consideration of the project under the EPBC Act in June 2007. The project was considered not to require approval under the EPBC Act based on the provided documentation and the proposed action.

Table 5 Regulatory consent conditions applicable to this FFMP

Condition number	Condition details	Section in EMP
Snapper (DA 06-168) Modification 5		
Schedule 3 – Specific Environmental Conditions, Condition 16 – Flora and Faun – **Flora and Fauna Management**		
	The Proponent shall prepare and implement a Flora and Fauna Management Plan for the project to the satisfaction of the Secretary. This plan must: (a) be prepared in consultation with the BCD by a suitably qualified expert(s) whose appointment(s) has been approved by the Secretary; (b) be submitted to the Secretary for approval prior to carrying out any development on the site: and (c) include a: • vegetation clearance protocol; • threatened species management protocol; • description of the detailed measures that would be implemented to: - control weeds, feral pests, and access; - salvage and reuse material from the site for habitat enhancement; - collect and propagate seed; - manage grazing, fauna entrapment in the dredge pond, bushfires, and remnant vegetation on site; and • program to monitor the effectiveness of the protocols and management measures in the plan.	Section 4 See also - Ginkgo and Snapper Bushfire Management Plan - Ginkgo and Snapper Land Management Plan
Schedule 3 – Specific Environmental Conditions, Condition 17 – Flora and Fauna – **Offset Management Plan**		
	The Proponent must prepare and implement an Offset Management Plan to the satisfaction of the Secretary. This plan must: (a) be prepared in consultation with the BCD by a suitably qualified expert whose appointment has been endorsed by the Secretary;	See Offset Management Plan

Condition number	Condition details	Section in EMP
	(b) be submitted to the Secretary for approval prior to carrying out any development on the site; and (c) describe the measures to implement the flora and fauna offset (see statement of commitment 4 in Appendix 4 and the detailed description of this offset in the EA), including: - the objectives for the offset - a description of the short, medium and long term measures that would be implemented, including appropriate fencing to exclude grazing, incrementally de-stocking the offset area over three years, removal of unnecessary existing fences, erosion control, signage of the offset, revegetation of unnecessary access tracks, animal pest control, weed management, fire management and threatened species management. - detailed performance and completion criteria for the implementation of the offset; - a detailed description of how the performance of the offset would be monitored, using techniques such as photographic monitoring and permanent flora quadrats; - a description of how the offset would be protected in the long-term; and - details of who would be responsible for monitoring, reviewing and implementing the plan.	
Schedule 3 – Specific Environmental Conditions, Condition 18 – Flora and Fauna - **Offset Bond**		
	After the first Independent Environmental Audit (See Schedule 4 of the conditions) after year 10 of the mining operations, the Proponent shall lodge a suitable offset bond with the Secretary. This bond must be determined by the audit team in consulatation with the Proponent and contain sufficient funds to ensure the remaining works in the Offset Management Plan are fully implemented. The Proponent shall revise this bond to the satisfaction of the Secretary after each subsequent audit. *Notes:*	Not applicable

<table>
<tr><th>Condition number</th><th>Condition details</th><th>Section in EMP</th></tr>
<tr><td></td><td>(d) Remaining works are those works required for areas for which completion criteria (as set out in the Offset Management Plan) have not been met, as determined by the Independent Environmental Audit.

(e) Areas for which completion criteria have been met, as verified by the Audit, will not require a bond.

(f) Where offset completion criteria are met for a particular area, as verified by the Audit, the Secretary will release the bond for that area.</td><td></td></tr>
<tr><td colspan="3">Ginkgo and Crayfish (DA 251-09-01) Modification 13</td></tr>
<tr><td colspan="3">Schedule 3 – Specific Environmental Conditions; Condition 18 – Biodiversity – Biodiversity Offset Strategy</td></tr>
<tr><td></td><td>The Applicant shall implement a Biodiversity Offset Strategy (as summarised in Table 4 and shown in Appendix 6 of the conditions) to the satisfaction of the Secretary.

<u>Biodiversity Offset Strategy:</u>

Table 4: Biodiverstiy Offset Strategy
<table>
<tr><th><u>Area</u></th><th><u>Minimum Size/Amount</u></th></tr>
<tr><td>Southern Mallee Offset</td><td>521 hectares of Southern Mallee vegetation communities, including at least 4 hectares of Chenopod Mallee vegetation communities.</td></tr>
<tr><td>Crayfish Deposit Offset</td><td>2,082 hectares</td></tr>
<tr><td>MOD 12 Offset Areas</td><td>1, 671 hectares</td></tr>
<tr><td>MOD 13 Offset Areas</td><td>759 hecatres</td></tr>
</table>
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 Secretary.</td><td>See:
- Offset Management Plan
- Ginkgo and Crayfish Expansion Mining Operations Plan</td></tr>
</table>

Condition number	Condition details	Section in EMP
	• *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.* • *At the time of determination of MOD 13, the Applicant retains 4,597 surplus ecosystem credits and 4,462 surplus species credits.*	
Schedule 3 – Specific Environmental Conditions; Condition 19 and 19A – Biodiversity – **Long Term Security of Offset**		
	19. By 30 June 2016, unless otherwise agreed with Secretary, the Applicant shall make suitable arrangements to provide appropriate long term security for the biodiversity offset area identified in Table 4 and Appendix 6 of the conditions, to the satisfaction of the Secretary.	Not Applicable
	19 A. By 30 June 2018, unless otherwise agreed with the Secretary, the Applicant shall make suitable arrangements to provide appropriate long term security for the biodiversity offset area identified as Biodiversity Offset Areas 7 and 8 in Appendix 6 of the conditions, to the satisfaction of the Secretary.	
Schedule 3 – Specific Environmental Conditions; Condition 20 – Biodiversity – **Offset Management Plan**		
	The Applicant must prepare and implement an Offset Management Plan to the satisfaction of the Secretary. This plan must: (a) be prepared in consultation with the BCD by a suitably qualified expert whose appointment has been endorsed by the Secretary; (b) be submitted to the Secretary for approval within 6 months of the date of consent for MOD 9, unless otherwise agreed with the Secretary; (c) establish baseline data for the existing habitat in the biodiversity offset areas; (a) describe the short, medium, and long term measures that would be implemented to: • manage the vegetation and habitat in the biodiversity offset areas; and • implement the biodiversity offset strategy, including detailed performance and completion criteria;	See Offset Management Plan

Condition number	Condition details	Section in EMP
	(b) include a program to monitor and report on the effectiveness of these measures, and progress against detailed performance and completion criteria; (c) include fire management prescriptions for ecological outcomes in conjunction with other local and regional fire management planning; (d) include a description of how artificial watering points would be closed; (e) include a description of how the offset would be protected in the long-term; (f) identify the potential risks to the successful implementation of the Biodiversity Offset Strategy, and the contingency measures that would be implemented to mitigate these risks; and (j) include details of who would be responsible for monitoring, reviewing, and implementing the plan.	
Schedule 3 – Specific Environmental Conditions; Condition 21 and 21A – Biodiversity – **Conservation Bond**		
	21. Within 12 months of the date of consent for MOD 9, unless otherwise agreed with the Secretary, the Applicant shall lodge a conservation bond with the Department to ensure that the Biodiversity Offset Strategy is implemented in accordance with the performance and completion criteria described in the Offset Management Plan. The sum of the bond shall be determined by: (a) calculating the full cost of implementing the offset strategy (other than land acquisition costs); and (b) employing a suitably qualified quantity surveyor to verify the calculated costs. If the offset strategy is completed generally in accordance with the completion criteria in the Offset Management Plan to the satisfaction of the Secretary, the Secretary will release the bond. If the offset strategy is not completed generally in accordance with the completion criteria in the Offset Management Plan, the Secretary will call in all or part of the conservation bond, and arrange for the satisfactory completion of the relevant works. *Notes:*	Not applicable

Condition number	Condition details	Section in EMP
	• *Alternative funding arrangements for long-term management of the biodiversity offset strategy, such as provision of capital and management funding as agreed by BCD as part of a Biobanking Agreement or transfer to conservation reserve estate can be used to reduce the liability of the conservation and biodiversity bond.* • *The sum of the bond may be reviewed in conjunction with any revision to the biodiversity offset strategy.* • *With the agreement of the Secretary and BCD, the bond may be released progressively in accordance with the progress of the Biodiversity Offset Strategy*.	
	21 A. Within 6 months of the date of consent for MOD 13, unless otherwise agreed with the Secretary, the Applicant shall: (a) revise the sum of the conservation bond required by condition 21 above to account for the additional offset areas; and (b) lodge the additional bond amount with the Department.	
Schedule 3 – Specific Environmental Conditions; Condition 22 – Biodiversity – **Flora and Fauna Management**		
	The Applicant shall prepare and implement a Flora and Fauna Management Plan for the development to the satisfaction of the Secretary. This plan must: (a) be prepared in consultation with BCD by a suitably qualified expert whose appointment has been endorsed by the Secretary; (b) be submitted to the Secretary for approval prior to any vegetation clearing at the Crayfish Deposit, unless otherwise agreed with the Secretary: and (c) describe: • vegetation clearance protocols, including quantification of the amount of *Swainsona flavicarinata* and *Swainsona adenophylla*; • methods for re-establishment of native vegetation and habitat; • threatened species management measures with particular reference to *Swainsona flavicarinata*, *Swainsona adenophylla*, Western Blue-tongue (*Tiliqua occipitalis*) lizard, Bolam's Mouse (*Pseudomys bolami*) and Marble-faced Delma	Section 4 and appendices See Also Ginkgo and Snapper Environmental Monitoring Plan Ginkgo and Snapper Erosion and Sediment Control Plan Ginkgo and Snapper Land Management Plan Mining Operations Plans (MOP) for Ginkgo and Snapper

Condition number	Condition details	Section in EMP
	(*Delma australis*), including any proposed translocation protocols and additional surveys; • the specific management measures for the Marble-faced Delma; • the specific management measures for the Bolam's Mouse, including additional surveys on site and in the biodiversity offset areas; • the detailed measures that would be implemented to: - control weeds, feral pests, and access; - salvage and reuse material from the site for habitat enhancement; - collect and propagate seed; - manage grazing and remnant vegetation on site; and - prevent fauna entrapment in the dredge pond; • a program to monitor the effectiveness of the protocols and management measures in the plan.	

This table incorporates the changes from the Snapper Project Approval 06_0168 Modification 6 dated February 2015, Ginkgo Project Approval DA251-09-01 Modification 12 dated April 2016 and Ginkgo Project Approval DA251-09-01 Modification 13 dated December 2017.

3.2.2 Relevant legislation and other requirements

This group of projects is subject to the requirements of the New South Wales POEO Act 1997 and its subordinate legislation. A full legislative register is provided in the EMS (2015); acts, regulations and policies specific to this FFMP are listed below.

Federal (Commonwealth)

Acts

- *Environment Protection and Biodiversity Conservation Act 1999*

State (NSW)

Acts

- *Environmental Planning and Assessment Act 1979*
- *Mining Act 1992*
- *Biodiveristy and Conservation Act 2016*
- *Local Land Services Act 2013*
- *Noxious Weeds Act 2003*

Regulations

- *Threatened Species Conservation Regulation 2010*

Relevant standards, codes of practice and guidelines

Noxious and environmental weed control handbook – a guide to weed control in non-crop, aquatic and bushland situations (NSW DPI, 2011).

3.3 Roles and responsibilities

Overall roles and responsibilities for environmental management at the Murray Basin mines are outlined in Tronox's EMS.

Environmental department (Senior Rehabilitation Officer/Environmental Officer) is responsible for maintaining the currency of the FFMP and for implementing the environmental mitigation measures and monitoring outlined in Section 4.

3.4 Training and inductions

Overall training and induction requirements for Tronox's operations at the Murray Basin mines are outlined in the EMS (2015).

An environmental education program will be included in employee and contractor inductions and will include training relevant to the management of native flora and fauna.

3.5 Complaint, non-conformance and incident management

Complaint, non-conformance and incident management for Tronox's operations at the Murray Basin mines is described in Tronox's EMS.

3.6 Environmental reporting and correspondence

Conditions of Approval for the Murray Basin mines (see Table 4), require that Tronox submit an Annual Environmental Management Report (AEMR) to the Secretary of the DPIE. Details of information to be included in the AEMR are provided in the EMS (2015). The AEMR will provide

a summary of the flora and fauna management initiatives implemented for Murray Basin mines, present the results of the flora and fauna monitoring program and forecast the flora and fauna management and monitoring programs for the ensuing 12 months. Accordingly, the flora and fauna management and monitoring programs will be subject to annual review from various regulatory and advisory agencies.

The AEMR will, where applicable, report on the following flora/fauna components:

- status and results of the updated pre-clearance surveys and updated vegetation clearance protocol;
- identification and/or occurrence of threatened flora and fauna species;
- revegetation of disturbance areas;
- flora/fauna monitoring;
- general flora and fauna management initiatives;
- incidents related to flora and fauna; and
- management and monitoring programs for the following year.

Progression toward achievement rehabilitation objectives in revegetated areas will be reported in the AEMR as part of the Department of Primary Industries' (DPI) Mining Rehabilitation and Environmental Management Process (MREMP) during the life of the mine and until the Mining Lease is relinquished. The results of flora and fauna surveys undertaken by Tronox's contracted ecologist are detailed in reports that are may also be appended to the AEMR.

The EPLs (Table 4) for the Murray Basin mines stipulate that a monitoring and complaints summary be completed for each site as part of Tronox's AR that is completed for each site for each site and supplied to the EPA not later than 60 days after the end of each reporting period (see the EMS for further details). There are no specific monitoring requirements for flora and fauna required to be reported to the EPA as part of the AR but if there are complaints or incidents related to flora and fauna these must be reported.

3.7 Audits of the EMP

Conditions of Approval (see Table 4) for the Murray Basin mines require that Tronox conduct an Independent Environmental Audit every three years or as otherwise directed by the Secretary of the DPIE. Matters to be covered by the Independent Environmental Audit are described the EMS (2015).

Further detail of the how audits of EMPs will be conducted (including internal audits) is provided in the EMS.

3.8 Review and update of EMP

Conditions of Approval (see Table 4) for the Murray Basin mines outline requirements for revision and update of EMPs.

EMPs would be reviewed, and if necessary revised to the satisfaction of the Secretary, within three months of:

(a) the submission of an Annual Environmental Management Report;

(b) the submission of an incident report;

(c) the submission of an Independent Environmental Audit Report;

(d) any modification of the regulatory consent conditions; and

Further details on the requirements for review and update of EMPs are provided in the EMS.

4. Ecological management program

This section details the flora and fauna management strategies (mitigation measures) that will be implemented to minimise short-term and long-term potential impacts on protected and threatened flora and fauna and their habitats.

4.1 Objective

To protect flora and fauna values located within the MLAs, the HARs and ETLs.

4.2 Performance standard

Tronox will comply and document adherence to the specific requirements of:

- The Vegetation Clearance Protocol;
- Threatened Species Management Protocol; and
- Permits and licenses for flora and fauna management.

4.3 Mitigation measures

Tronox will comply and document adherence to the specific requirements of:

- Vegetation Clearance Protocol (Section 4.4 and Appendix J);
- Threatened Species Management Protocol (Section 4.5);
- General flora and fauna management initiatives (Section 4.7); and
- Summary of mitigation measures contained in other related management plans (Section 5.4).

4.4 Vegetation Clearance Protocol

A fully updated and revised Vegetation Clearance Protocol has been developed in September 2015 to minimise the impact of vegetation clearance activities at Murray Basin mines on flora and fauna, and in particular threatened species (Figure 13). The protocol is provided in its entirety as a single document in Appendix J, suitable for implementation in the field.

The Vegetation Clearance Protocol is applicable to all native species of flora and fauna, and is focused primarily on threatened species, being those listed under the National *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999* and NSW *Biodiversity and Conservation (BC) Act 2016.*

The most critical factor in the successful implementation of vegetation clearing, and this protocol, is the timing of all activities in order to avoid impacting on breeding populations of threatened bats, reptiles and birds, and minimise impacts and maximise the opportunity for dispersal of these threatened species away from the clearing areas at a time when they are mobile and not hibernating.

The key components of the protocol are:

- Delineation of areas to be cleared of native remnant vegetation;
- Pre-clearance targeted surveys for threatened flora and fauna;
    - Targeted threatened flora surveys and mitigation measures (Protocol 1);
    - Targeted threatened fauna surveys and mitigation measures:
        - Spinifex dependent fauna (Protocol 2);
        - Hollow bearing and large old tree dependent fauna (Protocol 3);
- Vegetation Clearing Protocol (Protocol 4).
- Fauna management strategies;
- Vegetation clearance.
- Threatened Species Management Protocol; and
- Monitoring.

Information obtained throughout each stage of the Protocol will contribute to the rehabilitation program for the mines.

This protocol is intended as a guide for the vegetation clearance contractor or Tronox operator undertaking clearance activities. The Vegetation Clearance Protocol should be implemented in consultation with a qualified ecologist as required by the Conditions for Approval (Table 5).

Tronox Vegetation Clearance Protocols Requirements

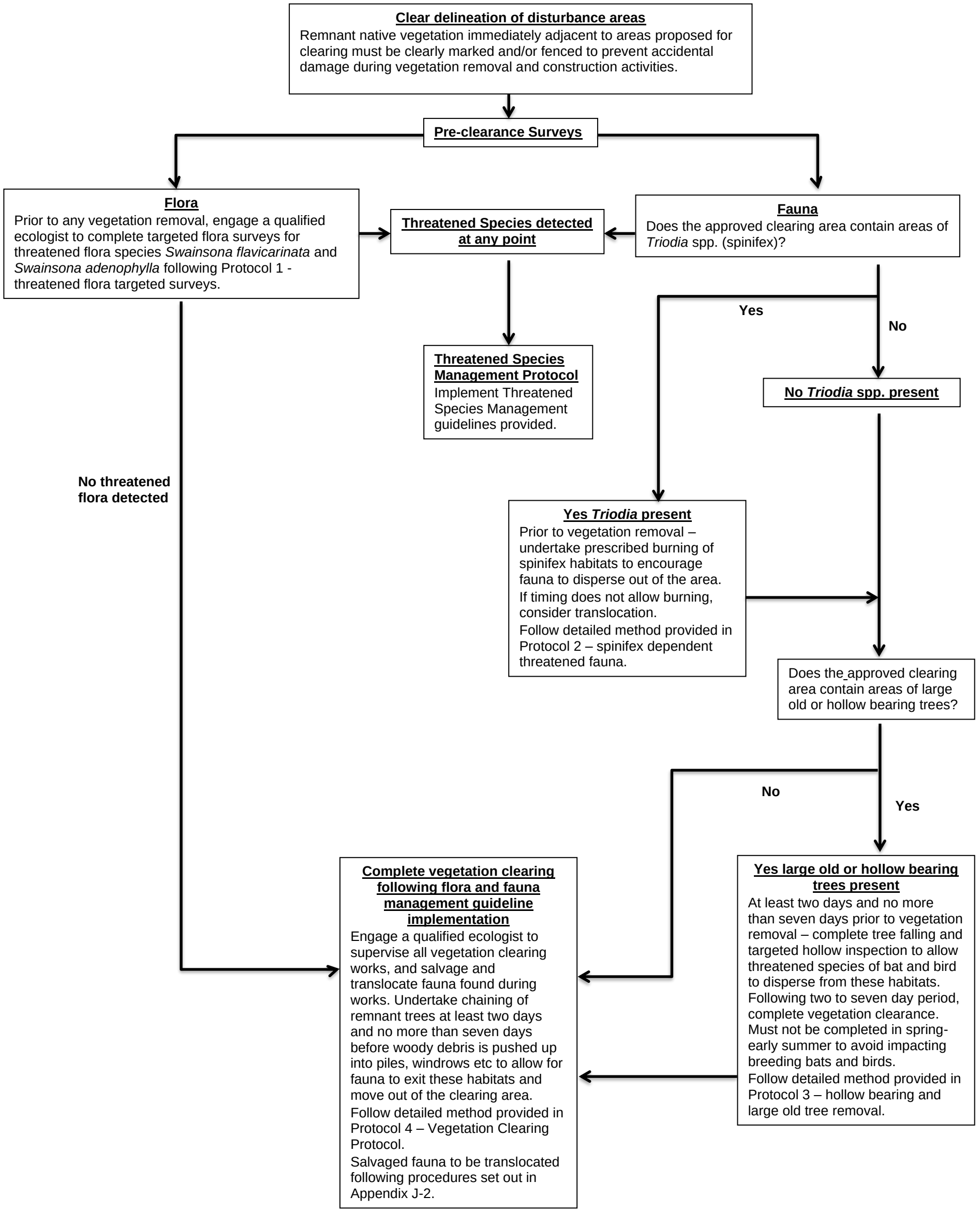


Figure 13 Vegetation Clearance Protocol

4.4.1 Minimising unnecessary clearance of native vegetation through delineation of disturbance areas

This stage of the protocol involves the delineation of areas to be cleared of native remnant vegetation and aims to avoid and unnecessary or unauthorised clearance of native vegetation. The boundary between the proposed clearance area and remnant native vegetation immediately adjoining proposed clearance areas will be clearly marked to prevent accidental damage during vegetation clearance activities or construction works. Protection, where feasible, will extend to all strata and life forms including trees, shrubs, grasses, other herbs and forbs, ground litter, fungi and logs.

To minimise the risk of accidental removal of areas of vegetation to be retained, Tronox also has the following general process in place:

1. Areas to be cleared are to be communicated to the site surveyor and the areas of vegetation to be removed clearly marked and pegged out;
2. A vegetation clearance form is signed by Tronox and the pre-clearance contractor, communicated to the clearing contractor and then kept on file;
3. A site visit is conducted prior to clearing commencing by Tronox's environmental department with the clearing contractor to check all parties are aware of what areas are to be cleared and retained;
4. The process documented in the vegetation clearance protocol is applied (Section 4.4); and
5. Once all steps in the vegetation clearance protocol are completed, clearing commences.

Areas to be delineated as disturbance areas are shown on Figure 3, Figure 4 and Figure 5 for Ginkgo, Figure 7 and Figure 8 for Snapper and Figure 10 for Crayfish. These figures also show the location of the vegetation communities which will not be cleared (which fall outside the MLAs). Note that vegetation clearance for Ginko and Snapper has been completed.

For Crayfish:

- Mallee communities will be cleared within the MLA, and along the infrastructure corridor alignment (all within ML1504);
- Belah woodland communities will be cleared within the MLA, and along the infrastructure corridor alignment (all within ML1504);
- Riverine woodland will be cleared within the MLA, and along the infrastructure corridor alignment (all within ML1504);
- Shrubland and Grassland will be cleared within the MLA, and along the infrastructure corridor alignment (all within ML1504).

4.4.2 Pre-clearance surveys for flora and fauna

Protocol 1– Targeted threatened flora surveys

Targeted surveys for threatened flora species Violet Swainson-Pea (*Swainsona adenophylla*) and Yellow-Keeled Swainsona (*Swainsona flavicarinata*) are required, as per the approval for Crayfish. Although these species appear in the conditions, neither species has been detected in the area. Suitable habitat for both species does not present in the impact area. *S. adenophylla* in particular is considered highly unlikely to occur in the area, with just one previous record from NSW.

Surveys must be carried out by a suitably qualified ecologist, at least one week prior to the commencement of vegetation removal, to allow detection and documentation of these, or potentially other threatened flora species, and possible translocation of individuals to a suitable area following consultation with the NSW DPIE Biodiversity Conservation Division (BCD). If either of these or other threatened flora species are recorded, details including population size will be submitted to the Atlas of NSW Wildlife.

Targeted survey would include random meander transects through potential habitat for these species.

A more detailed flora translocation procedure will be developed in consultation with BCD in the highly unlikely even that either of these species are found on site. This procedure will vary depending upon the species detected during pre-clearance threatened flora surveys, and would follow other similar translocation management plans for these or similar species produced previously, with individuals photographed, location recorded with GPS, and details documented and submitted to BCD.

Target Flora Species:

Violet Swainson-Pea (*Swainsona adenophylla*) NSW BC Act – Endangered

A slender perennial forb to 30 cm high, the plant is distinguished by the swollen leaflets and conspicuous glands. Flowers purple or pink, pea-like, 6-9 mm long.

Distribution: This species is most widespread in central South Australia, with records from one location in both New South Wales and Victoria. Collected in 1979 from Barmah State Forest, near Echuca, in Victoria but not located since. In NSW it is known from one collection in Kinchega National Park, south west of Menindee, where it was described as 'common'.

Habitat and ecology: Grows on red sandy or stony flats, especially near lake margins. Associated species in South Australia include *Eucalyptus microtheca* and *Acacia* species. The records from Victoria were on higher River Red Gum (*Eucalyptus camaldulensis*) terraces, well away from the main river channel. Flowering period is June to September (or summer after good rains). Most *Swainsona* species are erratic in occurrence, carpeting the landscape after significant rain in areas of low and irregular rainfall.

Yellow-Keeled Swainsona (*Swainsona flavicarinata*) NSW BC Act Endangered

A greyish-green forb to about 45 cm high, with pea-like flowers, purple, red or pink with a greenish-yellow keel. Pod 10-15 mm long, softly downy.

Distribution: Not common in NSW, having an outlier population in the Broken Hill-Menindee district in the far western plains. More common in the southern parts of the NT and inland SA.

Habitat and ecology: Grows in deep red sand, recorded from a roadside on a treeless plain in NSW. In central Australia, the species grows in Mulga communities on red earths and on stony soils supporting Bladder Saltbush. Also found on sandy plains and ridges, in grassland, and in watercourses and floodplains near creeks or rock holes. Associated species include *Acacia*

murrayana, *A. aneura*, *Maireana aphylla*, *Atriplex vesicaria*, *Triodia*, *Solanum* and *Euphorbia* spp. Flowers from June to October. Recorded infrequent to locally common in populations.

Protocol 2 Spinifex dependent fauna

This protocol aims to minimise impacts from vegetation clearance to threatened fauna species including Marble-faced Delma (*Delma australis*) and Western Blue-tongue Lizard (*Tiliqua occipitalis*), which rely on spinifex habitats for their survival.

Where areas of *Triodia* spp. (spinifex) cover is found, Tronox will endeavor to complete slow, cool, fuel-reduction burns. These burns will be conducted in autumn, outside of the main breeding season for birds, bats and reptiles, but while conditions allow movement of these species before winter hibernation begins. If this is not possible, spring may be suitable depending on temperature and wind conditions. Fire weather conditions will also be a critical factor to allow the removal of ground and spinifex habitats, encouraging the dispersal of these threatened species out of the impact area and into the adjoining areas of remnant native vegetation.

During the process of undertaking the controlled burn, an appropriately qualified ecologist should be engaged to oversee and where necessary capture and translocate fauna which does not or is unable to disperse themselves or is injured. Capture and translocation of all animals will follow the translocation protocol outlined in Appendix J2.

If timing and conditions do not allow burning to be carried out, other translocation techniques would be considered, such as targeted trapping, spotlighting, or active observation of the clearing process. Captured animals would be translocated to nearby suitable habitats or to the Offset area, following the translocation protocol outlined in Appendix J2.

Target Fauna Species:

Western Blue-tongued Lizard (*Tiliqua occipitalis*)

Listed as Vulnerable under the NSW BC Act, this species has scattered records across central western and western NSW. It diurnally forages for insects, snails, native vegetation and carrion.

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. Preferred vegetation type appears to be mixed mallee/*Triodia* communities. Terrestrial, and known to utilise rabbit warrens for shelter.

Marble-faced Delma (*Delma australis*)

The Marble-faced Delma is listed as Endangered under the NSW BC Act, and is also known as the Southern Legless Lizard is a slender pygopid (legless lizard) that has an average snout-vent length of about nine centimeters, with the tail twice as long as the body. It is brown to reddish brown above, while the undersurface and lips are off-white or greyish. The top and sides of the head, throat and ventral surface is covered in vertical black bars, while the snout is short and rounded.

This species is widely distributed from Western Australia, through much of South Australia extending in to the southern Northern Territory and in north western Victoria and south western NSW. In NSW, most records are either from the Scotia mallee west of the Darling River in the far south west or from the central Murray centered on Round Hill and Nombinnie Nature Reserves. Recent surveys have detected this species east of the Darling River to the north of Wentworth and, more surprisingly, in spinifex occurring on rocky hillsides to the north west of Broken Hill.

In NSW this species appears to be restricted to temperate mallee woodlands or spinifex grasslands but elsewhere is also found in chenopod shrublands, heathlands and buloke associated with mallee habitats or eucalypt lined watercourses. The species occupies areas with a sandy substrate but may also utilise cracking red loam soils, but has also recently been recorded in spinifex on rocky hillsides. Found in deep leaf litter, under rocks, logs, fallen timber or in grass clumps such as spinifex. They are considered to be terrestrial although they may climb into hummock grass and even sleep in the branches of small shrubs. They are generally active during the day but have been observed being active at night or around sunrise and sunset. They are active hunters and their main food consists of various types of insects and spiders. Lays two eggs in November or December which hatch after approximately 70 days.

Other potential spinifex dependent threatened fauna that may occur include Southern Ningaui (*Ningaui yvonneae*) listed as Vulnerable under the NSW BC Act, Mallee Slender Blue-tongue Lizard (*Cyclodomorphus melanops elongatus*) listed as Endangered under the NSW BC Act, and Jewelled Gecko (*Strophurus elderi*) listed as Vulnerable under the NSW BC Act.

Figure 14 Marble-faced Delma (*Delma australis*), trapped in western NSW, 2014.

Figure 15 Western Blue-tongued Lizard (*Tiliqua occipitalis*), observed in Western NSW, 2011.

Figure 16 Jewelled Gecko (*Strophurus elderi*) trapped in western NSW, 2014.

Figure 17 Southern Ningaui (*Ningaui yvonneae*) trapped in western NSW, 2014.

Figure 18 Mallee Slender Blue-tongue Lizard (*Cyclodomorphus melanops elongatus*) trapped in western NSW, 2006.

Protocol 3 Hollow bearing and large old tree dependent fauna

A number of threatened fauna species which are reliant on large old and hollow-bearing trees either as refuge or for breeding purposes, are likely to occur in the vegetation clearing areas. Large old trees provide critical habitat in the form of hollows, deep cracks and crevices, and accumulations of loose bark which are used as roosting and breeding sites for a range of species of native microbats and birds. The size of tree, typically measured as diameter at breast height (DBH), at which hollows, cracks and crevices are likely to form, varies greatly between tree species, but is likely in mallee eucalypts over 15cm DBH, Black Box (*Eucalyptus largiflorens*) over 40cm DBH, and Belah (*Casuarina pauper*) over 40cm DBH (taken from Victorian EVC benchmarks for 'large old trees' in neighboring Murray Mallee bioregion, part of the same Murray Darling Depression IBRA region).

Prior to any vegetation and habitat removal, Protocol 3 - Hollow bearing and large old tree dependent fauna will be implemented for trees equal to or greater than the DBH benchmarks mentioned above. This aims to minimise direct impacts and mortality to threatened fauna species including: Little Pied Bat (*Chalinolobus picatus*), Inland Forest Bat (*Vespadelus baverstocki*), Corben's Long-eared Bat (*Nyctophilus corbeni*) and Major Mitchell's Cockatoo, (*Lophochroa leadbeateri*), by removing key habitat features and encouraging their dispersal out of the development area.

A major factor in the successful mitigation of impacts on threatened species from the clearing of hollow bearing and large old trees is the timing of these works. It is critical that clearing of hollow bearing and large old trees must not be completed between spring and early summer (September to January inclusive) to avoid impacting on threatened species of breeding bats and birds that are likely to be using these habitats. Hollow bearing and large old trees should not be fallen in winter (June-August inclusive), when bats may be hibernating and have greater difficulty moving to neighboring areas.

Previous pre-clearance surveys of remnant vegetation at the nearby Snapper mine site involved the thorough assessment of all trees on site (primarily Belah (*Casuarina pauper*)), targeting threatened bats in particular. During three surveys, 2,492 trees were assessed, with a total of 270 bats recorded in 128 trees, averaging a bat tree encounter rate of 5.1% (Ogyris 2013, 2014a, 2014b). Of the 270 bats recorded in fallen trees, 12 were threatened species, and of these, two mortalities of threatened species were recorded, of a total of 5 bat mortalities. This represents a residency rate of 0.5% and a mortality rate of 0.08% for threatened hollow dependent bat species. The low residency and mortality rates of bats in fallen trees suggests that the need to comprehensively examine each fallen tree is unlikely to be necessary or an effective mitigation measure, and that provided trees are fallen and left *in situ* for a sufficient period, resident animals should disperse of their own accord. The impacts to threatened bat species is likely to be minimal, as animals will be highly unlikely to return to hollows in fallen trees, and will move to neighboring areas of habitat.

Within the Crayfish site, the abundance of large old trees including Belah, Black Box and mallee appears less than previous areas that have been cleared. However, the Crayfish site generally appears to support smaller trees predominantly comprised of mallee, many of which appear to contain smaller hollows, but this is widespread across the site thus requiring a broader approach to pre-clearance rather than the inspection of every tree and associated hollows.

Clearing of large old trees will ideally involve the falling of these trees by chainsaw, as opposed to by chaining, which is more destructive to the trees and hollows, and more likely to cause direct mortality to resident fauna. Areas of hollow bearing and large old tree are relatively small, and could easily be targeted for falling by chainsaw, a few days before remaining trees are fallen by chaining.

Clearing of trees, both hollow bearing and large old trees, and areas of smaller trees, must be completed two to five days immediately prior to the further clearance of remaining vegetation (i.e. pushing vegetation into heaps and windrows) to allow time for fauna to vacate these habitats, but not left for so long that other fauna may re-colonise them.

During the conduct of tree clearing, an appropriately qualified ecologist should be engaged to oversee and where necessary capture and translocate fauna which does not or is unable to disperse themselves, or is injured. Capture and translocation of all animals will follow the translocation protocol outlined in Appendix J2.

Target Fauna Species:

Bolam's Mouse (*Pseudomys bolami*)

Listed as Endangered under the NSW BC Act

Bolam's Mouse is a small rodect wighing between 9 and 21 grams. The head and body length is between 50 – 80 mm and tail length 71 – 103 mm. The fur is a dull amber-brown to olive-brown with dark tips above, and white below. It has large ears and hind feet and a long, heavily furred tail.

Distribution: Bolam's Mouse is found in southern Western Australia and South Australia, extending east into the south-western corner of NSW.

Habitat and Ecology: This species occurs in a chenopd shrubland plains or low mallee woodland where there is a developed understorey of *Acacia, Dodonaea* or *Eremophila* species. It tends to favour plains areas, spillways and along valley bottoms where loam or clay soils occur. Bolam's Mouse is a nocturnal species and utilised burrows for shelter. Diet consists of seeds, fruits, blossoms, grasses and herbs as well as invertebrates such as beetles and spiders. Breeding usisally occurs in spring and early summer with a maximum litter size of six.

Figure 19 Bolam's Mouse (*Pseudomys Bolami*)

Little Pied Bat (*Chalinolobus picatus*)

Listed as Vulnerable under the NSW BC Act.

The Little Pied Bat is a distinctive black and white bat that weighs four to eight grams. The head and body are about 4.5 cm in length; the tail 3.5 cm. The fur is glossy black on the back, grey on the belly, with white fur along the flanks forming a 'V' in the pubic area.

Distribution: The Little-Pied Bat is found in inland Queensland and NSW (including Western Plains and slopes) extending slightly into South Australia and Victoria.

Habitat and ecology: This species occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest and mallee and Bimbil box woodlands. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. Can tolerate high temperatures and dryness but need access to nearby open water. Feeds on moths and possibly other flying invertebrates.

Inland Forest Bat (*Vespadelus baverstocki*)

Listed as Vulnerable under the NSW BC Act.

One of a number of small (3 to 7 grams) insectivorous bats in the genus Vespadelus. It is generally sandy-brown above, with the underparts being paler (cream to pale brown).

Identification is difficult, with overlap in size and fur colouration with some species occurring in the same area, particularly Southern Forest Bat *V. regulus* and Little Forest Bat *V. vulturnus*. These species can be separated by cranial measurements, genetic typing, or for males, glans penis morphology. Identification based on echolocation calls is also difficult, as there is considerable overlap in the frequency of the calls, particularly with the Little Forest Bat.

Distribution: Because of the difficulty of identification, the distribution of this species, particularly in NSW, is very poorly known. Believed to occur widely in all the mainland states, generally in areas with annual rainfall less than 400 millimeters. In Victoria it is confined to the extreme north west. In NSW it has been most regularly captured in the far south west, north from the Murray River to Menindee, and at least as far east as the Balranald-Ivanhoe Road. There is some evidence to suggest that this species also occurs in the central NSW mallee, centered on Nombinnie Nature Reserve, although there has been very little recent survey in this part of the state. There are also records just south of the Queensland border around the Culgoa River, though whether this connects with other NSW populations, or is the southern extent of a northern population is unknown. There are records further east in NSW but the identification of these records have not been confirmed. There are relatively few records of any *Vespadelus* species in the northwest of NSW and so whether this species does occur here is unknown.

Some of the gaps in knowledge on the distribution of this and other bat species in western NSW probably reflects the lack of survey effort in most of this region.

Habitat and ecology: This species is known to roost in tree hollows and abandoned buildings. Known to roost in very small hollows in stunted trees only a few meters high. The habitat requirements of this species are poorly known but it has been recorded from a variety of woodland formations, including Mallee, Mulga and River Red Gum. Most records are from drier woodland habitats with riparian areas inhabited by the Little Forest Bat. However, other habitats may be used for foraging and/or drinking. Colony size ranges from a few individuals to more than sixty. Females congregate to raise young in November and December, with young carried for the first week following birth. Young are independent by January. These bats fly rapidly and cover an extensive foraging area and are presumed to feed on flying insects.

Corben's Long-eared Bat (*Nyctophilus corbeni*) (listed by Commonwealth as Greater Long-eared Bat (*Nyctophilus timoriensis*)

Listed as vulnerable under both the NSW BC Act and EPBC Act

The south eastern form of the Greater Long-eared Bat is also known as Eastern Long-eared Bat and has recently been described as new species Corben's Long-eared Bat (*N. corbeni*). It is

uniformly dark grey-brown. The ears are about 3 cm long and larger than the head. It has a low ridge of skin running between the eyes and across the nose. It has a head and body length of 5

- 7 cm and weighs about 14 grams.

Distribution: Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species.

Habitat and ecology: Inhabits a variety of vegetation types, including mallee, buloke *Allocasuarina leuhmanni* and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices and under loose bark. Slow flying agile bat, utilising the understorey to hunt non-flying prey - especially caterpillars and beetles - and will even hunt on the ground. Mating takes place in autumn with one or two young born in late spring to early summer

Major Mitchell's Cockatoo, (*Lophochroa leadbeateri*)

Listed as Vulnerable under the NSW BC Act.

This unmistakable cockatoo of the dry inland, Major Mitchell's Cockatoo is the only Australian cockatoo that is salmon-pink below and white above. It is also called the Pink Cockatoo, and until recently was listed under the name of *Cacatua leadbeateri*. It is smaller than the Sulphur-crested Cockatoo *C. galerita*, but slightly larger than a Galah *Eolophus roseicapillus*. Its most prominent feature is its large white-tipped crest that is banded in red and gold. Its call is a distinctive stammering whinny.

Distribution: Found across the arid and semi-arid inland, from south-western Queensland south to north-west Victoria, through most of South Australia, north into the south-west Northern Territory and across to the west coast between Shark Bay and about Jurien. In NSW it is found regularly as far east as about Bourke and Griffith, and sporadically further east than that.

Habitat and ecology: Inhabits a wide range of treed and treeless inland habitats, always within easy reach of water. Feeds mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of species of saltbush, wattles and cypress pines. Normally found in pairs or small groups, though flocks of hundreds may be found where food is abundant. Nesting, in tree hollows, occurs throughout the second half of the year; nests are at least 1 km apart, with no more than one pair every 30 square kilometers.

4.4.3 Vegetation Clearing Protocol

Protocol 4 Vegetation clearing

Pre-clearance Flora and Fauna Surveys and Activities

Timing of vegetation clearance and completion of pre-clearance activities is the single most important factor in the mitigation of impacts to threatened species.

Where areas of *Triodia* spp. will be treated with slow, cool, fuel-reduction burns, ideally these burns will be conducted in autumn, outside of the main breeding season for birds, bats and reptiles, but while conditions still allow movement of these species before winter hibernation begins. If this is not possible, spring may be suitable depending on weather conditions. Fire weather conditions will also be a critical factor to allow the removal of ground and spinifex habitats, encouraging the dispersal of these threatened species out of the impact area and into the adjoining areas of remnant native vegetation.

It is also critical to the successful mitigation of impacts from the clearing of hollow bearing and large old trees that clearing must not be undertaken between spring and early summer (September to January inclusive) to avoid impacting on threatened species of breeding bats and birds that are likely to be using these habitats. Hollow bearing and large old trees should also not be fallen in winter (June-August inclusive), when bats may be hibernating and have greater difficulty moving to neighboring areas.

Pre-clearance surveys must be undertaken by suitably qualified ecologists, the 'Project Ecologist', and are to be undertaken in three Stages – Stage 1, will involve fauna pre-clearance surveys when controlled burning of spinifex is completed (possibly weeks or months before stage 2), and while selected large old and hollow bearing trees are felled by chainsaw (beginning 2 to 5 days prior to remaining native vegetation removal. Stage 2 will involve the chaining of vegetation, including most tree removal, a minimum of 2 days but no more than 5 days before the further removal of remaining native vegetation in Stage 3; and Stage 3 will involve the subsequent removal of all remaining native vegetation, for example by pushing of all cleared vegetation into heaps and windrows.

Stage 1 – Flora and fauna pre-clearance survey:

i. Flora and fauna pre-clearance surveys must be completed following the methods and timelines summarised in Protocol 1, 2 and 3. Burning of spinifex would be considered, subject to seasonal requirements, up to 3 years ahead of clearing, as this removal of spinifex habitat will not regenerate in this time, avoiding issues with re-colonisation by fauna. Falling of hollow bearing and large old trees should be completed in the two to five days immediately preceding the clearance of remaining vegetation by chaining to allow fauna to move from the clearance area into the surrounding remnant native vegetation. It is critical that these timelines are followed to allow enough time for fauna to move out of these higher quality habitats, but not so long after that fauna may begin to re-colonise the habitats.

ii. Prior to falling any targeted hollow-bearing trees or logs, a hard object (e.g., hammer, crowbar, excavator bucket – depending on size and strength of tree, limb or log) will be used to knock on the tree, limb or log for a period of 2-3 minutes, to encourage fauna to exit. Sticks, poles or other similar hand-held objects will also be used to hit the trunk of the tree at various points, to encourage animals to vacate the tree;

iii. When targeted hollow-bearing and old trees are being cut down, Project Ecologists will be nearby (but at a safe distance). When the hollow-bearing section is down, and the contractor says that it is safe to proceed, the Project Ecologists will examine the fallen hollow-bearing section for any animals that may be present, and in the case of injured or deceased animals, will apply the capture and removal protocol outlined in Appendix A if necessary;

iv. All hollow-bearing sections are to remain *in situ* for a minimum period of at least 48 hrs (but not more than a period of five days) prior to being moved to the storage area. Allowing the hollow section to remain on the ground for a restricted period will provide fauna the opportunity to vacate of their own accord (e.g. insectivorous bats), and will minimise the risk of subsequent re-colonisation by ground-dwelling fauna. All of these activities would be undertaken in consultation with the Project Ecologist;

v. If threatened species are detected during this process, they will be recorded and reported to BCD, following Appendix A and B;

Stage 2 – Removal of trees and vegetation, primarily by chaining:

vi. Following pre-clearance flora and fauna surveys, when prioritised high quality spinifex areas have been potentially burnt, and prioritised large old and hollow-bearing trees have

been fallen and left in place for a minimum of two and no more than five days (to provide fauna the opportunity to vacate of their own accord, and minimise the risk of subsequent re-colonisation by ground-dwelling fauna), the chaining of vegetation will be completed to lay over all trees and large shrubs. Chaining of vegetation should be done at least two and no more than five days before the final stage 3 of pushing vegetation into heaps and windrows for storage, again to provide fauna the opportunity to vacate of their own accord, and minimise the risk of subsequent re-colonisation by ground-dwelling fauna. An ecologist will be available during this process to capture and salvage any injured fauna that are observed during this process.

Stage 3 – Remove Native Vegetation and pushing into heaps and windrows for storage

vii. Following pre-clearance flora and fauna surveys, and the removal of trees and vegetation, primarily by chaining, at least two and no more than five days should elapse before trees, limbs and logs are pushed into heaps and windrows for storage of woody debris, again providing fauna the opportunity to vacate of their own accord, and minimise the risk of subsequent re-colonisation by ground-dwelling fauna.

Storage and replacement of removed trees, limbs and logs (including hollow bearing)

All cleared woody vegetation and timber (including hollowing bearing trees, logs and limbs) would be stored as follows:

viii. Rootballs, tree trunks and limbs, logs and woody debris greater than 5cm in diameter should be pushed into heaps or windrows and stored, along with topsoil, for later use during the rehabilitation process. Coarse woody debris provides a critical habitat feature to fauna that takes many years to develop in a rehabilitated area from regenerating vegetation, and can assist in reducing soil erosion from wind and water flow.

Pre-works Sites Surveys for Ground-dwelling fauna

ix. Each morning, prior to the commencement of clearing, the ‘clearance area’ will be thoroughly searched by the Project Ecologist for the presence of native fauna;

x. This will include a brief ‘walk-over’ of the site to check for fauna activity. This check will be more focussed at ground-dwelling fauna species that are less mobile, and therefore less able to avoid injury or death during the clearance process;

xi. Captured native fauna will be moved to suitable adjacent habitat using the protocols outlined in Appendix A;

4. Identification of native fauna

xii. The Project Ecologist will be immediately informed of the presence of native fauna in or within close proximity to the vegetation clearance area. The Project Ecologist will determine if the animal is at any risk of injury or mortality from clearing activities;

xiii. If it is determined by the Project Ecologist that none of the construction activities are likely to increase the risk of injury, mortality or stress to the animal, the construction activities can continue and the fauna species will be monitored to make sure it doesn’t enter parts of the clearance area that could potentially result in the injury or death of the animal;

xiv. If the Project Ecologist determines that some or all of the construction activities are likely to increase the risk of injury, mortality or stress to the animal, then the Project Ecologist would ‘capture and translocate’ the animal in accordance with the measures identified in Appendix A. Vegetation clearing activities will be monitored closely to ensure that it does not impact the animal at risk in the time leading up to its capture and removal from site

With all stages of the vegetation clearing process it is important that contractors should not handle any fauna at all, but should contact the Project Ecologist to attend the site and carry out the capture and removal protocols outlined in Appendix J;

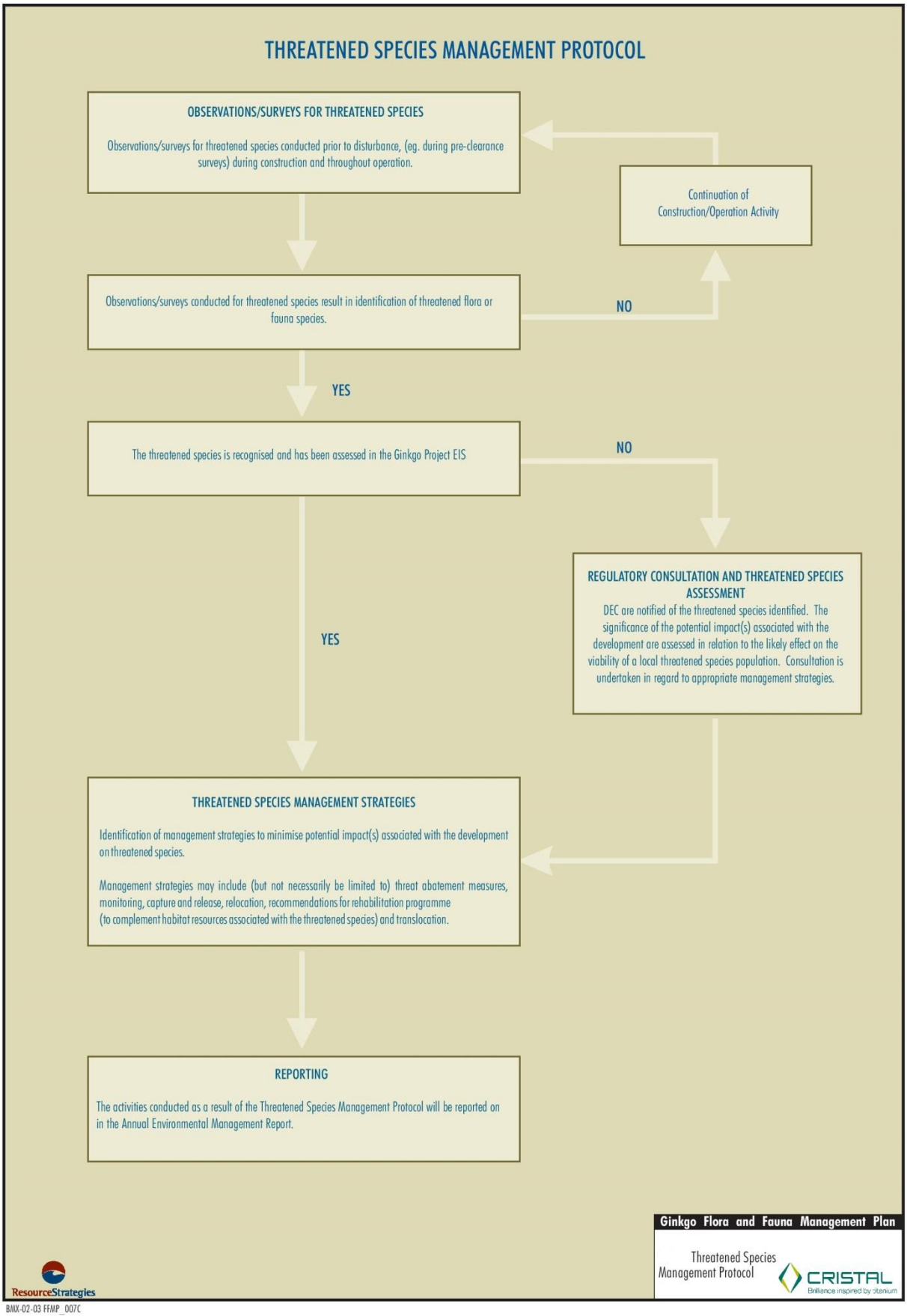


Figure 20 Threatened Species Management Protocol

4.4.4 Fauna management strategies

The principal aims of the fauna management strategies are to minimise the impact of clearing activities on resident fauna. Greater detail on the methods to be used for these fauna management strategies are provided in the vegetation clearance protocol (section 4.4).

Short-term management strategies during vegetation clearance

Short-term management strategies during the vegetation clearance process should include:

- inspection and/or observations to confirm the use of hollows and/or nests as a roosting or nesting resource;
- identification of appropriate timing for the vegetation clearance activities to take place (e.g. outside the breeding season of the species identified, potentially late summer or autumn, as per the vegetation clearance protocol);
- capture and removal of animal(s) to alternative suitable habitat (as per the vegetation clearance protocol);
- in the event that roosting bats are identified, the following options would be considered:
  - cause sufficient physical disturbance to the roost (without damage) to encourage roost members to move to an alternative roost site;
  - as slowly as possible, fell the tree using an excavator and inspect on felling. Capture exiting bats for release that night;
  - relocate the roost to adjacent suitable vegetation.
- modification of the disturbance area (change to construction/operational footprint); and/or
- a combination of the above measures.

Captured fauna will be moved to the nearest vegetation remnant which contains similar habitat, at an appropriate time of day (e.g. night-time for nocturnal species) and during appropriate weather conditions (e.g. not extreme heat or high rainfall).

Long-term management strategies

Long-term management strategies identified to minimise the loss of potential habitat resources include:

- the placement of nest boxes in areas of remnant habitat for birds and arboreal mammals;
- the placement of bat boxes in suitable areas of remnant habitat for bats;
- the relocation of habitat features salvaged from felled trees (eg. branches with hollows) in suitable habitat; and,
- inclusion of indigenous (to the area), hollow-developing tree species in the rehabilitation program.

Following implementation of the appropriate short-term fauna management strategies and identification of appropriate long-term management strategies, vegetation clearance can proceed. The selected fauna management strategies and results of implementation are to be documented in specialist (ecologist) reports which are appended to the AEMR as required.

4.4.5 Vegetation clearance

Where the removal of vegetation is necessary for the development and operation of Murray Basin mines, specific procedures have been developed to maximise the re-use of cleared

vegetative material in the rehabilitation program and to implement efficiency during clearing operations. These are defined in detail in the Vegetation Clearance Protocol in section 4.4.

Specifically, the following vegetation clearance procedures will be employed.

- The delineation of disturbance areas described in Section 4.4.1.
- 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.
- 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 practicable.
- The removal of native vegetation which contains potential roosting/nesting resources for birds, bats and/or arboreal mammals will be conducted outside of breeding/hibernating periods (e.g. for a large number of species late summer/early autumn is the most appropriate).
- The vegetation clearance will be conducted within one week following the fauna habitat assessments to reduce the potential for species to occupy surveyed habitat.
- Habitat trees identified in the habitat assessment will be inspected for fauna immediately prior to and upon felling. The following management options will be implemented for fauna captured during felling:
  - Any injured fauna will be moved away from danger, if safe to do so. Appropriately qualified individuals (ecologists) will assist with the rescue of injured native fauna when available and provide advice regarding native fauna welfare.
  - Depending on the animal, uninjured fauna will either be released into surrounding suitable habitat at the time of capture or a more suitable time (eg. at night for arboreal mammals and bats).
  - In the event a bat roost containing a maternity colony is felled, the following measures are to be conducted:
    - roost and bat fauna collected and temporarily stored in a cool location;
    - roost returned to the location prior to dusk and positioned above the ground with a free fall of approximately 1-3 m;
    - adults and young captured from the roost are to be placed within the roost; and
    - the roost to be checked the following morning for success of adult retrieval of young.
- Cleared vegetation should be used in the rehabilitation program (i.e. for provision of fauna habitat, mulching, and minimisation of soil erosion).
- Any disturbance to stream bank and aquatic vegetation will be conducted in accordance with integrated erosion and sediment control initiatives (detailed in the Erosion and Sediment Control Plan) and relevant statutory conditions. All scrub, undergrowth and timber removed would be burnt or otherwise disposed of (as described above) so that debris cannot be swept back into a stream during a flood.
- Soil resources will be stripped and stockpiled for subsequent use during the rehabilitation program

The management of vegetation throughout the different stages of the Protocol will be documented in the AEMR.

Detailed vegetation clearance schedules are provided in the Ginkgo Mining Operations Plan (MOP) (January 2013 to December 2016) and the Snapper MOP (December 2009 to December 2014). A summary of these vegetation clearance schedules is also provided in the Land Management Plan for the Murray Basin mines.

4.5 Threatened Species Management Protocol (TSMP)

The TSMP has been developed to:

- Facilitate the assessment of threatened species identified during any project activity and not previously assessed by the Ginkgo EIS (Bemax 2001) and Snapper Project EA (Bemax 2007) to minimise impacts on local populations of threatened species from the development; and
- Facilitate the implementation of threatened species management strategies to minimise potential impacts on all threatened flora and fauna species.

The key components of the TSMP are observations/surveys for threatened species, regulatory consultation, threatened species assessment, threatened species management strategies and reporting (Figure 20).

4.5.1 Observations/surveys for threatened species

Observations and/or surveys for threatened species made in the project area and immediate surrounds prior to disturbance, during construction and throughout operation. This stage of the Protocol is facilitated by the pre-clearance surveys and Vegetation Clearance Protocol (Section 4.4) and the flora/fauna monitoring program (Section 5).

In the event that a threatened species previously assessed by EIS and/or EA documentation (i.e. those species listed in Table 9, Table 10, Table 11, Table 12, Table 13, Table 14, Table 16, Table 17, Table 18 and Table 25) is identified within the MLAs, the threatened species management strategies stage of the Protocol is initiated. In the event that a threatened species not previously assessed is identified, the Regulatory Consultation and threatened species assessment stage is initiated. As identified above, consultation with BCD would occur if pre-clearance surveys detect threatened species activities that have been identified as significant by the surveyors, such as maternity roosts of threatened bats.

4.5.2 Regulatory consultation and threatened species assessment

The BCD will be notified in the event that a threatened species not previously assessed by the EIS and/or EA documentation is identified within disturbance areas and/or immediate surrounds.

An assessment will be made of the significance of the potential impact(s) associated with the development in relation to the likely effect on the viability of a local threatened species population. Consultation will be undertaken with the BCD in regard to appropriate management strategies for the species identified.

4.5.3 Threatened species management strategies

Management strategies include (but are not necessarily limited to) threat abatement measures, monitoring, capture and release, relocation, provision of habitat resources in the rehabilitation program and translocation.

Threat abatement

Threat abatement is the implementation of management strategies at the site to alleviate threatening processes that have the potential to prevent the species from persisting at the site. Actions include, however are not necessarily limited to, the modification of disturbance areas and the scheduling of vegetation clearance activities to occur at a particular time (e.g. when hollows are not being utilised as a nesting/roosting resource by the threatened fauna species). Implementation of the vegetation clearance schedule (as provided in the MOPs for Ginkgo, Snapper and Crayfish) will be undertaken where practicable and/or to the extent that the potential for other environmental impacts (e.g. soil erosion resulting from exposed cleared areas) is minimised.

Monitoring

A monitoring program should be established to obtain additional information regarding the species utilisation of the disturbance area, surrounding landscape, and offset area. Additional monitoring programs would be established when appropriate to assess the success of the management strategies implemented as a result of the threatened species management strategies stage of the Protocol.

It is recommended that monitoring for the offset areas follows the same approach employed for monitoring sites that were established in 2007, 2009 and 2011 by the then NSW Department of Natural Resources (now BCD) and Lower Murray Darling Catchment Management Authority in conjunction with GHD as part of the '*Establishing a site-based monitoring programme for threatened fauna in mallee dunefields in the Lower Murray Darling Catchment Management Authority area, south-west NSW'* (DECC, 2008) and also that of DEC 2004 '*Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities, Working Draft*'. Site selection is outlined in detail in these report, but follows the principles of:

- Sampling sites located away from disturbance factors such as roads and fences;
- Sites located a minimum of approximately 1.5 km from artificial watering points;
- Treatment and control sites located at a similar distance from the nearest watering point;
- The treatment and control sites located in the same vegetation community and similar vegetation structure; and
- The treatment and control sites located in the same landform type and soil type.

These principles when applied correctly, result in the establishment of effective control sites experiencing as similar as possible climatic and ecological conditions as the treatment sites.

For the monitoring and management of the Bolam's Mouse, Marble-faced Delma and Western Bluetongue Lizard, discussions with BCD have indicated that monitoring both within the offset area (refer to the Offset Management Plan) and suitable habitat within the general proximity of the existing Crayfish mining lease and Snapper mining lease (Bolam's Mouse only) will be required. Employing the approach outlined above would address a number of objectives for the offset plan as it would both:

- Allow for the monitoring of the condition of the offset reserve via the establishment of both 'treatment' (sites within the offset) and 'control' sites within similar habitats in the general area;
- Monitor the population of Bolam's Mouse/ Marble-faced Delma/Western Bluetongue Lizard both within and outside of the relevant offset areas as per conditions of approval.

Following this recommended approach, ten 'treatment' sites would be permanently established within the offset area. Five 'control' sites would established for monitoring of Bolam's Mouse

within suitable habitat within the vicinity of the Snapper mine offset and the Crayfish mineral lease/offset area in high quality Belah-Rosewood habitats observed in the vicinity of both areas. An additional five 'control' sites would be established within suitable high quality *Triodia* spp habitat within the vicinity of the Crayfish mineral lease/offset area for the monitoring of Marble-faced Delma and Western Bluetongue Lizard.

Capture and release

This option relates to the release of captured threatened fauna individuals back into the habitat at the point of capture or in suitable nearby habitat. This option would be exercised when it is determined that the area to be disturbed does not represent a significant portion of the habitat and a sufficient buffer can be imposed between the disturbance and the main habitat area.

Capture and release will be undertaken by a qualified ecologist with experience in capture, release and relocation of fauna, following Appendix J for managing captured, injured and deceased animals. The process involves marking up maps and recording GPS locations of identified threatened fauna that require removal followed up by the removal of fauna and the destruction of the habitat feature (for example, knocking over tree hosting a bat) to prevent the return of the species removed prior to vegetation clearance.

Details of survey techniques to be employed are outlined in the Offset Management Plan.

Relocation

In some locations, threatened bat species have been found to utilise a network of roosts, rather than being fixed to one roost (e.g. the Yellow-bellied Sheathtail Bat in the central west of New South Wales). Hence, there is the potential to relocate known roosts to nearby suitable vegetation, when the roost is unoccupied by the threatened species.

As for capture and release above, relocation will be undertaken by the qualified contracted by Tronox. The contractor must maintain and implement a procedure for the steps involved in the capture, release and relocation of fauna, following Appendix J for managing captured, injured and deceased animals.

Provision of habitat in the rehabilitation program

This management option allows for the provision of habitat resources, for a specific threatened species, to be included in the rehabilitation program. Management measures 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.

The environmental department (Senior Rehabilitation Officer and the Environmental Officer) are responsible for organising the provision of additional habitat resources as determined necessary through consultation with the qualified ecologist and/or government departments.

Translocation

The translocation of any threatened flora and fauna species will be conducted in accordance with the Vegetation Clearing Protocol, and the guidelines provided in Appendix J, which includes:

- NSW Code of practice for injured sick and orphaned protected fauna;
- NPWS (2001b) Policy for the Translocation of Threatened Fauna in NSW;
- Australian Network for Plant Conservation (ANPC) (2004) Guidelines for the Translocation of Threatened Plants in Australia;
- IUCN (1987) Position Statement on Translocation of Living Organisms; and

- IUCN (1998) Guidelines for Re-Introductions.

Table 6 Definitions of 'translocation'

Translocation of Threatened Flora Species (Australian Network for Plant Conservation, 2004)	Translocation of Threatened Fauna Species (NPWS, 2001b)
Translocation: is the deliberate transfer of plants or regenerative plant material from one place to another, including existing or new sites or those where a taxon is now extinct. There are four types of translocation: Re-stocking: an attempt to increase population size or diversity by adding further individuals to an existing population. Re-introduction: an attempt to establish a population in a site where it formerly occurred, but where it can now reasonably be held to be extinct. Introduction: an attempt to establish a population in a site where it is not known either to occur now or to have occurred in historical times, but which is within the known distribution range and habitat type of the taxon. Conservation introduction: an attempt to establish a taxon, for the purpose of conservation, in an area that is outside the known distribution range of the taxon, but which is an appropriate habitat for the taxon.	Translocation: is the movement of living organisms from one area with free release in another. There are three types of translocation: Introduction: the release of an organism outside its historically known range. Re-introduction: the release of an organism into part of its historically known range from which it has become extinct. Supplementation: addition of individuals to an existing population of the same species.

The translocation process involves the following components:

- *Feasibility Assessment* - including a biological and ecological assessment of the species, an environmental assessment of the translocation site and a logistical assessment. This assessment will be conducted prior to the threatened species being translocated.
- *Translocation Protocol* consisting of:
  - *Translocation Proposal* - to be prepared utilising the information obtained by the feasibility assessment and submitted to the NPWS for approval. The Translocation Proposal will be prepared in accordance with the NPWS (2001c) *Guidelines for the Contents of a Translocation Proposal*.
  - *Pre-translocation Preparation* – the implementation of actions outlined in the Translocation Proposal required prior to translocation of the species (eg. marking out boundaries of the translocation habitat for flora species, experimental trials, appropriate regeneration/restoration of habitat and amelioration or removal of uncontrolled threats).
  - *Translocation* – implementation of the translocation program to suitable, secure areas as close as possible to their point of origin.
  - *Post-translocation* – short-term and long-term management, as well as monitoring and evaluation programs.

All stages of the translocation process are documented.

4.6 Monitoring and Reporting

The activities conducted as a result of the TSMP are reported in the AEMR, and for native flora and fauna as described in Appendix J.

4.7 General flora and fauna management

Strategies to manage the impact of surface water management, erosion and sediment control and flooding mitigation measures (including heavy machinery impacts) on flora and fauna are inherent within the vegetation clearance and threatened species management protocols described in Section 4.4 and Section 4.5.

4.7.1 Protection of land and water resources

Potential land contamination risks identified that have potential to directly impact biodiversity include spills associated with diesel and lubricant transport, storage and usage, and from spills or leakages of saline sand residues or groundwater.

Potential impacts of the development on surface water systems are limited due to the location of the mine site away from any surface water systems. The Darling River and Great Darling Anabranch are large regional surface water features which, at their closest points, are located some 20 km north-east and 20 km north-west of the mine site, respectively. There are no well-defined drainage channels within the mine area or surrounds. Some overland flow does occur during prolonged rainfall events and surface waters accumulate in topographic depressions and then evaporate or seep to the groundwater table over time.

Details of measures to minimise the potential for land and water contamination are outlined in the:

- Mining Operations Plans (MOP for Ginkgo, Snapper and Crayfish),
- Murray Basin Mines Integrated Water, Erosion and Sediment Control Plan (WESCP) and
- Murray Basin Mines Waste Management Plan (WLMP).

4.7.2 Vehicular traffic management and culverts

The movement of vehicles associated with the Murray Basin mines has the potential to increase the incidence of fauna mortality via vehicular strike. To reduce this potential, the number of roads constructed has been minimised, employees and contractors will be instructed to only use designated roads, speed limits will be imposed on vehicles using designated roads (such as the HAR) and tracks, and signposting will be installed to remind personnel of the danger of vehicles to wildlife. Vehicle speed will be restricted to 50 km/h on all roads inside the MLA and on the HAR at the Great Darling Anabranch crossing.

A speed limit of 60 km/h will be imposed when water ponds within low-lying areas at HAR culverts. These areas coincide with potential breeding habitat for the Painted Burrowing Frog (*Neobatrachus pictus*). Culvert construction will therefore reduce the potential for vehicle strike of the Painted Burrowing Frog as well as other amphibians, mammals and reptiles.

Culvert designs along the HAR incorporate typical hydrological design principles and fauna considerations, or fauna considerations only.

Further details on how traffic is managed are included in the Murray Basin Traffic Management Plan and Code of Conduct.

Drainage culverts

Typical hydrological design principles include rainfall event annual recurrence intervals and rainfall frequency duration considerations. Maintaining drainage flows through the installation of drainage culverts allows the movement of free water beneath the HAR and provides an avenue for the movement of the Painted Burrowing Frog beneath the HAR during breeding. The culverts also provide an avenue for movement of other small mammals and reptiles beneath the HAR. A conceptual design of drainage culverts is shown on Figure 12.

Monitoring the use of these culverts by the Painted Burrowing Frog and other mammals and reptiles is discussed in Section 0.

Culverts for fauna use

Where road design requirements do not necessitate the installation of drainage culverts, culverts specifically designed to facilitate the movement of reptiles, amphibians and mammals will be installed. A conceptual design of a culvert (or tunnel) for fauna use is shown on Figure 14.

Monitoring the use of these culverts by amphibians, and small mammals and reptiles is discussed in Section 0.

4.7.3 Management of permanent and temporary open excavations

To minimise the potential for native fauna to become trapped in holes in the ground (e.g. open bore holes used for groundwater monitoring and holes excavated for the ETL poles), the holes will be capped and/or temporarily covered when appropriate whilst under construction.

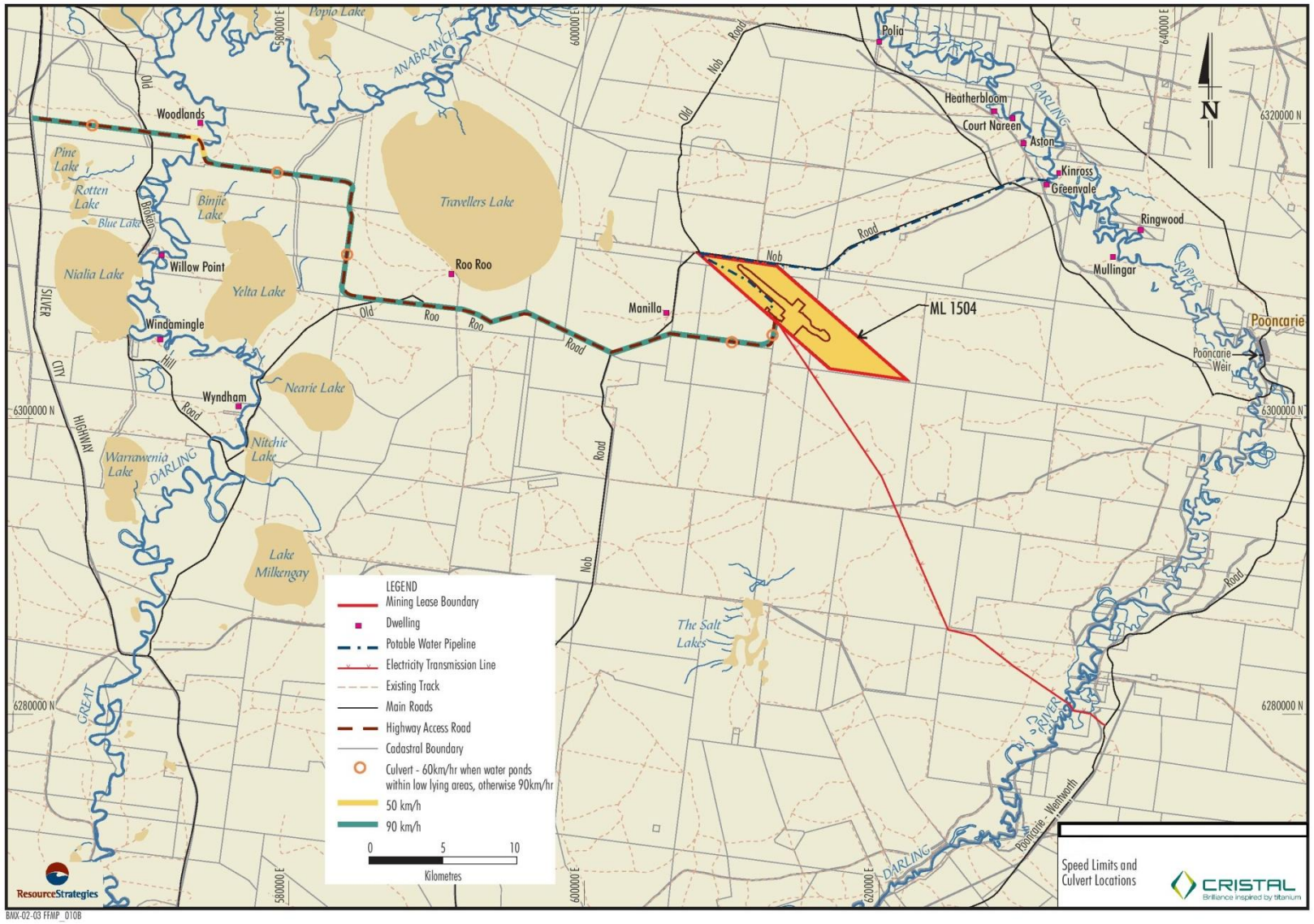


Figure 21 Vehicle speed limits and culvert locations

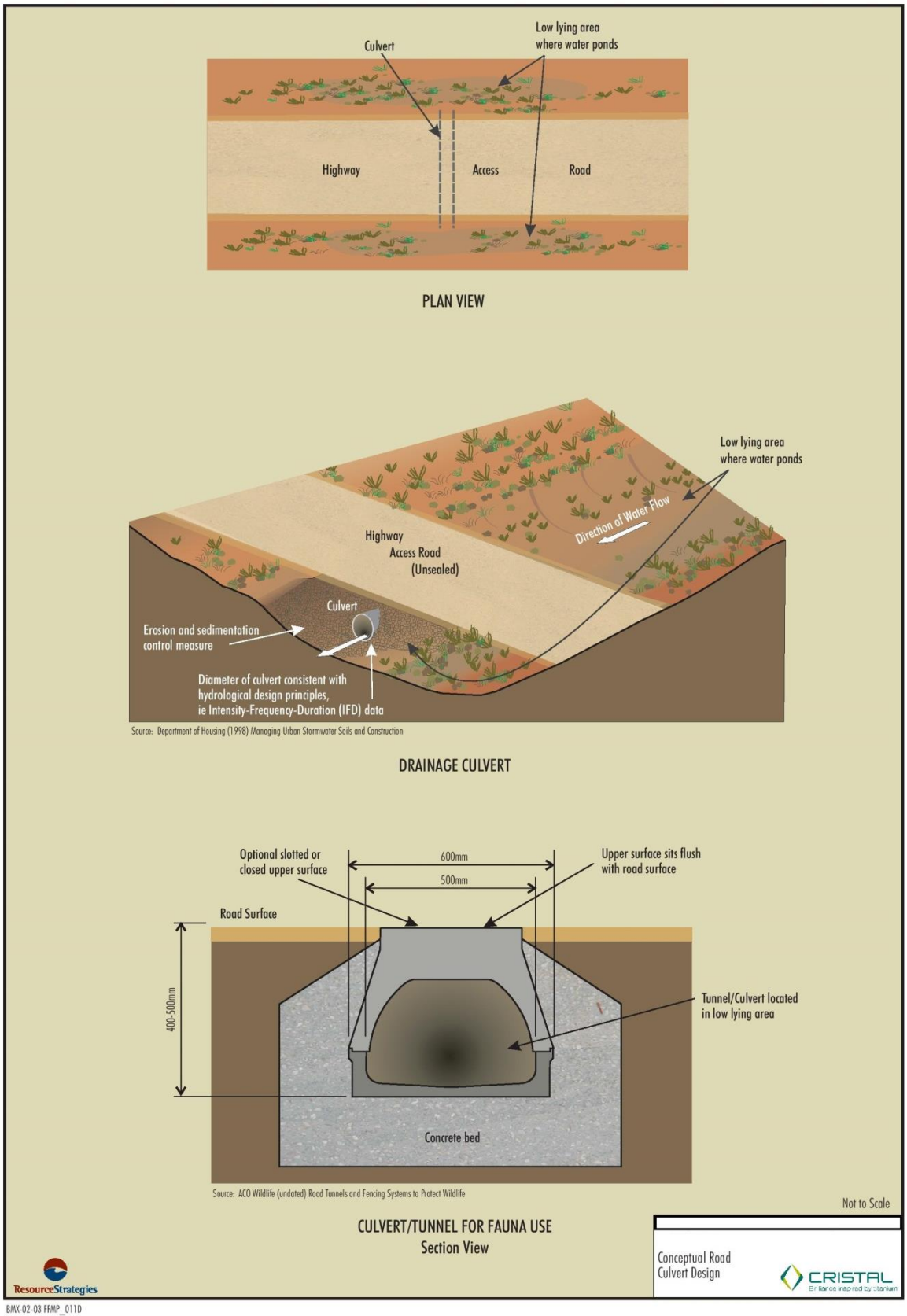


Figure 22 Conceptual culvert design

4.7.5 Project waterbody inspections

Large waterbodies including those that are man-made (i.e., dredge ponds and water dam) can attract wildlife. The start-up dams at Ginkgo and Snapper (including the initial water dam at Ginkgo) have been decommissioned and therefore are no longer subject to project waterbody inspections. The dredge ponds for each of Ginkgo and Snapper are located generally at the same level as the groundwater table (average depth of 40 m below ground level) and provide sufficient freeboard for the dredge and floating plant. The water quality of the dredge ponds is saline with total dissolved solids levels of 42,000 to 47,000 mg/L (comparable to seawater).

It considered highly unlikely that Painted Burrowing Frog individuals will colonise the dredge ponds due to predominantly dry conditions and the level of activity generated by works around the pond (24 hours per day), however, a conservative monitoring approach has been adopted. The dredge ponds and immediate surrounds are inspected regularly to monitor usage by fauna, including Painted Burrowing Frog. Inspections will be conducted at night (the Painted Burrowing Frog is a nocturnal species). Fauna utilisation of the dredge ponds is reported in the AEMR and BCD will be notified of any threatened species listed in the *Biodiversity and Conservation Act 2016* (BC Act) observed using the dredge ponds.

4.8 Mitigation measures relevant to flora and fauna detailed in other management plans

The Conditions of Approval for flora and fauna management (Table 5) list a range of requirements to minimise risks to flora and fauna. Some of these requirements are covered in other environmental management plans maintained by Tronox and are therefore not duplicated here. A summary of which plans cover each of these requirements is provided in Table 7. The five plans that cover aspects of environmental management relevant to flora and fauna management include:

- Mining Operations Plan (MOP) – mining, processing and rehabilitation operations including details on the areas of disturbance, mining and rehabilitation methods and rehabilitation schedules. There is a separate MOP for each of Snapper, Ginkgo and Crayfish. There is no IMRP for Snapper or Crayfish so additional detail on the revegetation methods that is included in the Ginkgo IMRP is generally covered in the MOP for Snapper and Crayfish.
- Land Management Plan (LMP) – Pastures and remnant vegetation management, prevention and rehabilitation of land degradation, control of weed infestation, livestock access management, eradication of vermin and noxious weeds and feral animal control.
- Water Management Plan (WMP) – including control of soil erosion and sedimentation generated from areas disturbed by mining, water quality management (including salinization), and containment of contaminated water.
- Offset Management Plan (OMP) – enhancement of native vegetation structure and flora and fauna habitats in areas secured as offset areas. Includes management measures specifically conducted in the offset area including stock control, feral animal control, threatened species management, and monitoring to show changes and improvement. Generally a stand-alone plan related to the management of offset areas. The controls in this flora and flora plan generally relate to areas cleared for mining activities and progressively rehabilitated.

Table 7 Environmental mitigation measures required by consent conditions covered in other Tronox environmental management plans

Requirement for management	Condition of Approval (Table 4)	Murray Basin mine management plan
Reconstruction of native bushland (revegetation/rehabilitation).	Ginkgo DA, Schedule 2, Condition 3.4.1 (a) (ii).	Mining Operation Plan (MOP)
Feral animal control.	Ginkgo DA, Schedule 2, Condition 3.4.1 (a) (ii), (iii) and (f) xi. Snapper DA, Schedule 3, Condition 16 (c).	Land Management Plan (LMP) Offset Management Plan (OMP)
Fencing of reconstructed/rehabilitated native bushland.	Ginkgo DA, Schedule 2, 3.4.1(a)(ii) and (f) xiii.	LMP, OMP
Surface water control in reconstructed areas (erosion and sediment control).	Ginkgo DA, Schedule 2, 3.4.1(a) (ii).	Water, Erosion and Sediment Control Plan (WESCP)
Weed control.	Ginkgo DA, Schedule 2, 3.4.1(a) (ii) and (f) xi. Snapper DA, Schedule 3, Condition 16 (c).	LMP, OMP
Control of stock access and grazing of remnant vegetation and revegetated areas.	Ginkgo DA, Schedule 2, 3.4.1(a)(ii). Snapper DA, Schedule 3, Condition 16 (c).	LMP, OMP
Fire management including bushfires and management of remnant vegetation onsite.	Snapper DA, Schedule 3, Condition 16 (c).	Bushfire Management Plan (BFMP)
Establishment of enhancement techniques for revegetated areas during periods of low or limited rainfall.	Ginkgo DA, Schedule 2, 3.4.1(f) xv.	MOP
Fertiliser application in regenerated/revegetated areas.	Ginkgo DA, Schedule 2, 3.4.1(f) xiv.	MOP
Application of lime/gypsum to control soil pH and improve soils structure in revegetated areas.	Ginkgo DA, Schedule 2, 3.4.1(f)xvi.	MOP (Ginkgo and Snapper)
Replanting of areas where revegetation has been unsatisfactory.	Ginkgo DA, Schedule 2, 3.4.1(f)viii	MOP
Salvage and use of materials from on site for habitat enhancement in reconstructed areas.	Snapper DA, Schedule 3, Condition 16 (c)	MOP
Collection and propagation of seed for rehabilitation.	Snapper DA, Schedule 3, Condition 16 (c)	MOP

5. Monitoring

Post clearance monitoring will focus on areas of surrounding remnant vegetation, and the area of Offset linked to this area of clearing. This monitoring will target Marble–faced Delma and Western Blue-tongue Lizard, as required in the mine approval documents, and as detailed in the Offset Management Plan, which has been prepared as a separate document by Tronox.

Monitoring is focused on detecting improvements to flora, fauna and ecological condition/function of the offset area from baseline levels, and changes to neighboring habitats adjoining the mines.

The monitoring framework detailed in this FFMP for flora and fauna relates to monitoring undertaken to meet the objectives of the rehabilitation program for mined-out areas. Details on the current rehabilitation program are included in the MOP and IMRP for Ginkgo and the MOP for Snapper. In summary, the general objectives of the 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.

This section details monitoring undertaken in rehabilitated areas for flora and fauna and summarises other relevant monitoring undertaken to support the above objectives. Monitoring of the performance of the offset areas is covered in the Offset Management Plan (OMP) and is generally consistent with the approaches outlined here.

5.1 Flora

Throughout mining operations, a number of permanent flora survey quadrats (of varying sizes to survey tree, shrubs and groundcover) have been established in the rehabilitation areas and at control sites to obtain quantitative data on plant species diversity and abundance. The control sites will serve as a reference point against which the rehabilitation areas can be assessed.

Contingency measures for revegetated areas (Section 5.4) will be implemented as a contingency to improve revegetation when monitoring results (from both flora control and revegetation monitoring sites) demonstrate that:

- there is an occurrence of high revegetation stock mortality;
- there is erosion damage to revegetation areas;
- there are detrimental effects to revegetation areas caused by fire;
- there are detrimental effects to revegetation areas caused by pest and weed incidence;
- rainfall is limiting the performance of revegetation areas; and/or
- soil structure/fertility is limiting the performance of revegetation areas;

A number of the disturbance areas will not become available for revegetation until the operations have ceased (i.e. administration and workshop buildings, diesel storage facility, mineral concentrate stockpile platform and process water borefield). Monitoring at this time will include visual monitoring (photo points and assessment of vegetation quadrats established by the contracted ecologist) on a regular basis to ensure vegetation is establishing and to determine the need for any maintenance and/or contingency measures (such as the requirement for supplementary plantings, erosion control and weed control).

In addition to visual monitoring, a number of parameters will be monitored (e.g. species present, relative abundance of each species, dry matter of standing biomass and percent groundcover) prior to lease relinquishment. The specific parameters will be determined in consultation with the relevant regulatory authorities, and in accordance with the Mine Closure Plans and the DPI requirements for mine closure.

5.2 Fauna

Surveys will be conducted to assess the success of the rehabilitation program in providing suitable habitat for a range of vertebrate fauna. Surveys will be conducted to monitor the diversity and abundance of amphibians, reptiles, birds and mammals within the rehabilitation areas and corresponding control (i.e. reference) sites.

To enable the control sites to be compared against the rehabilitation sites, permanent monitoring points, transects and trap lines have been established at the commencement of surveys, for use throughout the life of the mine. Methodology utilised includes:

- Visual and opportunistic observations;
- Active searches;
- Pitfall/funnel traps;
- Nocturnal spotlighting;
- Identification of bird calls (e.g. 20 min, 2 ha bird census);
- Call playback;
- Observations for scats, tracks and nests;
- Identification of amphibian calls;
- Elliott traps; and
- Harp trapping/Anabat (ultrasonic call recording) for microchiropteran bats.

In addition to the above, additional monitoring would be considered to assess the success of specific management measures, such as culverts beneath the HAR and those developed as a component of the TSMP.

The quadrats surveyed each year will be reported in the AEMR and supporting survey reports completed by the contracted ecologist.

5.3 Revegetation

Contingency measures for revegetated areas (Section 5.4) will be implemented to improve revegetation and habitat re-establishment when monitoring results (from both fauna control and revegetation monitoring sites) demonstrate that:

- there is an occurrence of high revegetation stock mortality;
- there is erosion damage to revegetation areas;
- there are detrimental effects to revegetation areas caused by fire;
- there are detrimental effects to revegetation areas caused by pest and weed incidence;
- rainfall is limiting the performance of revegetation areas;
- soil structure/fertility is limiting the performance of revegetation areas;
- detrimental effects on native fauna populations are occurring due to feral animals; and/or
- fencing would benefit the re-establishment of native fauna habitat and their populations.

5.4 Contingency Measures

5.4.1 Threatened Species

As per section 4.5.2, if a threatened species not previously identified during the approval surveys is found onsite, BCD will be notified and measures to determine the impact and mitigate any potential impacts will be undertaken. This is to be conducted by the qualified ecologist contracted by Tronox in conjunction with the BCD office in Buronga, NSW.

5.4.2 Rehabilitation Areas

Contingency measures for revegetated areas will be implemented when results of the monitoring program indicate their requirement to facilitate the objectives of the rehabilitation program. Maintenance measures include but not be limited to:

- Replanting failed or unsatisfactory areas;
- Repairing erosion problems;
- Fire management;
- Pest and weed control;
- Control of feral animal populations;
- Maintain and repair fencing;
- Fertilizer application;
- Establishment of enhancement techniques (e.g. watering) for revegetation areas especially during periods of low or limited rainfall; and
- Application of lime or gypsum to control pH and improve soil structure.

The need for some of the above maintenance measures is determined via the monthly site inspection checklist (erosion, pests and weeds, feral animals). The rest of the above maintenance measures occur on as need basis as noted by the environmental department (primarily the Senior Rehabilitation Officer). If required, Tronox will consult with a restoration ecologist or land management practitioner about effective measures to rectify issues that are impacting on achieving the rehabilitation objectives. BCD would be consulted if this requires changes to management plans. All methods applied will be recorded to identify if they are effective and for future use.

6. Reporting

An AEMR will be prepared for both Ginkgo and Snapper (see Section 3.6).

Tronox's contracted ecologist will prepare reports that detail the results of all flora and fauna surveys undertaken including pre-clearance surveys, surveys of revegetated areas, threatened species surveys and relocation (if required) and offset area surveys, as outlined in Appendix J.

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Appendices

Appendix A Background information – Ginkgo and surrounds

Climate

Ginkgo lies in an arid climatic zone. Rainfall is typically distributed uniformly throughout the year although variability is greater during summer and autumn. The mean annual rainfall recorded at Menindee Post Office (since 1876) (approximately 100 km north of ML 1504) and Lake Victoria Storage (since 1922) (approximately 115 km south-west of ML 1504) is approximately 244 and 264 mm, respectively. The mean annual rainfall recorded at Pooncarie (approximately 40 km east of ML 1504) and rural stations for over 100 years ranged from approximately 255 mm to 266 mm.

Records indicate that January is typically the hottest month and July the coldest. The highest mean daily maximum for January of 34.1 degrees Celsius (^{o}C) and the lowest mean daily minimum for July (4.0 ^{o}C) were recorded at the Menindee Post Office.

Geology and Soils

Ginkgo is located in the Murray Basin, a large sedimentary basin covering some 300,000 km^2 of inland south-eastern Australia and extending across the borders of NSW, Victoria and South Australia.

Within the Murray Basin, sedimentary accumulations of the Early Tertiary to Recent age up to 600 m thick overly a basement of Proterozoic to Mesozoic sediments and granitic rocks.

The three major soil types encountered within ML 1504 are solonised brown soils, calcareous red earths and siliceous sands (based on Stace *et al*., 1968).

Physiography and Land Use

Ginkgo comprises flat to undulating sandplains and dunefields covered by a combination of grassland, low woodland and shrublands. Land use within the Project area is predominantly comprised of pastoral leasehold lands that are used for light intensity rangeland grazing. Ephemeral lakes in the vicinity of the HAR (e.g. Travellers Lake) are used for opportunistic cereal cropping when climatic conditions are suitable.

Ginkgo is located within the lower Darling River system, which extends from the Menindee Lakes to the junction of the Darling River and the Murray River at Wentworth. Also included in the lower Darling River system are numerous ephemeral wetland systems that are linked to the Darling River and the Great Darling Anabranch. As a result of the limited and well dispersed annual rainfall, the sandy soils, limited topographical relief and high evaporation rates, there are no well-defined drainage channels within ML 1504.

Land Systems

A total of ten land systems2 described by Walker (1991) for western NSW occur within the Project area and surrounds. The majority of these are sandplain and dunefield systems dominated by Belah, Rosewood and/or Bluebush vegetation communities. A summary description of each land system located within the Project area is provided in Table 8. The spatial distribution of these land systems is shown on Figure 15

Further to the above, Mount King Ecological Surveys (2001) recognised three broad habitat types within ML 1504, namely:

- Woodland of Belah, Wilga and Rosewood;
- Shrubland and grassland; and
- Mallee.

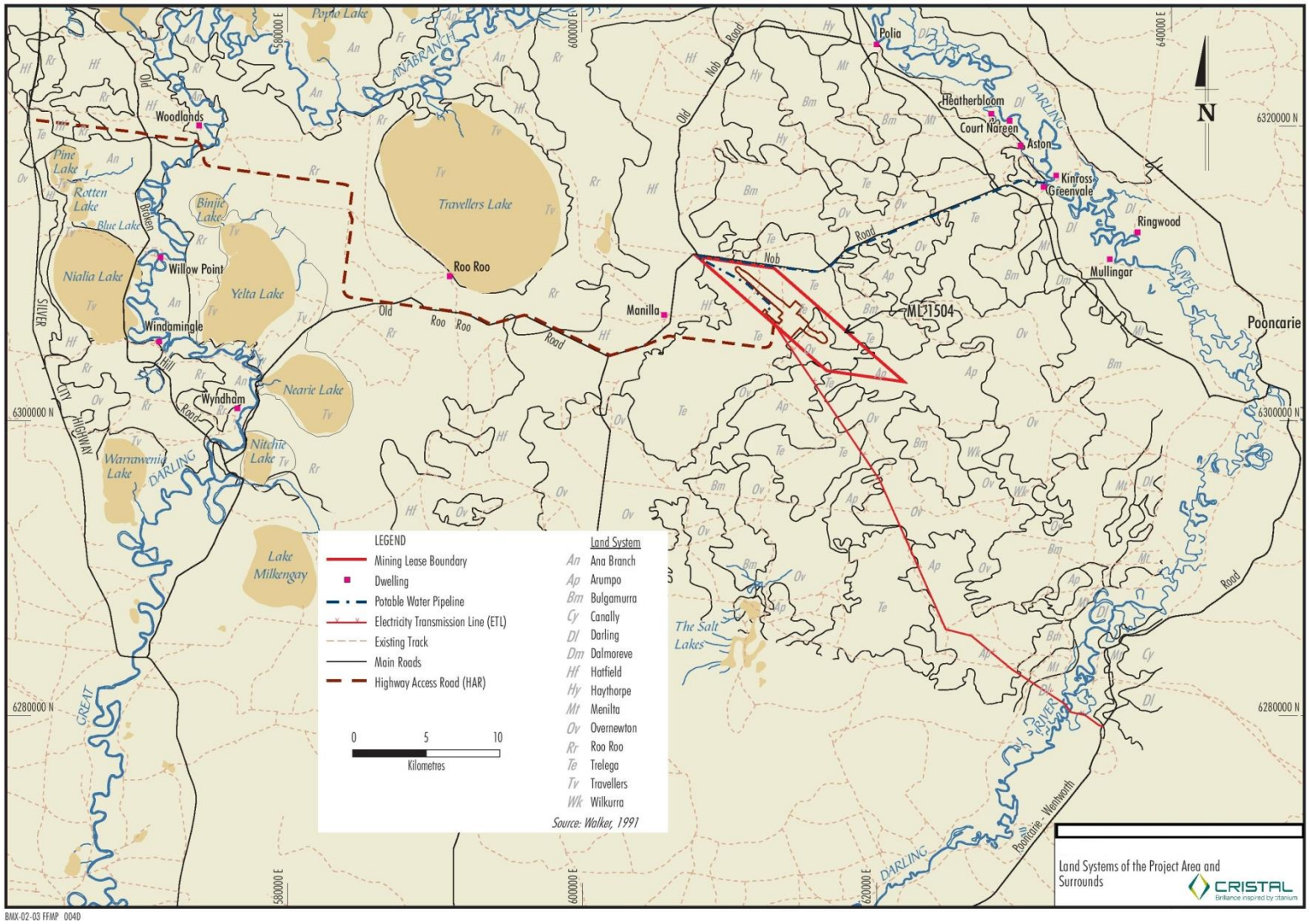

Figure 23 Land systems of Ginkgo, Snapper and Crayfish

Table 8 Summary of land systems of Ginkgo, Snapper and Crayfish

Land System	Description
Arumpo	Parallel dunes and sandplain with narrow calcareous swales. Vegetation/habitat includes dunes with dense mallee and variable spinifex; swales with belah, rosewood and inedible shrubs; variable speargrass, cannon-ball and forbs.
Bulgamurra	Extensive undulating sandplain with dunes and open flats. Vegetation/habitat includes dunes with white cypress pine or mallee and spinifex; areas of edible and inedible shrubs, variable speargrass, copperburrs and forbs; depressions with fringing black box.
Hatfield	Extensive undulating plains with bluebush. Vegetation/habitat includes plains with scattered clumps of rosewood and belah; dunes with clumped white cypress pine, prickly wattle and bluebushes; depressions with nitre goosefoot, blue bush and speargrass.
Overnewton	Extensive open plains. Vegetation/habitat includes sandplain with dense clumps of rosewood and belah; scattered bluebush and inedible shrubs; rises with mallee and white cypress pine and speargrass.
Trelega	Sandplains with belah and bluebush. Vegetation/habitat includes plains and swales with dense belah, scattered rosewood, mallee and wilga, and moderately dense bluebushes; dunes with dense mallee and spinifex, variable speargrass, copperburrs and forbs.
Roo Roo	Undulating plain with rises and depressions, associated with the Anabranch. Vegetation/habitat includes scattered belah and rosewood, dense bluebushes, variable speargrass, copperburrs and annual forbs.
Menilta	Scalded sandplain with unstable dunes adjacent to the Darling River floodplains. Vegetation/habitat includes plains with scattered belah, rosewood and white cypress pine, black box around depressions, scattered black bluebush, variable speargrass, bottlewashers, copperburrs and forbs.
Wilkurra	Level sandplains with belah. Vegetation/habitat includes uniformly dense stands of belah and rosewood, scattered mulga, wilga and inedible shrubs; white cypress pine on sandy rises; variable speargrass, copper burrs and forbs.
Darling	Lower Darling River and floodplain. Vegetation/habitat includes river cooba and river red gum; stands of nitre goosefoot, lignum, cane-grass and narrow-leaf hopbush; abundant annual saltbushes, copperburrs and forbs.
Anabranch	Anabranch of the Darling River. Vegetation/habitat includes scattered to clumped black box and river red gum along channels, river cooba; dense lignum and nitre goosefoot in lower areas; prickly wattle, narrow-leaf hopbush and occasional bluebushes on lunettes; abundant grasses and forbs after flooding.

Threatened Flora

The NSW BCD threatened species database was assessed to provide an indication of threatened flora species which could possibly occur within the project area and surrounds. This database provided a list of species for which further detailed assessment (i.e. Eight Part Tests) of habitat requirements and distribution characteristics was conducted during the EIS. Eight Part Tests of Significance have been considered for 21 threatened flora species known or considered possible occurrences in the Project area or surrounds under Section 5A of the NSW Environmental Planning and Assessment Act, 1979 for the Ginkgo Mineral Sands Project EIS (Orchid Research and Marianne Porteners Environmental Consulting, 2001). The Eight Part Tests determined that no threatened species would be significantly affected by the Project to the extent of undermining the viability of a local population of that species.

Table 9 Threatened flora species with potential habitat components likely to occur at Ginkgo

Scientific Name	Common Name	BC Act, 2016	EPBC Act, 1999
Acacia acanthoclada	Harrow Wattle	E	
Acacia carnei	Purple-wood Wattle	V	V
Acanthocladium dockeri	Spiny Everlasting	PE	
Atriplex infrequens	A Saltbush	V	V
Austrostipa metatoris	A Speargrass	V	V
Brachyscome papillosa	Mossgiel Daisy	V	V
Codonocarpus pyramidalis	Camel Poison	PE	V
Cratystylis conocephala	Bluebush Daisy	E	
Dodonaea stenozyga	Desert Hopbush	E	
Erodiophyllum elderi	Koonamore Daisy	E	
Kippistia suaedifolia	A Daisy	E	
Lasiopetalum behrii	Pink Velvet-bush	E	
Lepidium monoplocoides	Winged Peppercress	E	V
Leptorhynchos waitzia	Button Immortelle	E	
Pimelea serpyllifolia subsp. Serpyllifolia	Thyme Rice-flower	E	
Santalum murrayanum	Bitter Quandong	E	
Solanum karsense	Menindee Nightshade	V	V
Swainsona adenophylla	A Swainson Pea	E	
Swainsona colutoides	A Swainson Pea	E	
Swainsona flavicarinata	A Swainson Pea	E	
Swainsona pyrophila	Yellow Swainson Pea	V	V

Source: Orchid Research and Marianne Porteners Environmental Consulting (2001)

[1]BC Act, 2016 – NSW *Biodiversity and Conservation Act 2016*

EPBC Act, 1999 – Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999*

E – Endangered

V – Vulnerable

PE - Presumed Extinct

Fauna Species

Birds

Of the 136 bird species recorded by Project surveys (Mount King Ecological Surveys, 2001), 54 species were recorded within the mine site, 80 within infrastructure areas and 64 species within the general MLA.

The surveys recorded a wide variety of woodland birds, particularly within the Belah, Wilga, Black Box and River Red Gum communities. Shrubland habitats supported a range of small birds that utilised the dense vegetation for cover (such as chats and thornbills), while grassland habitats were utilised by a number of species that were only found in this habitat type (eg.Button-quails and Singing Bushlark).

Most waterbirds and waders were recorded in areas associated with the Darling River, Great Darling Anabranch and the complex of wetlands found in the region, while some were recorded within the mine site at tanks (e.g. Quamby and Bluebush Tanks) and in temporary pools of water formed following heavy rains. A number of raptor species were commonly observed hunting over grasslands and using nearby trees for perching (e.g. Black-shouldered Kite and Nankeen Kestrel), while nine of the thirteen parrot species were recorded from the mine site and surrounds (including the Mulga Parrot, Mallee Ringneck and Blue-winged Parrot). Nocturnal bird species recorded within the Project area include the Tawny Frogmouth, Southern Boobook and Australian Owlet-Nightjar.

Mammals

Sixteen native mammals were recorded within the Project area and surrounds, including 11 bat species (Mount King Ecological Surveys, 2001). The five non-bat species recorded were the Common Dunnart, Short-beaked Echidna, Western Grey Kangaroo, Red Kangaroo and Water Rat.

Reptiles

A total of 27 reptiles were recorded at Ginkgo, of which twenty were recorded within or near the mine site. A relatively high number of Gecko species were recorded, with many being found in woodland habitats. Burrowing reptile species recorded include the Prong-snouted Blind Snake and Eastern Robust Slider, while Hooded Scaly-foot was also recorded.

Amphibians

Four amphibians were recorded within the Project area, including three burrowing amphibians (the Painted Burrowing Frog, Trilling Frog and Mallee Spadefoot Toad) and the Spotted Grass Frog.

Pests

A total of six introduced species were recorded during surveys of the Project area and surrounds including the fox, cat, house mouse, dog, rabbit and feral goat. These species represent a potentially significant risk to native fauna in the area.

Threatened Fauna

A total of 12 threatened fauna species were recorded within the project area, their status and location are provided in Table 9.

Table 10 Threatened fauna species recorded during surveys of Ginkgo and surrounds

Scientific Name	Common Name	BC Act	EPBC Act	Location Description
Chalinolobus picatus	Little Pied Bat	V		Located by ultrasonic call analysis within the riverine community along the Darling River at the Greenvale homestead.
Vespadelus baverstocki	Inland Forest Bat	V		Located within mallee habitat and small water body in grassland in the southern portion of ML 1504.
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V		Located by ultrasonic call analysis within the riverine community along the Darling River.
Oxyura australis	Blue-billed Duck	V		Large ephemeral swamp beside road approximately 12 km north of ML 1504
Stictonetta naevosa	Freckled Duck	V		Large ephemeral swamp beside road approximately 12 km north of ML 1504,
Falco hypoleucos	Grey Falcon	V		Observed flying over grassland within the northern portion of ML 1504.
Lophoictinia isura	Square-tailed Kite	V		Observed flying over shrubland near Old Roo Roo Road, in the vicinity of the HAR.
Cacatua leadbeateri	Major Mitchell's Cockatoo	V		Observed at a number of sites within ML 1504, as well as over most of the Project area.
Polytelis anthopeplus	Regent Parrot	E	V	Observed within River Red Gum forest along the Darling River, south of Pooncarie.
Ninox connivens	Barking Owl	V		Heard calling in riverine woodland at the Greenvale homestead.
Tiliqua occipitalis	Western Blue-tongued Lizard	V		Captured within mallee habitat in the southern portion of ML 1504.
Neobatrachus pictus	Painted Burrowing Frog	E		Captured at three sites within ML 1504, as well as at the Greenvale homestead

Source: Mount King Ecological Surveys (2001)

[1] BC Act, 2016– NSW *Biodiversity and Conservation Act 2016*

EPBC Act, 1999 – Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999*

E – Endangered

V – Vulnerable

Seven Part Tests of Significance have been considered for the sixty-one species under Section 5A of the NSW Environmental Planning and Assessment Act, 1979 for the Ginkgo Mineral Sands Project EIS (Mount King Ecological Surveys, 2001). The Seven Part Tests determined that no threatened species would be significantly affected by the Project to the extent of undermining the viability of a local population of that species.

Table 11 Threatened fauna species considered possible within Ginkgo and surrounds

Common Name	Scientific Name	Status	
		BC Act, 2016	EPBC Act, 1999
Southern Ningaui	*Ningaui yvonneae*	V	
Stripe-faced Dunnart	*Sminthopsis macroura*	V	
Kultarr	*Antechinomys lanigera*	E	
Western Barred Bandicoot	*Perameles bougainville*	PE	
Bilby	*Macrotis lagotis*	PE	
Burrowing Bettong	*Bettongia lesueuri*	PE	
Brush-tailed Bettong	*Bettongia penicillata*	PE	
Koala	*Phascolarctos cinereus*	V	
Southern Hairy-nosed Wombat	*Lasiorhinus latifrons*	V	
Western Pygmy-possum	*Cercartetus concinnus*	V	
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	V	
Little Pied Bat	*Chalinolobus picatus*	V	
Greater Long-eared Bat	*Nyctophilus timoriensis*	V	
Inland Forest Bat	*Eptesicus baverstocki*	V	
Sandy Inland Mouse	*Pseudomys hermannsburgensis*	V	
Bolam's Mouse	*Pseudomys bolami*	E	
Long-haired Rat	*Rattus villosissimus*	V	
Forrest's Mouse	*Leggadina forresti*	V	
Australasian Bittern	*Botaurus poiciloptilus*	V	
Black-necked Stork	*Xenrhynchus asiaticus*	V	
Blue-billed Duck	*Oxyura australis*	V	
Freckled Duck	*Stictonetta naevosa*	V	
Black-breasted Buzzard	*Hamirostra melanosternon*	V	
Square-tailed Kite	*Lophoictinia isura*	V	
Grey Falcon	*Falco hypoleucos*	V	
Malleefowl	*Leipoa ocellata*	E	V
Brolga	*Grus rubicundus*	V	
Australian Bustard	*Ardeotis australis*	V	
Plain's Wanderer	*Pedionomus torquatus*	E	V
Bush Thick-knee	*Burhinus grallarius*	E	
Mongolian Plover	*Charadrius mangolus*	V	
Painted Snipe	*Rostratula benghalensis*	V	
Sanderling	*Calidris alba*	V	
Black-tailed Godwit	*Limosa limosa*	V	
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	V	
Red-tailed Black-cockatoo	*Calyptorhynchus banksii samueli*	V	E
Superb Parrot	*Polytelis swainsonii*	V	V
Regent Parrot	*Polytelis anthopeplus monarchoides*	E	V
Turquoise Parrot	*Neophema pulchella*	V	
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*	V	
Flock Bronzewing	*Phaps histrionica*	E	
Eastern Grass Owl	*Tyto capensis*	V	
Masked Owl	*Tyto novaehollandiae*	V	
Barking Owl	*Ninox connivens*	V	
Southern Scrub-robin	*Drymodes brunneopygia*	V	
Gilbert's Whistler	*Pachycephala inornata*	V	
Red-lored Whistler	*Pachycephala rufogularis*	V	V
Chestnut Quail-thrush	*Cinclosoma castanotum*	V	

Common Name	Scientific Name	Status	
		BC Act, 2016	EPBC Act, 1999
Striated Grass-wren	*Amytornis striatus*	V	
Hall's Babbler	*Pomatostomus halli*	V	
Redthroat	*Pyrrholaemus brunneus*	V	
Shy Hylacola	*Hylacola cauta*	V	
Rufous Fieldwren	*Calamanthus campestris*	V	
Black-eared Miner	*Manorina melanotis*	E	E
Painted Honeyeater	*Grantiella picta*	V	V
Pied Honeyeater	*Certhionyx variegatus*	V	
Bardick	*Echiopsis curta*	V	
Mallee Worm-lizard	*Aprasia inaurita*	V	
Gunther's Skink/Mallee Slender Blue-tongue	*Cyclodomorphus melanops elongatum*	V	
Western Blue-tongued Lizard	*Tiliqua occipitalis*	V	
Painted Burrowing Frog	*Neobatrachus pictus*	E	

Source: Mount King Ecological Surveys (2001)

[1] BC Act, 2016 – NSW *Biodiversity and Conservation Act 2016*

EPBC Act, 1999 – Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999*

E – Endangered

V – Vulnerable

PE - Presumed Extinct

Appendix B Background information – Snapper and surrounds

Climate

The climate for Snapper is the same as described for Ginkgo in Appendix A.

Geology and Soils

The climate for Snapper is the same as described for Ginkgo in Appendix A.

Physiography and Land Use

The climate for Snapper is the same as described for Ginkgo in Appendix A.

Threatened Flora

Potentially occurring threatened flora species within the project area are presented in Table 12.

Table 12 Threatened flora species with potential habitat components likely to occur at Snapper

Scientific Name	Common Name	BC Act	EPBC Act
Atriplex infrequens	A Saltbush	V	V
Brachyscome papillosa	Mossgiel Daisy	V	V
Erodiophyllum elderi	Koonamore Daisy	E	-
Cratystylis conocephala	Blue-bush Daisy	E	-
Lasiopetalum behrii	Pink Velvet-bush	E	-
Solanum karsense	Menindee Nightshade	V	V
Swainsona murrayana	Slender Darling-pea	V	V
Swainsona pyrophila	Yellow Swainson Pea	V	V
Swainsona colutoides	Bladder Senna	E	-
Santalum murrayanum	Bitter Quandong	E	-

Habitat Types

Mixed Woodland

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

Open Grassland/Shrubland with Scattered Trees

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

Mallee Shrubland

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

Birds

Fifty-three native birds were identified during the survey.

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

Mammals

Fifteen native mammal species were located during the survey, One Echidna, three macropods and 11 microbats were located.

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

Reptiles

Twenty-two reptile species were located during the survey.

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

Amphibians

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

Pests

Five introduced species were located during the survey.

Feral species records include Goat (*Capra hircus*) Sheep (*Ovis aries*), Red Fox (*Vulpes vulpes*), Rabbit (*Oryctolagus cuniculus*) and House Mouse (*Mus musculus*).

Threatened Fauna

Table 13 details the threatened fauna recorded during surveys of Snapper and surrounds.

Table 13 Threatened fauna species located during surveys at Snapper

Scientific name	Common name	Conservation Status 1		Northings and Eastings (AMG)	Number Individuals Recorded
		BC Act	EPBC Act		
Tiliqua occipitalis	Western Blue-tongued Lizard	V	-	6 303525 602426	1 trace
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	-	6 302865 604701	1
				6 301775 603752	1
				6 298434 607296	1
				6 303129 605266	14
Melanodryas cucullata	Hooded Robin	V	-	6 299083 607553	2
				6 302766 605347	1
				6 302462 603415	1
				6 300601 607023	1
				6 298015 609098	1
				6 303598 601488	1
				6 302557 605289	1
				6 301387 604378	1
				6 300256 607444	1
				6 629459 607485	1
				6 629777 608221	1
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	6 300925 608395	3
Chalinolobus picatus	Little Pied Bat	V	-	6 300894 608351	36
				6 299055 607533	7
				6 302889 604695	3
				6 302028 603776	9

1 Conservation Status
NSW BC Act
Commonwealth EPBC Act
V Vulnerable

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

Table 14 below lists the threatened fauna species with potential habitat components likely to occur in the study area, based on the occurrence of potential or known habitat and distribution of the species.

Table 14 Threatened fauna species with habitat components known or considered likely to occur at Snapper

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

1 Conservation Status
NSW BC Act
Commonwealth EPBC Act
V Vulnerable
E Endangered

Appendix C Background information – Crayfish and surrounds

Climate

Crayfish is an extension of Ginkgo, and lies in an arid climatic zone. Rainfall is typically distributed uniformly throughout the year although variability is greater during summer and autumn. The mean annual rainfall recorded at Menindee Post Office (since 1876) (approximately 100 km north of ML 1504) and Lake Victoria Storage (since 1922) (approximately 115 km south-west of ML 1504) is approximately 244 and 264 mm, respectively. The mean annual rainfall recorded at Pooncarie (approximately 40 km east of ML 1504) and rural stations for over 100 years ranged from approximately 255 mm to 266 mm. Records indicate that January is typically the hottest month and July the coldest. The highest mean daily maximum for January of 34.1 degrees Celsius (^{o}C) and the lowest mean daily minimum for July (4.0 ^{o}C) were recorded at the Menindee Post Office.

Geology and Soils

Crayfish is located in the Murray Basin, a large sedimentary basin covering some 300,000 km^2 of inland south-eastern Australia and extending across the borders of NSW, Victoria and South Australia. Within the Murray Basin, sedimentary accumulations of the Early Tertiary to Recent age up to 600 m thick over a basement of Proterozoic to Mesozoic sediments and granitic rocks.

The three major soil types encountered within ML 1504 are solonised brown soils, calcareous red earths and siliceous sands (based on Stace *et al*., 1968).

Physiography and Land Use

Crayfish comprises flat to undulating sandplains and dunefields covered by a combination of grassland, low woodland and shrublands. Land use within the Project area is predominantly comprised of pastoral leasehold lands that are used for rangeland grazing. Ephemeral lakes in the vicinity of the project area (e.g. Travellers Lake) are used for opportunistic cereal cropping when climatic conditions are suitable.

Crayfish is located within the lower Darling River system, which extends from the Menindee Lakes to the junction of the Darling River and the Murray River at Wentworth. Also included in the lower Darling River system are numerous ephemeral wetland systems that are linked to the Darling River and the Great Darling Anabranch. As a result of the limited and well dispersed annual rainfall, the sandy soils, limited topographical relief and high evaporation rates, there are no well-defined drainage channels within ML 1504.

Land Systems

A total of ten land systems3 described by Walker (1991) for western NSW occur within the Project area and surrounds. The majority of these are sandplain and dunefield systems dominated by Belah, Rosewood and/or Bluebush vegetation communities. A summary description of each land system located within the Project area is provided in Table 21. The spatial distribution of these land systems is shown in Figure 15

Further to the above, FloraSearch Surveys (2012) recognised nine vegetation communities within ML 1504, namely: Black Box Woodland, Black Oak (Belah) - Western Rosewood Woodland, Black Oak - Pearl Bluebush Woodland, Chenopod Mallee Woodland / Shrubland and Dune Mallee Shrubland, Pearl Bluebush Shrubland, *Austrostipa* Grassland, Turpentine Tall Open Shrubland and Depression Herbfield.

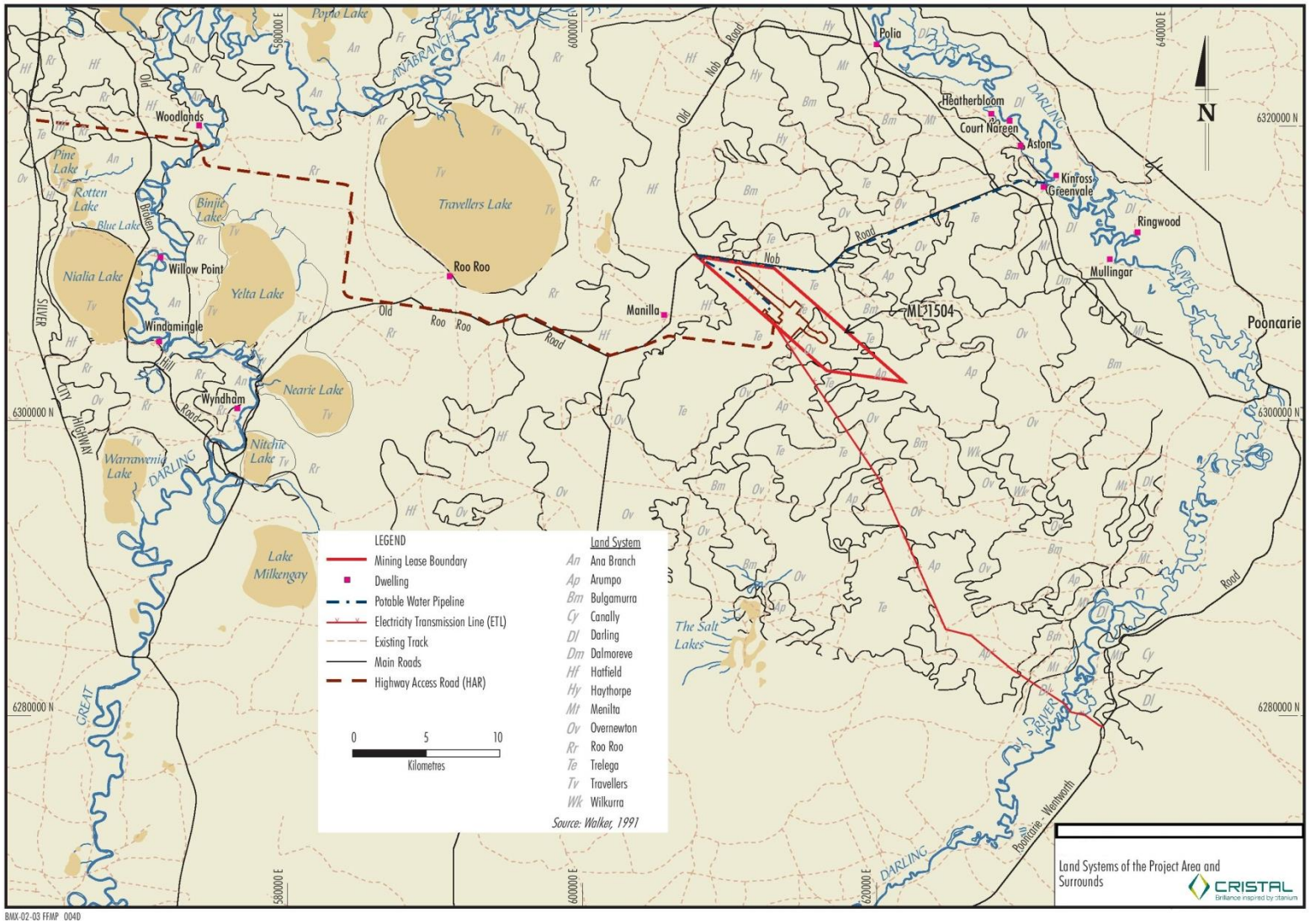

Figure 24 Land systems of Ginkgo, Snapper and Crayfish

Table 15 Summary of land systems of Ginkgo, Snapper and Crayfish

Land System	Description
Arumpo	Parallel dunes and sandplain with narrow calcareous swales. Vegetation/habitat includes dunes with dense mallee and variable spinifex; swales with belah, rosewood and inedible shrubs; variable speargrass, cannon-ball and forbs.
Bulgamurra	Extensive undulating sandplain with dunes and open flats. Vegetation/habitat includes dunes with white cypress pine or mallee and spinifex; areas of edible and inedible shrubs, variable speargrass, copperburrs and forbs; depressions with fringing black box.
Hatfield	Extensive undulating plains with bluebush. Vegetation/habitat includes plains with scattered clumps of rosewood and belah; dunes with clumped white cypress pine, prickly wattle and bluebushes; depressions with nitre goosefoot, blue bush and speargrass.
Overnewton	Extensive open plains. Vegetation/habitat includes sandplain with dense clumps of rosewood and belah; scattered bluebush and inedible shrubs; rises with mallee and white cypress pine and speargrass.
Trelega	Sandplains with belah and bluebush. Vegetation/habitat includes plains and swales with dense belah, scattered rosewood, mallee and wilga, and moderately dense bluebushes; dunes with dense mallee and spinifex, variable speargrass, copperburrs and forbs.
Roo Roo	Undulating plain with rises and depressions, associated with the Anabranch. Vegetation/habitat includes scattered belah and rosewood, dense bluebushes, variable speargrass, copperburrs and annual forbs.
Menilta	Scalded sandplain with unstable dunes adjacent to the Darling River floodplains. Vegetation/habitat includes plains with scattered belah, rosewood and white cypress pine, black box around depressions, scattered black bluebush, variable speargrass, bottlewashers, copperburrs and forbs.
Wilkurra	Level sandplains with belah. Vegetation/habitat includes uniformly dense stands of belah and rosewood, scattered mulga, wilga and inedible shrubs; white cypress pine on sandy rises; variable speargrass, copper burrs and forbs.
Darling	Lower Darling River and floodplain. Vegetation/habitat includes river cooba and river red gum; stands of nitre goosefoot, lignum, cane-grass and narrow-leaf hopbush; abundant annual saltbushes, copperburrs and forbs.
Anabranch	Anabranch of the Darling River. Vegetation/habitat includes scattered to clumped black box and river red gum along channels, river cooba; dense lignum and nitre goosefoot in lower areas; prickly wattle, narrow-leaf hopbush and occasional bluebushes on lunettes; abundant grasses and forbs after flooding.

Threatened Flora

The NSW BCD threatened species database was assessed by FloraSearch (2012) to provide an indication of threatened flora species which could possibly occur within the project area and surrounds. This database provided a list of 20 species for which further detailed assessment (i.e. likelihood of occurrence) of habitat requirements and distribution characteristics was conducted during the EA. Six Part Tests of Significance were considered for five threatened flora species known or considered possible occurrences in the Project area or surrounds for the Crayfis Mineral Sands Project EA (FloraSearch 2012). The Six Part Tests determined that no threatened species would be significantly affected by the Project to the extent of undermining the viability of a local population of that species (FloraSearch 2012).

Table 16 Threatened flora species known or with potential habitat components likely to occur at Crayfish (from FloraSearch 2012)

Scientific Name	Common Name	BC Act, 2016	EPBC Act, 1999
Acacia acanthoclada	Harrow Wattle	E	
Acacia carnei	Purple-wood Wattle	V	V
Atriplex infrequens	A Saltbush	V	V
Austrostipa nullanulla	Club Speargrass	E	
Austrostipa wakoolica	A Speargrass	E	
Brachyscome papillosa	Mossgiel Daisy	V	V
Codonocarpus pyramidalis	Camel Poison	PE	V
Cratystylis conocephala	Bluebush Daisy	E	
Dodonaea stenozyga	Desert Hopbush	CE	
Erodiophyllum elderi	Koonamore Daisy	E	
Kippistia suaedifolia	A Daisy	E	
Lasiopetalum behrii	Pink Velvet-bush	E	
Lepidium monoplocoides	Winged Peppercress	E	V
Leptorhynchos waitzia	Button Immortelle	E	
Pimelea serpyllifolia subsp. Serpyllifolia	Thyme Rice-flower	E	
Santalum murrayanum	Bitter Quandong	E	
Solanum karsense	Menindee Nightshade	V	V
Swainsona colutoides	A Swainson Pea	E	
Swainsona pyrophila	Yellow Swainson Pea	V	V
Swainsona sericea	Silky Swainson Pea	V	V

Source: FloraSearch (2012)

[1]BC Act, 2016 – NSW *Biodiversity and Conservation Act 2016*

EPBC Act, 1999 – Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999*

CE – Critically Endangered

E – Endangered

V – Vulnerable

PE - Presumed Extinct

Fauna Species

A Fauna Assessment was prepared by Biodiversity Monitoring Services (2012) for this Modification, generally in accordance with the Draft Guidelines for Threatened Species Assessment (DEC and DPI, 2005).

A total of 77 bird, 13 native mammal, eight introduced mammal, 19 reptile and four amphibian species were located within the Study Area during the two surveys. Of this assemblage, 59 bird, 11 native mammal, five introduced mammal, 19 reptile and one amphibian species were located within the Modification Area and Haul Road Area.

Pests

A total of four introduced species were recorded during surveys of the Project area and surrounds including the fox, cat, rabbit and feral goat. These species represent a potentially significant risk to native fauna in the area.

Threatened Fauna

A total of seven threatened fauna species were recorded within the project area by Biodiversity Monitoring Services (2012), their status and location are provided in Table 17.

A desktop analysis by Biodiversity Monitoring Services (2012) of the BCD database, and the CSIRO and Australian Government's Atlas of Living Australia web site, combined with the results of surveys generated a list of 32 threatened species that are known to, or have the potential to occur in the study area, and are listed in Table 18.

These 32 threatened species underwent further detailed assessment (likelihood of occurrence) of habitat requirements and distribution characteristics was conducted during the EA. Three factor tests of significance of impacts were considered for 32 threatened fauna species known or considered possible to occur in the project area or surrounds for the Crayfish Mineral Sands Project EA (Biodiversity Monitoring Services 2012). The three factor tests determined that no threatened species would be significantly affected by the Project to the extent of undermining the viability of a local population of that species (Biodiversity Monitoring Services 2012). It was deemed that "the relatively small loss of an amount of the native vegetation communities and landscape features will be compensated for by the setting aside and management of the Biodiversity Offset Area. Consequently, populations of most Threatened species that are found or could occur within the Modification Area are unlikely to be significantly affected. However, some of the small reptiles with restricted habitat preferences and limited home ranges may be affected. These include those that have been located within or close to the Modification (e.g.

Jewelled gecko, Crowned Gecko, Wedgesnout Ctenotus, Western Blue-tongue Lizard, Marble-faced Delma). Pre-clearance surveys would be undertaken in accordance with the Vegetation Clearance Protocol." (Biodiversity Monitoring Services 2012).

Table 17 Threatened fauna species recorded during surveys of Crayfish

Scientific Name	Common Name	BC Act	EPBC Act
Chalinolobus picatus	Little Pied Bat	V	
Vespadelus baverstocki	Inland Forest Bat	V	
Hieraaetus morphnoides	Little Eagle	V	
Daphoenositta chrysoptera	Varied Sittella	V	
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	
Delma australis	Marble-headed Delma	E	

Source: Biodiversity Monitoring Services (2012)

[1] BC Act, 2016 – NSW *Biodiversity and Conservation Act 2016*

EPBC Act, 1999 – Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999*

E – Endangered

V – Vulnerable

Three factor tests of Significance have been considered for the 32 species for the Crayfish Mineral Sands Project EIS (Biodiversity Monitoring Services 2012). The three factor tests determined that no threatened species would be significantly affected by the Project to the extent of undermining the viability of a local population of that species.

Table 18 Threatened fauna species considered possible within Crayfish and surrounds

Common Name	Scientific Name	Status	
		BC Act, 2016	EPBC Act, 1999
Corben's Long-eared Bat	*Nyctophilus corbeni/ timoriensis*	V	V
Inland Forest Bat	*Eptesicus baverstocki*	V	
Little Pied Bat	*Chalinolobus picatus*	V	
Southern Ningaui	*Ningaui yvonneae*	V	
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	V	
Barking Owl	*Ninox connivens*	V	
Black-breasted Buzzard	*Hamirostra melanosternon*	V	
Blue-billed Duck	*Oxyura australis*	V	
Brown Treecreeper (eastern sub-species)	*Climacteris picumnus victoriae*	V	
Chestnut Quail-thrush	*Cinclosoma castanotum*	V	
Freckled Duck	*Stictonetta naevosa*	V	
Gilbert's Whistler	*Pachycephala inornata*	V	
Grey Falcon	*Falco hypoleucos*	V	
Grey-crowned Babbler (southeastern sub-species)	*Pomatostomus temporalis temporalis*	V	
Hooded Robin	*Melanodryas cucullata*	V	
Little Eagle	*Hieraaetus morphnoides*	V	
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	V	
Regent Parrot	*Polytelis anthopeplus*	E	V
Shy Heathwren	*Hylacola cauta*	V	
Spotted Harrier	*Circus assimilis*	V	
Square-tailed Kite	*Lophoictinia isura*	V	
Varied Sittella	*Daphoenositta chrysoptera*	V	
Crowned Gecko	*Diplodactylus stenodactylus*	V	
Jewelled Gecko	*Strophurus elderi*	V	
Mallee Worm-lizard	*Aprasia inaurita*	V	
Marbled-headed Delma	*Delma australis*	E	
Ringed Brown Snake	*Pseudonaja modesta*	V	
Slender Mallee Blue-tongue Lizard	*Cyclodomorphus melanops elongatus*	V	
Wedged-snout Ctenotus	*Ctenotus brooksi*	V	
Western Blue-tongued Lizard	*Tiliqua occipitalis*	V	
Yellow-tailed Plain Slider	*Lerista xanthura*	V	
Painted Burrowing Frog	*Neobatrachus pictus*	E	

Source: Biodiversity Monitoring Services (2012)

[1] BC Act, 2016 – NSW *Biodiversity and Conservation Act 2016*

EPBC Act, 1999 – Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999*

E – Endangered

V – Vulnerable

Appendix D Ginkgo flora and fauna species (all recorded in EIS and SEE surveys)

Table 19 Flora species recorded at Ginkgo and surrounds

Scientific Name	Common Name
Aizoaceae	
Glinus lotoides	Hairy carpet-weed
**Psilocaulon tenue*	Match-head plant
Zaleya galericulata	Hogweed
Amaranthaceae	
Alternanthera denticulata	Lesser joyweed
Ptilotus exaltatus var. exaltatus	Showy foxtail
Ptilotus sp.	
Asclepiadaceae	
Marsdenia australis	Native Pear
Asphodelaceae	
**Asphodelus fistulosus*	Onion weed
Asteraceae	
Brachyscome melanocarpa	Black-seed daisy
Calotis erinacea	Tangled burr-daisy
**Carthamus lanatus*	Saffron thistle
**Centaurea melitensis*	Maltese cockspur
Centipeda cunninghamii	Common sneezeweed
**Conyza bonariensis*	Flax-leaf fleabane
**Dittrichia graveolens*	Stinkwort
Epaltes australis	Spreading nut-heads
Minuria cunninghamii	Bush minuria
Myriocephalus stuartii	Poached eggs
Olearia pimeleoides	Showy daisy-bush
**Onopordum acaulon*	Stemless thistle
Podolepis capillaris	Invisible plant
Pseudognaphalium luteoalbum	Jersey cudweed
Vittadinia cervicularis var. cervicularis	A fuzzweed
Vittadinia cuneata var. hirsuta	A fuzzweed
Vittadinia gracilis	Soft fuzzweed
**Xanthium occidentale*	Noogoora burr
**Xanthium spinosum*	Bathurst burr
Boraginaceae	
**Echium plantagineum*	Patterson's curse
**Heliotropium europaeum*	Common heliotrope
Brassicaceae	
Arabidella trisecta	Shrubby cress
**Brassica tournefortii*	Wild turnip
**Carrichtera annua*	Ward's weed
Campanulaceae	
Wahlenbergia fluminalis	River bluebell
Caryophyllaceae	
**Silene apetala*	A catchfly
Casuarinaceae	
Casuarina pauper	Belah
Chenopodiaceae	
Atriplex acutibractea ssp. acutibractea	A saltbush
Atriplex holocarpa	Pop saltbush

Scientific Name	Common Name
Atriplex limbata	Spreading saltbush
Atriplex lindleyi	Eastern flat-top saltbush
Atriplex leptocarpa	A saltbush
Atriplex nummularia	A saltbush
Atriplex stipitata	Bitter saltbush
Chenopodium curvispicatum	A saltbush
Chenopodium desertorum	Desert goosefoot
Chenopodium desertorum ssp. anidiophyllum	Mallee goosefoot
Chenopodium desertorum ssp. desertorum	Desert goosefoot
Chenopodium desertorum ssp. rectum	A goosefoot
Chenopodium pumilio	Small crumbweed
Dissocarpus biflorus	Copperburr
Dissocarpus paradoxus	Cannon-ball
Einadia nutans ssp. oxycarpa	Climbing saltbush
Enchylaena tomentosa var. tomentosa	Ruby saltbush
Maireana brevifolia	Yanga bush
Maireana pentatropis	Erect mallee bluebush
Maireana pyramidata	Black bluebush
Maireana sedifolia	Pearl bluebush
Maireana trichoptera	A bluebush
Maireana turbinata	A bluebush
Osteocarpum acropterum var. deminuta	Water weed
Rhagodia ulicina	Spiny saltbush
Salsola kali	Buckbush
Sclerolaena brachyptera	Short-winged copperburr
Sclerolaena calcarata	Red copperburr
Sclerolaena constricta	A copperburr
Sclerolaena decurrens	Green copperburr
Sclerolaena diacantha	Grey copperburr
Sclerolaena divaricata	Pale poverty-bush
Sclerolaena lanicuspis	Woolly copperburr
Sclerolaena muricata	Black roly-poly
Sclerolaena obliquicuspis	Limestone copperburr
Sclerolaena parviflora	Mallee copperburr
Sclerolaena intricata	Tangled poverty-bush
Sclerolaena ventricosa	Salt copperburr
Convolvulaceae	
Convolvulus erubescens	Australian bindweed
Cucurbitaceae	
**Citrullus lanatus*	Camel melon
**Cucumis myriocarpus ssp. leptodermis*	Paddy melon
Cupressaceae	
Callitris glaucophylla	White cypress pine
Euphorbiaceae	
Chamaesyce drummondii	Caustic weed
Fabaceae	
Caesalpinoideae	
Senna artemisioides ssp. petiolaris	Woody cassia
Senna artemisioides ssp. coriacea	Desert cassia
Senna artemisioides ssp. zygophylla	Punty Bush
Faboideae	
**Medicago polymorpha*	Burr medic
Swainsona greyana	A Darling pea
Mimosoideae	

Scientific Name	Common Name
Acacia colletioides	Spine bush
Acacia stenophylla	River cooba
Acacia victoriae	Prickly wattle
Lamiaceae	
**Marrubium vulgare*	Horehound
Mentha pulegium	Pennyroyal
**Salvia verbenaca*	Wild sage
Teucrium racemosum	Grey germander
Lomandraceae	
Lomandra leucocephala ssp. robusta	Woolly-head mat-rush
Loranthaceae	
Amyema pendula	Drooping mistletoe
Lysiana exocarpi ssp. exocarpi	Harlequin mistletoe
Malvaceae	
Abutilon halophilum	Plains lantern-flower
Lavatera plebeia	Native hollyhock
Sida ammophila	Sand sida
Sida intricata	Twiggy sida
Myoporaceae	
Eremophila oppositifolia ssp. oppositifolia	Weeooka
Eremophila sturtii	Turpentine
Myoporum platycarpum ssp. platycarpum	Sugarwood
Myrtaceae	
Eucalyptus camaldulensis	River red gum
Eucalyptus dumosa	Congoo mallee
Eucalyptus foecunda	Slender-leaf mallee
Eucalyptus gracilis	Yorrell
Eucalyptus largiflorens	Black box
Eucalyptus socialis	Pointed mallee
Oleaceae	
Jasminum lineare	Desert Jasmine
Pittosporaceae	
Pittosporum phylliraeoides	Weeping Pittosporum
Plantaginaceae	
Plantago drummondii	Dark sago-weed
Poaceae	
Agrostis avenacea	Blown grass
Austrostipa scabra ssp. falcata	Rough spear-grass
Austrostipa sp.	Spear-grasses
**Bromus rubens*	Red brome
Chloris truncata	Windmill grass
Cynodon dactylon	Couch grass
Dactyloctenium radulans	Button grass
Enneapogon avenaceus	Common bottlewashers
Eragrostis setifolia	Neverfail
**Hordeum leporinum*	Barley grass
Panicum simile	Two colour panic
Paspalidium jubiflorum	Warrego Grass
Triodia scariosa subsp. scariosa	Porcupine grass
Polygonaceae	
Emex australis	Spiny emex
Muehlenbeckia florulenta	Lignum
Rumex brownii	Slender dock
Proteaceae	

Scientific Name	Common Name
Hakea leucoptera	Needlewood
Rutaceae	
Geijera parviflora	Wilga
Santalaceae	
Exocarpos aphyllus	Leafless cherry
Exocarpus strictus	Dwarf Cherry
Santalum acuminatum	Quandong
Sapindaceae	
Alectryon oleifolius ssp. canescens	Rosewood
Dodonaea viscosa ssp. angustissima	Narrow-leaf hopbush
Scrophulariaceae	
Gratiola pedunculata	Stalked brooklime
Stemodia florulenta	Blue rod
Solanaceae	
**Datura inoxia*	Downy thornapple
**Lycium ferocissimum*	African boxthorn
Nicotiana occidentalis ssp. obliqua	Native tobacco
**Nicotiana glauca*	Tree tobacco
**Solanum nigrum*	Black-berry nightshade
Thymelaeaceae	
Pimelea microcephala ssp. microcephala	Shrubby rice-flower
Verbenaceae	
**Verbena officianalis*	Common verbena
Zygophyllaceae	
Zygophyllum apiculatum	Gall weed
Zygophyllum crenatum	Lobed Twinleaf
Zygophyllum eremaeum	Climbing twinleaf
Zygophyllum iodocarpum	Violet twinleaf

Table 20 Fauna species recorded at Ginkgo and surrounds

Scientific name	Common name	General area	Infrastructure areas	Mine site
	Amphibians			
Limnodynastes tasmaniensis	Spotted Grass Frog	X	X	
Neobatrachus sudelli	Mallee Spadefoot Toad	X	X	X
Neobatrachus pictus	Painted Burrowing Frog	X	X	X
Neobatrachus centralis	Trilling Frog			X
	Reptiles			
Chelodina longicollis	Eastern Snake-necked Turtle		X	
Strophurus elderi	Jewelled Gecko			X
Diplodactylus tessellatus	Tessellated Gecko	X		
Diplodactylus vittatus	Wood Gecko			X
Lucasium stenodactylum	Crowned Gecko			X
Lucasium damaeum	Beaded Gecko			X
Rhynchoedura ornata	Beaked Gecko			X
Gehyra variegata	Tree Dtella	X		X
Heteronotia binoei	Bynoe's Gecko		X	
Pygopus schraderi	Hooded Scaly-foot			X
Ctenophorus fordi	Mallee Military Dragon	X	X	X
Pogona vitticeps	Central Bearded Dragon	X	X	X
Tympanocryptis lineata	Lined Earless Dragon			X
Varanus gouldii	Gould's Goanna			X
Varanus varius	Lace Monitor	X		
Cryptoblepharus carnabyi	Carnaby's Wall Skink	X	X	
Ctenotus atlas	Southern Mallee Ctenotus			X
Ctenotus leonhardii	Leonardi's Ctenotus			X
Ctenotus schomburgkii	Barred Wedgesnout Ctenotus			X
Eremiascincus fasciolatus	Narrow-banded Sand-swimmer			X
Lerista punctatovittata	Eastern Robust Slider			X
Morethia boulengeri	Boulenger's Skink			X
Morethia obscura	Shrubland Morethia Skink			X
Tiliqua occipitalis	Western Blue-tongued Lizard			X
Tiliqua rugosa	Shingle-back	X	X	
Ramphotyphlops bituberculatus	Prong-snouted Blind Snake	X		
Morelia spilota metcalfei	Carpet Python	X		
	Birds			
Struthidea cinerea	Apostlebird	X	X	X
Tachybaptus novaehollandiae	Australasian Grebe	X	X	
Anhinga novaehollandiae	Australasian Darter	X	X	
Falco longipennis	Australian Hobby	X	X	
Cracticus tibicen	Australian Magpie		X	
Aegotheles cristatus	Australian Owlet-Nightjar	X	X	X
Pelecanus conspicillatus	Australian Pelican	X		
Anthus novaeseelandiae	Australian Pipit	X		
Corvus coronoides	Australian Raven	X		
Acrocephalus stentoreus	Australian Reed-Warbler		X	
Tadorna tadornoides	Australian Shelduck	X		
Threskiornis molucca	Australian White Ibis	X	X	

Chenonetta jubata	Australian Wood Duck	X	X	
Ninox connivens	Barking Owl	X		X
Sugomel niger	Black Honeyeater	X		
Milvus migrans	Black Kite	X		
Cygnus atratus	Black Swan	X		
Chalcites osculans	Black-eared Cuckoo	X		
Coracina novaehollandiae	Black-faced Cuckoo-Shrike	X	X	
Artamus cinereus	Black-faced Woodswallow		X	
Elseyornis melanops	Black-fronted Dotterel	X		
Elanus axillaris	Black-shouldered Kite	X		
Northiella haematogaster	Blue Bonnet	X		
Oxyura australis	Blue-billed Duck	X	X	
Entomyzon cyanotis	Blue-faced Honeyeater			
Neophema chrysostoma	Blue-winged Parrot			
Falco berigora	Brown Falcon			
Cincloramphus cruralis	Brown Songlark		X	X
Climacteris picumnus victoriae	Brown Treecreeper			X
Melopsittacus undulatus	Budgerigar	X		
Ardea ibis	Cattle Egret	X		
Pomatostomus ruficeps	Chestnut-crowned Babbler			
Acanthiza uropygialis	Chestnut-rumped Thornbill	X	X	
Psophodes cristatus	Chirruping Wedgebill	X		
Nymphicus hollandicus	Cockatiel	X		
Phaps chalcoptera	Common Bronzewing			X
Oreoica gutturalis	Crested Bellbird		X	
Ocyphaps lophotes	Crested Pigeon		X	X
Epthianura tricolor	Crimson Chat			X
Geopelia cuneata	Diamond Dove			
Artamus cyanopterus	Dusky Woodswallow		X	X
Dromaius novaehollandiae	Emu		X	
Fulica atra	Eurasian Coot	X		
Petrochelidon ariel	Fairy Martin	X	X	
Stictonetta naevosa	Freckled Duck	X	X	
Eolophus roseicapillus	Galah	X	X	
Phalacrocorax carbo	Great Cormorant	X	X	
Ardea alba	Great Egret	X		
Cracticus torquatus	Grey Butcherbird	X	X	
Falco hypoleucos	Grey Falcon	X	X	
Rhipidura albiscapa	Grey Fantail	X	X	
Colluricincla harmonica	Grey Shrike-thrush	X	X	X
Anas gracilis	Grey Teal	X	X	
Pomatostomus temporalis	Grey-crowned Babbler	X	X	X
Lichenostomus plumulus	Grey-fronted Honeyeater	X	X	
Aythya australis	Hardhead	X	X	X
Poliocephalus poliocephalus	Hoary-headed Grebe		X	
Melanodryas cucullata cucullata	Hooded Robin		X	X
Mirafra javanica	Horsefields Bushlark	X	X	X
Acanthiza apicalis	Inland Thornbill		X	X
Ardea intermedia	Intermediate Egret			X
Microeca fascinans	Jacky Winter	X	X	
Dacelo novaeguineae	Laughing Kookaburra		X	
Elanus scriptus	Letter-winged Kite			

Phalacrocorax sulcirostris	Little Black Cormorant	X	X	
Turnix velox	Little Button-quail			X
Cacatua sanguinea	Little Corella		X	
Corvus bennetti	Little Crow		X	
Hieraaetus morphnoides	Little Eagle		X	
Philemon citreogularis	Little Friarbird		X	
Microcarbo melanoleucos	Little Pied Cormorant	X	X	X
Corvus mellori	Little Raven		X	
Grallina cyanoleuca	Magpie-lark			X
Lophochroa leadbeateri	Major Mitchell's Cockatoo	X	X	
Barnardius zonarius barnardi	Mallee Ringneck	X	X	
Vanellus miles	Masked Lapwing	X		
Artamus personatus	Masked Woodswallow	X		X
Psephotus varius	Mulga Parrot	X	X	
Falco cenchroides	Nankeen Kestrel	X		
Epthianura aurifrons	Orange Chat		X	
Anas superciliosa	Pacific Black Duck		X	X
Cacomantis pallidus	Pallid Cuckoo		X	
Geopelia striata	Peaceful Dove		X	
Falco peregrinus	Peregrine Falcon		X	X
Cracticus nigrogularis	Pied Butcherbird		X	
Phalacrocorax varius	Pied Cormorant	X		X
Porphyrio porphyrio	Purple Swamphen		X	X
Todiramphus pyrrhopygius	Red-backed Kingfisher		X	X
Petroica goodenovii	Red-capped Robin		X	
Turnix pyrrhothorax	Red-chested Button-quail		X	X
Erythrogonys cinctus	Red-kneed Dotterel	X	X	X
Recurvirostra novaehollandiae	Red-necked Avocet			X
Psephotus haematonotus	Red-rumped Parrot	X		X
Polytelis anthopeplus monarchoides	Regent Parrot		X	X
Myiagra inquieta	Restless Flycatcher		X	
Platalea regia	Royal Spoonbill		X	
Cincloramphus mathewsi	Rufous Songlark		X	
Pachycephala rufiventris	Rufous Whistler	X	X	
Todiramphus sanctus	Sacred Kingfisher		X	X
Lichenostomus virescens	Singing Honeyeater			X
Ninox novaeseelandiae	Southern Boobook			X
Aphelocephala leucopsis	Southern Whiteface			X
Acanthagenys rufogularis	Spiny-cheeked Honeyeater		X	X
Pardalotus punctatus	Spotted Pardalote			X
Lophoictinia isura	Square-tailed Kite	X		X
Threskiornis spinicollis	Straw-necked Ibis			X
Pardalotus striatus	Striated Pardalote		X	
Cacatua galerita	Sulphur-crested Cockatoo		X	
Circus approximans	Swamp Harrier		X	
Podargus strigoides	Tawny Frogmouth	X	X	
Petrochelidon nigricans	Tree Martin			X
Aquila audax	Wedge-tailed Eagle	X	X	
Hirundo neoxena	Welcome Swallow			X
Chlidonias hybrida	Whiskered Tern		X	
Haliastur sphenurus	Whistling Kite	X		X

Pomatostomus superciliosus	White-browed Babbler		X	X
Artamus leucorynchus	White-browed Woodswallow	X		
Egretta novaehollandiae	White-faced Heron	X	X	
Epthianura albifrons	White-fronted Chat			X
Ardea pacifica	White-necked Heron			X
Lichenostomus penicillatus	White-plumed Honeyeater	X	X	
Corcorax melanorhamphos	White-winged Chough		X	X
Malurus leucopterus	White-winged Fairy-wren	X	X	X
Rhipidura leucophrys	Willie Wagtail			X
Platycercus elegans flaveolus	Yellow Rosella			X
Platalea flavipes	Yellow-billed Spoonbill		X	X
Lichenostomus ornatus	Yellow-plumed Honeyeater		X	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill			X
Manorina flavigula	Yellow-throated Miner	X	X	
Taeniopygia guttata	Zebra Finch		X	X
	Mammals	X		X
Tachyglossus aculeatus	Short-beaked Echidna		X	X
Sminthopsis murina	Common Dunnart			X
Macropus fuliginosus	Western Grey Kangaroo			
Macropus giganteus	Red Kangaroo			X
Tadarida australis	White-striped Freetail-bat			X
Mormopterus planiceps	Inland Mastiff Bat	X	X	X
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	X	X	X
Chalinolobus gouldii	Gould's Wattled Bat	X	X	
Chalinolobus morio	Chocolate Wattled Bat		X	
Chalinolobus picatus	Little Pied Bat		X	
Scotorepens balstoni	Inland Broad-nosed Bat	X	X	X
Nyctophilus Sp.	Unidentified Long-eared Bat	X	X	X
Vespadelus vulturnus	Little Forest Eptesicus	X	X	
Vespadelus baverstocki	Inland Eptesicus	X	X	
Hydromys chrysogaster	Water Rat		X	
Mus musculus	House Mouse	X	X	X
Oryctolagus cuniculus	Rabbit		X	X
Capra hircus	Feral Goat	X	X	
Vulpes vulpes	Fox	X	X	X
Canis lupus	Dog	X	X	X
Felis catus	Feral Cat	X	X	X
Struthidea cinerea	Apostlebird	X	X	X
Tachybaptus novaehollandiae	Australasian Grebe	X	X	
Anhinga novaehollandiae	Australasian Darter	X	X	X

Appendix E Vegetation descriptions for Ginkgo and surrounds

Descriptions of the ten broad vegetation associations occurring in the Project area based on assessments conducted by Orchid Research and Marianne Porteners Environmental Consulting (2001) and Resource Strategies (2003) are provided below.

Community 1 - Belah Woodland (*Casuarina pauper*)

Benson Vegetation Community equivalent: Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray-Darling Depression (Benson 58)

Habitats dominated or co-dominated by Belah (*Casuarina pauper)* are common in the Project area (Figure 3, Figure 4 and Figure 5). Belah is associated with several other tree species, as well as many shrubs and herbs. Sub-communities include Belah woodland (*Casuarina pauper*), Belah/Rosewood Woodland (*Casuarina pauper/Alectryon oleifolius* subsp. *canescens*) and Belah/Bluebush woodland (*Casuarina pauper/Maireana* spp). These sub-communities tend to overlap and grade into one another. The Belah woodlands also grade into the chenopod shrublands, low chenopod shrublands and mallee communities that form mosaics with it across the Project area. Belah woodland is the dominant vegetation community in ML 1504 (Figure 3).

The Belah woodland (*Casuarina pauper*) sub-community represents approximately 3.8 km (8.8%) of the modified ETL and approximately 3.2 km (9.3 %) of the realignments to the modified HAR (Figure 4 and Figure 5). However, the Belah/Rosewood Woodland (*Casuarina pauper/Alectryon oleifolius* subsp. *canescens*) represents a majority (30.1%) of the modified ETL, covering approximately 12.6 km of the length, and approximately 5.7 km (16.6 %) of the realignments to the modified HAR (Figures 4 and 5). The Belah/Rosewood Woodland has a higher structural complexity than the Belah association, resulting from a number of overstorey and midstorey species including *Enchylaena tomentosa, Sclerolaene obliquicuspis, Dissocarpus paradoxus, Atriplex stipitate.*

The Belah Woodland community is characterised by a predominant Belah overstorey and scattered chenopod understorey. Species commonly associated with *Casuarina pauper* in the Project area include Wilga (*Geijera parviflora),* Sugarwood (*Myoporum platycarpum* subsp. *platycarpum)* and Rosewood (*Alectryon oleifolius* subsp. c*anescens). S*hrub species in *C. pauper* woodland include Weeping Pittosporum (*Pittosporum phylliraeoides),* Needlewood (*Hakea leucoptera)*, Leafless Cherry (*Exocarpus aphylla),* Spine Bush (*Acacia colletioides)*, Black Bluebush (*Maireana pyramidata*), Pearl Bluebush (*M. sedifolia)*, Yanga Bush (*M. brevifolia)*, Cannonballs (*Dissocarpus paradoxus)*, Limestone Copperburr (*Sclerolaena obliquicuspis)*, Bitter Saltbush (*Atriplex stipitata)*, Ruby Saltbush (*Enchylaena tomentosa* var. *tomentosa)*, Spiny Goosefoot (*Rhagodia ulicina)*, Buckbush (*Salsola kali)*, Desert Goosefoot (*Chenopodium desertorum)*, Twiggy Sida (*Sida intricata)*, Showy Daisy Bush (*Olearia pimelioides)* and Desert Cassia (*Senna artemisioides* nothosubsp. c*oriacea)*.

Prominent understorey species include Bogan Flea (*Calotis hispidula)*, Desert Fuzzweed (*Vittadinia eremaea)*, Flannel Cudweed (*Actinobole uliginosum)*, Annual Spinach (*Tetragonia moorei)*, Lobed Twinleaf (*Zygophyllum crenatum)* and Violet Twinleaf (*Z. iodocarpum)*.

Community 2 - Black Box Woodland (*Eucalyptus largiflorens*)

Benson Vegetation Community equivalent: Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (Benson 15)

Black Box communities occurred as fringing woodland beside the Darling River and the Great Darling Anabranch and small areas in depressions in sandplains and dune swales in ML 1504 (Figure 3). Black Box Woodland was found along the modified ETL in drainage areas and at higher levels on the floodplain of the Darling River, and skirting the River Red Gum vegetation association on the Great Darling Anabranch on the HAR modifications (Figure 4 and Figure 5). Community 2 represents approximately 3.3 km (8.0 %) of the length of the modified ETL and approximately 0.7 km (2.0 %) of the realignments to the modified HAR.

Flora species associated with the riverine grey clays included Black Roly Poly (*Sclerolaena muricata*), Slender-fruit Saltbush (*Atriplex leptocarpa*), Cottony Saltbush (*Chenopodium curvispicatum)*, Blue Rod (*Stemodia florulenta)*, Spreading Nutheads (*Epaltes australis)*, Caustic Weed (*Chamaesyce drummondii)*, River Bluebell (*Wahlenbergia fluminalis)*, Black-seed Daisy (*Brachyscome melanocarpa)*, Small Crumbweed (*Chenopodium pumilio)*, Hairy Carpet Weed (*Glinus lotoides)*, Water Weed (*Osteocarpum acropterum* var. *deminuta)* and Hogweed (*Zaleya galericulata)*.

Sandy mound areas supported low chenopod shrubs, including Pale Poverty Bush (*Sclerolaena divaricata)*, Short-winged Copperburr (*Sclerolaena brachyptera)*, Redburr (*Sclerolaena calcarata)* and Tangled Copperburr (*Sclerolaena intricata)*.

Species associated with *E. largiflorens* sandplain and swale depressions included Blown Grass (*Agrostis avenacea)*, Flannel Cudweed (*Actinobole uliginosum)*, Woolly Heads (*Myriocephalus rhizocephalus)*, Salt Sea-spurrey (*Spergularia* sp. 3), Many-stemmed Bluebell (*Wahlenbergia multicaulis)*, Stalked Brooklime (*Gratiola pedunculata)*, Common Sneezeweed (*Centipeda cunninghamii)* and Blue Rod (*Stemodia florulenta)*.

Community 3 - Mallee Shrubland (*Eucalyptus socialis/E. dumosa*)

Benson Vegetation Community equivalent: Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (Benson 170) & Deep sand mallee of irregular dunefields of the semi-arid (warm) zones (Benson 172)

Mallee habitats form highly distinctive communities in the south-eastern parts of ML1504 (Figure 3). Two sub-communities are recognised, and differ in the presence or absence of Porcupine Grass (*Triodia scariosa* subsp. *scariosa),* which occurs within mallee on loose sandy soils of the upper slopes and crests of dunes. The *Eucalyptus socialis/ E. dumosa* - Mallee Shrubland sub-community was found on the modified ETL but not on the HAR modifications (Figure 5). Community 3 represents approximately 9.4 km (22.5%) of the length of the modified ETL.

The mallee upper storey comprised entirely tall, multi-stemmed *Eucalyptus* species including Dumosa Mallee (*E. dumosa),* Pointed Mallee (*E. socialis)*, Yorrell (*E. gracilis)* and Slender-leaf Mallee *(E. leptophylla).* The understorey is comprised of a diverse array of shrubs and herbs, including many species not found in other communities. Prominent shrubs included Erect Mallee Bluebush (*Maireana pentatropis)*, Satiny Bluebush (*Maireana georgei)*, Woolly-fruit Copperburr (*Eriochiton sclerolaenoides)*, Mallee Copperburr (*Sclerolaena parviflora)*, Grey Copperburr (*Sclerolaena diacantha)*, Mallee Goosefoot (*Chenopodium desertorum* subsp. *anidiophyllum)* and Shrubby Rice-flower (*Pimelea microcephala* subsp. *microcephala)*.

Herbaceous species included Invisible Plant (*Podolepis capillaris)*, Showy Foxtail (*Ptilotus exaltatus* var. *exaltatus)*, Long Tails (*Ptilotus polystachyus* var. *polystachyus)*, Rough Halgania

(*Halgania cyanea)*, Woolly-head Mat-rush (*Lomandra leucocephala* subsp. *robusta)*, a Fuzzweed (*Vittadinia cervicularis* var. *cervicularis)* and several Twinleaf species including Gall Weed (*Zygophyllum apiculatum)*, Climbing Twinleaf (*Z. eremaeum)* and Dwarf Twinleaf (*Z. ovatum)*.

Community 4 – Chenopod Shrubland/Grasslands - Bluebush Shrubland (***Maireana pyramidata/M. sedifolia***)

Benson Vegetation Community equivalent: Pearl Bluebush low open shrubland of the arid and semi-arid plains (Benson 154)

Extensive tracts of treeless Bluebush shrubland occur within ML1504 and surrounds. This chenopod community is dominated by several species of *Maireana* that form dense compact shrubs to about one metre in height. Black Bluebush (*M. pyramidata)* is the most dominant species in the community, while Pearl Bluebush (*M. sedifolia)* is also abundant.

The *Maireana pyramidata/ M. sedifolia* (Bluebush/ Copperburr Shrubland) was found on the modified ETL and the HAR modifications (Figure 4 and Figure 5). This community represents the majority of the HAR but only approximately 4 km (9.5%) of the ETL and approximately 24.3 km (70.9%) of the realignments to the modified HAR.

The understorey of this community is dominated by chenopods from genera such as *Dissocarpus*, *Sclerolaena* and *Atriplex*. The dominant species are Cannonballs (*Dissocarpus paradoxa)* and Limestone Copperburr (*Sclerolaena obliquicuspis)*. Other common species are Salt Copperburr (*Sclerolaena ventricosa)*, Pale Poverty-bush (*Sclerolaena divaricata)* and Pop Saltbush *(Atriplex holocarpa)*.

The Bluebush shrublands feature a wide range of ephemeral herbs in wet spring seasons, especially members of the daisy family, Asteraceae. Species include Wires and Wool (*Lemooria burkittii*), Soft Billy-buttons (*Pycnosorus pleiocephalus)*, Clay Sunray (*Rhodanthe stuartiana)*, Pigmy Sunray (*Rhodanthe pygmaeus)*, Bogan Flea (*Calotis hispidula)*, Soft Fuzzweed (*Vittadinia gracilis* and *Vittadinia cervicularis* var. *cervicularis)*. Grasses often form large, almost pure patches within this community, and include Slender Speargrass (*Austrostipa scabra* subsp. *falcata)* and Mulka (*Eragrostis dielsii)*.

Community 5 – Chenopod Shrubland/Grasslands - Copperburr Low Shrubland (***Sclerolaena spp.***)

Benson Vegetation Community equivalent: Black Roly Poly low open shrubland of the Riverina and Murray-Darling Depression Bioregions (Benson 216)

Low shrublands dominated by copperburrs, predominantly *Dissocarpus paradoxus* and *Sclerolaena* species are common within ML 1504 and along the HAR (Figure 3and Figure 4 respectively). These communities are regarded by some as artificial, resulting from overgrazing and/or clearing of natural bluebush or Belah communities.

This community has much in common with Bluebush shrubland except that bluebushes are absent. Two sub-communities were identified, *viz*. one dominated by Cannonballs (*Dissocarpus paradoxus)* and Limestone Copperburr (*Sclerolaena obliquicuspis)*, and the other by Pale Poverty-bush (*S. divaricata)* and Salt Copperburr (*S. ventricosa)*.

Common associated herb species in this community within ML 1504 include Grey Copperburr (*S. diacantha)*, Soft Billy-buttons (*Pycnosorus pleiocephalus)*, Soft Fuzzweed (*Vittadinia gracilis* and *Vittadinia cervicularis* var. *cervicularis)* and Australian Bindweed (*Convolvulus erubescens)*. Associated grasses include patches of Slender Speargrass (*Austrostipa scabra* subsp. *falcata)* and *A. nitida*.

Associates of S. ventricosa/S. divaricata include Water Weed (Osteocarpum acropterum subsp. deminuta), Eastern Flat-top Bush (Atriplex lindleyi), Short-winged Copperburr (Sclerolaena brachyptera), Sand Sida (Sida ammophila) and Fuzzweed (Vittadinia cuneata var. hirsuta). Grasses include Common Bottle-washers (Enneapogon avenaceous) and species of Speargrasses (Austrostipa spp.).

Community 6 - Depression Herbfields

Benson Vegetation Community equivalent: Couch Grass grassland wetland on river banks and floodplains of inland river systems (Benson 50)

Low lying depressions, pans or run-on areas are scattered across ML 1504. These sites form temporary ponds in wet conditions and support distinctive communities of herbs. Trees and shrubs are absent. Common species include Bogan Flea (*Calotis hispidula)*, Desert Sneezeweed (*Centipeda thespidioides)*, Common Sneezeweed (*Centipeda cunninghamii)*, Common Nardoo (*Marsilea drummondii)*, Blue Rod (*Stemodia florulenta)* and two lovegrasses, Mulka (*Eragrostis dielsii)* and Neverfail (*E. setifolia)*. This community covered a negligible proportion of ML 1504 and therefore was not mapped by Ogyris (2000).

Community 7 – Disturbed herbland/grasslands - *Austrostipa spp.* (Speargrass Grasslands)

Benson Vegetation Community equivalent: Derived corkscrew grass grassland/forbland on sandplains and plains in the semi-arid (warm) climate zone (Benson 165)

More or less extensive grassland areas, dominated by speargrasses (*Austrostipa* spp.) are scattered across the Project area. In general these areas appear to represent degraded or disturbed sites that have been colonized by grasses and other colonizing herbs, including many weeds. Although dominated by grasses, they also usually support *Dissocarpus paradoxus* and *Sclerolaena obliquicuspis*, and are therefore similar to the copperburr low shrublands that also appear to represent degraded habitats.

Associated species include Poached Eggs (*Myriocephalus stuartii*), Buckbush (*Salsola kali)*, Common Crowfoot (*Erodium cicutarium)*, and the weeds, Saffron Thistle (*Carthamus lanatus)*, Stemless Thistle (*Onopordum acaulon)*, Maltese Cockspur (*Centaurea melitensis)*, Paddy Melon (*Citrullus lanatus)*, Camel Melon (*Cucumis myriocarpus* subsp. *leptodermis)*, Black-berry Nightshade (*Solanum nigrum)* and Wild Sage (*Salvia verbenaca)*. The main grasses include Slender Speargrass (*A. scrabra* subsp. *falcata)*, Blown Grass (*Agrostis avenacea)*, Two Colour Panic (*Panicum simile)* and the introduced Red Brome (*Bromus rubens)*.

Community 8 – *Eucalyptus camaldulensis* (Riverine Woodland)

Benson Vegetation Community equivalent: River Red Gum – Warrego Grass – Couch Grass riparian tall woodland wetland of the semi-arid (warm) climate zone (Benson 8)

This community does not occur in ML 1504. The Riverine Woodland community was found only on or close to the Darling River and the Great Darling Anabranch and their major billabongs. Within the Project area, the community consists mainly of a narrow strip of trees along the top edge of the river bank/billabong along the modified ETL (Figure 5) and HAR (Figure 4). The woodland consists of River Red Gums (*Eucalyptus camaldulensis*) which give way to Black Box (*Eucalyptus largiflorens*) woodland within 20 m of the edge of the river bank/billabong.

The main tree associates of *E. camaldulensis* were Black Box (*E. largiflorens)* and River Cooba (*Acacia stenophylla)*. Associated lower shrub species include Ruby Saltbush (*Enchylaena tomentosa)*, Lignum (*Muehlenbeckia florulenta)*, Sand Sida (*Sida ammophila)* and Black Roly

Poly (*Sclerolaena muricata).* Grass and herb species include Warrego Grass (*Paspilidium jubiflorum)*, Lesser Joyweed (*Alternanthera denticulata),* Native Tobacco (*Nicotiana occidentalis* subsp. *Obliqua)*, Sneezeweed (*Centipeda cunninghamii*), Darling Pea (*Swainsona greyana)* and Slender Dock (*Rumex brownii*).

Community 9 - *Muehlenbeckia florulenta* (Dry Swamp)

Benson Vegetation Community equivalent: Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina and Murray Darling Depression Bioregions) (Benson 17)

This vegetation community was associated with the Darling River and is subject to periodic flooding and ponding (Figure 5). This community represents approximately 758.6 m (1.8%) of the modified ETL, but was not found on the HAR modifications or within ML 1504. This small Lignum swamp was fringed by River Red Gums (*Eucalypts camaldulensis*).

A total of seven native species and one weed species were recorded in this community on the modified ETL. A majority of the species in this community were from the family Chenopodiacea (3 taxa), and Myrtaceae (2 taxa).

Medicago polymorpha (Burr medic) was the only introduced understorey species found in this community.

Community 10 - Acacia/ Eremophila/ Dodonaea (Tall Shrubland)

Benson Vegetation Community equivalent: Narrow-leaved Hopbush-Scrub Turpentine-Senna shrubland on semi-arid and arid sandplains and dunes (Benson 143)

The *Acacia/Eremophila/Dodonaea* (Tall Shrubland) community occurs on the upper floodplain of the Darling River (Figure 5). Dense patches of this vegetation, represented approximately 3.4 km (8.2%) of the modified ETL. This community did not occur in ML 1504 or along the HAR.

A total of 17 native species and 4 weed species were recorded in this vegetation community on the ETL (Figure 5). A majority of the species in this community were from the family Chenopodiacea (5 taxa), Myrtaceae (3 taxa) and Mimosoideae (2 taxa).

Introduced understorey species included, *Carthamus lanatus* (Saffron thistle),*Carrichtera annua* (Ward's weed), *Medicago polymorpha* (Burr medic) and *Medicago laciniata* (Cut-leaf medic).

Cleared/Grazing

Benson Vegetation Community equivalent: (likely to be) Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW (Benson 166)

In years of higher rainfall, these cleared/grazing areas would be dominated by annual or short lived perennial grasses, herbs and forbs, particularly exotic species and weedy native species. Under current conditions grass tussocks and Chenopods are the most common vegetation (Figure 4 and Figure 5). A total of 16 native species and 4 weed species were recorded in cleared grazing land on the ETL. Cleared grazing land represents approximately 3.8 km (9.1%) of the ETL. Where the HAR follows fence lines and existing roads, corridors exists of cleared land of at least 3 m in width.

Introduced understorey species included, *Carthamus lanatus* (Saffron thistle), and *Medicago polymorpha* (Burr medic).

Appendix F Flora and fauna species at Snapper and surrounds (all recorded in EA surveys)

Table 21 Flora species recorded at Snapper and surrounds

Scientific Name	Common Name	Community							
		1	2	3	4	5	6	7	Opp
CLASS MAGNOLIOPSIDA									
SUBCLASS MAGNOLIIDAE									
Aizoaceae									
**Psilocaulon tenue*	Match-head plant	X					X		
Tetragonia moorei	A Spinach	X	X	X			X	X	
Amaranthaceae									
Ptilotus sessilifolius	Crimson Foxtail	X	X		X	X			X
Ptilotus polystachyus var. polystachyus	Long-tails				X				
Apiaceae									
Daucus glochidiatus form G	Native Carrot	X							
Asclepiadaceae									
Marsdenia australis	Native Pear		X				X		X
Asteraceae									
Brachyscome ciliaris var. ciliaris	Variable Daisy		X		X		X		
Brachyscome lineariloba	Hard-headed Daisy	X	X	X	X	X	X	X	
Calotis hispidula	Bogan Flea		X				X	X	
**Carthamus lanatus*	Saffron Thistle	X	X		X	X	X	X	X
**Centaurea melitensis*	Maltese Cockspur	X	X		X	X	X	X	
Centipeda minima	Spreading Sneezeweed								X
Chthonocephalus pseudevax	Ground-heads	X	X	X	X	X	X	X	
**Cirsium vulgare*	Spear Thistle								X
**Dittrichia graveolens*	Stinkwort	X	X	X	X		X		
Hyalosperma glutinosum ssp. glutinosum					X				
Ixiolaena leptolepis	Stalked Ixiolaena		X						
Lemooria burkittii	Wires-a-wool		X	X			X		
Olearia pimeleoides	Showy Daisy-bush		X						
**Onopordum acaulon*	Stemless Thistle	X			X		X		
Podolepis capillaris	Invisible Plant				X				
Pogonolepis muelleriana	Stiff Cup-flower						X	X	
Pseudognaphalium leuteoalbum	Jersey Cudweed								X
Pycnosorus pleiocephalus	Soft Billy-buttons	X	X	X			X		
**Reichardia tingitana*	False Sowthistle		X						
Rhodanthe pygmaea	Woolly Sunray	X	X	X					
Rhodanthe stuartiana	Clay Sunray	X	X	X			X	X	
**Sonchus oleraceus*	Common Sowthistle								X
Vittadinia cervicularis var. subcervicularis	A Fuzzweed				X				
Vittadinia cuneata var. cuneata forma cuneata	Fuzzweed		X		X	X	X	X	
Vittadinia cuneata var. hirsuta	Fuzzweed		X	X					
Vittadinia eremaea	A Fuzzweed						X		
Vittadinia gracilis	Woolly New Holland Daisy	X					X		
Boraginaceae									

**Echium plantagineum*	Paterson's Curse				X	X			
Halgania cyanea	Rough Halgania				X				
**Heliotropium supinum*	Prostrate Heliotrope								X
Omphalolappula concava	Burr Stickseed	X	X		X		X	X	
Brassicaceae									
**Alyssum linifolium*	Flax-leaf Alyssum	X	X	X			X		
**Brassica tournefortii*	Mediterranean Turnip		X		X			X	
**Carrichtera annua*	Ward's Weed	X	X	X			X	X	
Harmsiodoxa brevipes	Short Cress	X	X	X		X	X	X	
Lepidium papillosum	Warty Peppercress	X	X	X			X		
Ledidium phleobopetalum	Veined Peppercress						X		
**Sisymbrium erysimoides*	Smooth Mustard	X	X	X		X	X	X	X
Stenopetalum lineare	Threadcress	X	X	X	X		X		
Campanulaceae									
Wahlenbergia gracilenta	Annual Bluebell						X		
Caryophyllaceae									
**Gypsophila tubulosa*	Chalkwort		X				X		
**Herniaria cinerea*	Hairy Rupturewort		X		X	X	X	X	
**Silene gallica var. gallica*	French Catchfly	X	X		X	X	X	X	
**Spergularia rubra*	Sandspurrey	X	X	X	X	X			X
**Spergularia sp. 3 (Flora of Victoria)*	A Sandspurrey		X						X
Casuarinaceae									
Casuarina pauper	Black Oak		X	X			X		
Chenopodiaceae									
Atriples holocarpa	Pop Saltbush								X
Atriplex stipitata	Bitter Saltbush		X	X	X		X	X	
Atriplex suberecta	Lagoon Saltbush								X
Chenopodium cristatum	Crested Goosefoot		X						
Chenopodium curvispicatum	Cottony Saltbush		X	X					
Chenopodium desertorum ssp. desertorum	Desert Goosefoot	X	X	X	X		X		
Chenopodium desertorum ssp. rectum	A Goosefoot		X	X	X				
Chenopodium murale	Nettle-leaf Goosefoot	X							
Chenopodium nitrariaceum	Nitre Goosefoot		X				X		X
Dissocarpus biflorus var. cephalocarpa	Copperburr		X	X	X			X	
Dissocarpus paradoxus	Cannonball Burr	X	X	X	X	X	X	X	
Enchylaena tomentosa var. tomentosa	Ruby Saltbush	X	X	X		X	X		
Maireana brevifolia	Yanga Bush		X			X			X
Maireana enchylaenoides	Wingless Fissure-weed	X		X					
Maireana georgei	Slit-wing Bluebush	X	X	X	X		X		
Maireana integra	A Bluebush				X				
Maireana pentatropis	Erect Mallee Bluebush		X	X	X	X	X	X	
Maireana pyramidata	Black Bluebush		X	X			X		X
Maireana sedifolia	Pearl Bluebush		X	X	X		X	X	
Maireana trichoptera	A Bluebush		X		X		X	X	
Maireana villosa	A Bluebush		X		X				
Osteocarpum acropterum var. deminuta	Water Wood								X
Rhagodia spinescens	Spiny Saltbush		X	X					
Salsola kali	Buckbush		X	X	X		X	X	

Sclerolaena diacantha	Grey Copperburr	X	X	X			X	X	
Sclerolaena divaricata	Tangled Copperburr								X
Sclerolaena obliquicuspis	Limestone copperburr	X	X	X	X	X	X	X	
Sclerolaena parviflora	Mallee Copperburr				X				
Sclerolaena patenticuspis	Spear-fruit Copperburr	X	X	X	X	X	X	X	X
Crassulaceae									
Crassula colorata	Dense Stonecrop				X				
Cucurbitaceae									
**Citrullus colocynthis*	Wild Watermellon								X
Fabaceae: Faboideae									
Eutaxia microphylla	Mallee Bush-pea				X				
**Medicago polymorpha*	Burr Medic	X	X	X	X	X	X	X	X
**Medicago truncatula*	Barrel Medic	X	X				X	X	
Templetonia egena	Desert Broombush					X			
Fabaceae: Mimosoideae									
Acacia colletioides	Spine Bush	X	X	X	X		X		
Acacia oswaldii	Miljee					X			
Acacia rigens	Needle Wattle				X				
Geraniaceae									
**Erodium cicutarium*	Common Storksbill						X	X	
Erodium crinitum	Blue Storksbill		X						X
Goodeniaceae									
Goodenia sp.	A Goodenia						X		
Haloragaceae									
Myriophyllum verrucosum	Red Water-milfoil								X
Lamiaceae									
**Marrubium vulgare*	Horehound		X						X
**Salvia verbenaca*	Wild Sage		X	X		X	X	X	X
Teucrium racemosum	Grey Germander	X							
Westringia rigida	Stiff Westringia				X				
Loranthaceae									
Amyema linophyllum ssp. orientale	Slender Mistletoe		X						
Amyema preissii	Wireleaf Mistletoe	X							
Lysiana exocarpi ssp. exocarpi	Harlequin Mistletoe	X	X						
Malvaceae									
**Malva parviflora*	Small-flowered Mallow		X						X
Sida sp.	A Sida		X					X	
Myoporaceae									
Eremophila glabra	Tar Bush		X		X	X			
Eremophila sturtii	Turpentine Bush	X		X		X			
Myoporum platycarpum ssp. platycarpum	Sugarwood		X	X					
Myrtaceae									
Baeckea crassifolia	Desert Heath-myrtle				X				
Eucalyptus dumosa	Congoo mallee			X	X				
Eucalyptus gracilis	Yorrell			X	X				
Eucalyptus largiflorens	Black Box	X							
Eucalytpus socialis	Pointed Mallee			X	X				
Nitrariaceae									
Nitraria billardierei	Dillon Bush		X						X
Plantaginaceae									
Plantago drummondii	Dark Sago-weed						X	X	

Plumbaginaceae									
**Limonium lobatum*	Winged Sea Lavender		X	X	X	X	X		X
Polygonaceae									
Rumex crystallinus	Shiny Dock								X
Portulacaceae									
Calandrinia eremaea	Small Purslane				X				
Proteaceae									
Grevillea huegelii	Comb Spider-flower		X	X	X				
Rutaceae									
Geijera parviflora	Wilga		X	X			X		
Santalaceae									
Exocarpus aphyllus	Leafless Ballart		X	X			X		
Sapindaceae									
Alectryon oleifolius ssp. canescens	Rosewood	X	X	X			X		
Dodonaea viscosa ssp. angustissima	Narrow-leaf Hopbush				X	X			
Scrophulariaceae									
Stemodia florulenta	Bluerod	X							X
Solanaceae									
**Nicotiana glauca*	Tree Tobacco								X
**Solanum nigrum*	Black-berry Nightshade								X
Zygophyllaceae									
Zygophyllum ammophilum	Sand Twinleaf	X	X	X			X		
Zygophyllum angustifolium	Scrambling Twinleaf				X				
Zygophyllum apiculatum	Gall Weed			X	X				
Zygophyllum crenatum	Lobed Twinleaf		X						
Zygophyllum eremaeum	Climbing Twinleaf				X				
Zygophyllum ovatum	Dwarf Twinleaf		X	X			X	X	
Zygophyllum sp.							X	X	
SUBCLASS LILIIDAE									
Asphodelaceae									
Bulbine semibarbata	Wild Onion	X						X	
Lomandraceae									
Lomandra effusa	Scented Mat-rush				X				
Phormiaceae									
Dianella revoluta	Blue Flax-lily				X				
Poaceae									
Austrodanthonia caespitosa	White Top	X	X				X	X	
Austrostipa nitida	Speargrass	X	X	X	X	X	X	X	X
Austrostipa verticillate	Slender Bamboo Grass		X						
Bromus arenarius	Sand Brome		X			X	X		
**Bromus rubens*	Red Brome		X						
**Hordeum glaucum*	Northern Barley Grass	X	X	X		X	X		X
Lachnagrostis filiformis	Blown Grass								X
**Rostraria pumila*	Roughtail		□o						
**Schismus barbatus*	Arabian Grass	X	X	X		X	X	X	
Triodia scariosa ssp. scariosa	Porcupine Grass				X				
**Vulpia muralis*	A Fescue	X	X				X	X	

Table 22 Fauna species recorded at Snapper and surrounds

Scientific Name	Common Name	Observation 1
REPTILIA		
Amphibolurus nobbi	Nobbi Dragon	U
Pogona vitticeps	Central Bearded Dragon	C
Morelia spilota variegata	Carpet Python	1 skeleton
Pseudechis australis	Mulga Snake	1
Pseudonaja textilis	Eastern Brown Snake	1
Parasuta nigriceps	Short Tailed Snake	1
Diplodactylus vittatus	Eastern Stone Gecko	U
Gehyra variegata	Varied Dtella	C
Heteronotia binoei	Prickly Gecko	C
Lucasium damaeum	Beaded Gecko	U
Rhynchoedura ornata	Beaked Gecko	C
Underwoodisaurus milii	Thick-tailed Gecko	U
Cryptoblepharus carnabyi	Shiny-palmed Shinning-skink	U
Ctenotus atlas	Southern Mallee Ctenotus	U
Ctenotus brachyonix	-	U
Ctenotus regius	Pale-rumped Ctenotus	C
Ctenotus schomburgkii	Barred Wedge-snout Ctenotus	C
Lerista punctatovittata	Eastern Robust Slider	U
Morethia boulengeri	South-eastern Morethia Skink	C
Tiliqua occipitalis	Western Blue-tongued Lizard	1 skin
Tiliqua rugosa	Shingleback Lizard	U
Varanus gouldii	Sand Monitor	U
AVES		
Acanthiza apicalis	Inland Thornbill	U
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	U
Acanthiza uropygialis	Chestnut-rumped Thornbill	A
Aphelocephala leucopsis	Southern Whiteface	C
Smicrornis brevirostris	Weebill	U
Accipiter cirrhocephalus	Collared Sparrowhawk	1
Aquila audax	Wedge-tailed Eagle	1 nest
Hieraaetus morphnoides	Little Eagle	1
Aegotheles cristatus	Australian Owlet-nightjar	C
Anas gracilis	Grey Teal	U
Cracticus nigrogularis	Pied Butcherbird	C
Cracticus torquatus	Grey Butcherbird	C
Gymnorhina tibicen	Australian Magpie	A
Cacatua leadbeateri	Major Mitchell's Cockatoo	U
Eolophus roseicapillus	Galah	C
Nymphicus hollandicus	Cockatiel	U
Dromaius novaehollandiae	Emu	U
Climacteris affinis	White-browed Treecreeper	U
Climacteris picumnus2	Brown Treecreeper	C
Ocyphaps lophotes	Crested Pigeon	U
Phaps chalcoptera	Common Bronzewing	U
Corcorax melanorhamphos	White-winged Chough	U
Struthidea cinerea	Apostlebird	U
Corvus coronoides	Australian Raven	C
Corvus mellori	Little Raven	C
Dicaeum hirundinaceum	Mistletoebird	U
Grallina cyanoleuca	Magpie-lark	U
Rhipidura leucophrys	Willie Wagtail	U

Falco berigora	Brown Falcon	U
Falco cenchroides	Nankeen Kestrel	U
Falco peregrinus	Peregrine Falcon	1
Hirundo ariel	Fairy Martin	old nests
Malurus leucopterus	White-winged Fairy-wren	U
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	C
Lichenostomus ornatus	Yellow-plumed Honeyeater	1
Lichenostomus virescens	Singing Honeyeater	C
Melithreptus brevirostris	Brown-headed Honeyeater	1
Manorina flavigula	Yellow-throated Miner	U
Plectorhyncha lanceolata	Striped Honeyeater	U
Merops ornatus	Rainbow Bee-eater	U
Anthus australis	Australian Pipit	U
Daphoenositta chrysoptera	Varied Sitella	1
Colluricincla harmonica	Grey Shrike-thrush	U
Oreoica gutturalis	Crested Bellbird	C
Pachycephala rufiventris	Rufous Whistler	U
Melanodryas cucullata cucullata	Hooded Robin	U
Petroica goodenovii	Red-capped Robin	A
Podargus strigoides	Tawny Frogmouth	U
Pomatostomus ruficeps	Chestnut-crowned Babbler	C
Barnardius zonarius barnardi	Mallee Ringneck	C
Northiella haematogaster	Blue Bonnet	U
Psephotus varius	Mulga Parrot	U
Tyto alba	Barn Owl	U
Mammalia		
Capra hircus	Feral Goat	C
Ovis aries	Sheep	U
Vulpes vulpes	Red Fox	U
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	U
Orictylagus cuniculus	Rabbit	U
Macropus giganteus	Eastern Grey Kangaroo	1
Macropus fuliginosus	Western Grey Kangaroo	C
Macropus rufus	Red Kangaroo	C
Nyctinomus/Tadarida australis	White-striped Mastiff Bat	U
Mormopterus sp. 3		U
Mormopterus sp. 4		U
Mus musculus	House Mouse	U
Tachyglossus aculeatus	Short-beaked Echidna	U
Chalinolobus gouldii	Gould's Wattled Bat	U
Chalinolobus morio	Chocolate Wattled Bat	1 (?)
Chalinolobus picatus	Little Pied Bat	U
Nyctophilus sp./spp.	Unidentified Long-eared Bat	U
Scotorepens balstoni	Inland Broad-nosed Bat	U
Scotorepens greyii	Little Broad-nosed Bat	U
Vespadelus spp.	Unidentified Eptesicus	U

[1] Observation

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

Appendix G Vegetation descriptions for Snapper and surrounds

Vegetation Community 1 – Black Box Woodland

Benson Vegetation Community equivalent: Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (Benson 15)

Black Box Woodland occurs in and around a small playa depression in the north of the study area (Figure 7). The vegetation community is characterised by a single dominant tree species, Black Box (*Eucalyptus largiflorens*). Depressions containing Black Box typically accumulate water from the surrounding landscape and may occasionally be subject to periods of prolonged inundation. The vegetation community is an open-woodland formation with few shrubs in the understorey. Within the study area the main associate was a low tree, Rosewood (*Alectryon oleifolius* subsp. *canescens*). The only tall shrubs recorded were Spine Bush (*Acacia colletioides*) and Turpentine (*Eremophila sturtii*). The dominant low shrub was Ruby Saltbush (*Enchylaena tomentosa* var. *tomentosa*). The groundcover comprised a mixture of native chenopods, grasses and herbs, intermingled with introduced herbs and grasses. The dominant native groundcovers were Limestone Copperburr (*Sclerolaena obliquicuspis*), a Speargrass (*Austrostipa nitida*), Warty Peppercress (*Lepidium papillosum*) and Pygmy Sunray (*Rhodanthe pygmaea*). The introduced herbs and grasses were mainly Burr Medic (*Medicago polymorpha*) Barrel Medic (*Medicago truncatula*) Arabian Grass (*Schismus barbatus*) and a Fescue (*Vulpia muralis*).

Vegetation Community 2 – Black Oak (Belah)-Rosewood-Wilga Woodland

Benson Vegetation Community equivalent: Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray-Darling Depression (Benson 58)

Community 2 is the main natural vegetation community in the study area (Figure 7 and Figure 8). It is a low open-woodland dominated by Black Oak (*C. pauper*) in association with varying amounts of Rosewood (*A. oleifolius* subsp. *canescens*) and Wilga (*G. parviflora*). The shrub layer is dominated by several Bluebush (*Maireana*) species, mainly Pearl Bluebush (*M. sedifolia*) and Black Bluebush (*M. pyramidata*) but with Erect Mallee Bluebush (*M. pentatropis*) and A Bluebush (*M. trichoptera*) prominent on some plots. The main native ground cover species were also chenopods including Cannonball Burr (*Dissocarpus paradoxus*), Limestone Copperburr (*Sclerolaena obliquicuspis*), Ruby Saltbush (*Enchylaena tomentosa* var. *tomentosa*) and Bitter Saltbush (*Atriplex stipitate*). Other prominent native species included A Spinach (*Tetragonia moorei*), Hard-headed Daisy (*Brachyscome lineariloba*), Variable Daisy (*B. ciliaris* var. *ciliaris*), Ground Heads (*Chthonocephalus pseudevax*), Warty Peppercress (*Lepidium papillosum*), Narrow Thread-petal (*Stenopetalum lineare*), Sand Twinleaf (*Zygophyllum ammophilum*) and Speargrass (*Austrostipa* sp.). Several introduced ground cover species were also common in vegetation community 2 including Flax-leaf Alyssum (*Alyssum linifolium*), Smooth Mustard (*Sisymbrium erysimoides*), Hairy Rupture-wort (*Herniaria cinerea*), Sandspurrey (*Spergularia rubra*), Burr Medic (*Medicago polymorpha*), Northern Barley Grass (*Hordeum glaucum*) and Arabian Grass (*Schismus barbatus*).

Vegetation Community 3 – Chenopod Mallee Woodland/Shrubland

Benson Vegetation Community equivalent: Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (Benson 170)

Chenopod Mallee Shrubland with a predominantly Bluebush/Copperburr understorey occurs in the study area (Figure 7) and is also known as Sandplain Mallee (Porteners *et al.,* 1997). This vegetation community occurs on sandy soils with a higher clay content than for vegetation community 4, which occurs on sand dunes. The dominant mallee eucalypt species are the same for the two communities; White Mallee (*E. dumosa*), Pointed Mallee (*E. socialis*) and Yorrell (*E. gracilis*). Rosewood (*A. oleifolius* subsp. *canescens*) occurred in two vegetation community 3 quadrats as a codominant and was absent from vegetation community 4. Similarly, the tall shrub, Spine Bush (*Acacia colletioides*) was common in vegetation community 3 and absent from vegetation community 4. However, the main differences between communities 3 and 4 are in the understorey. Vegetation community 3 is dominated by the chenopods Black Bluebush (*Maireana pyramidata*) and Erect Mallee Bluebush (*M. pentatropis*) in the low shrub layer. The dominant native ground cover species were A Spinach (*Tetragonia moorei*), Narrow Thread-petal (*Stenopetalum lineare*), Cannonball Burr (*Dissocarpus paradoxus*), Wingless Fissure-burr (*Maireana enchylaenoides*), Limestone Copperburr (*Sclerolaena obliquicuspis*) and Sand Twinleaf (*Zygophyllum ovatum*). The main introduced species found in vegetation community 3 were Wards's Weed (*Carrichtera annua*), Smooth Mustard (*Sisymbrium erysimoides*), Sandspurrey (*Spergularia rubra*), Northern Barley Grass (*Hordeum glaucum*) and Arabian Grass (*Schismus barbatus*).

Vegetation Community 4 – Irregular Dune Mallee Shrubland

Benson Vegetation Community equivalent: Deep sand mallee of irregular dunefields of the semi-arid (warm) zone (Benson 172)

Mallee Shrubland with a predominantly Spinifex (*Triodia scariosa* subsp. *scariosa*) understorey occurs only in the easternmost corner of the study area in the south (Figur e7). This vegetation community occurs on loose sandy soils of low clay content, on irregular sand dunes (Porteners *et al.,* 1997) in the study area. The overstorey mallee eucalyptus species are the same as for vegetation community 3; White Mallee (*Eucalyptus dumosa*), Pointed Mallee *(E. socialis*) and Yorrell (*E. gracilis*). However, the loose sandy soils support a very different array of understorey species from that of vegetation community 3. As well as the dominant spinifex, vegetation community 3 included the native shrubs Erect Mallee Bluebush (*Maireana pentatropis*) and Rough Halgania (*Halgania cyanea*). Native ground cover species were predominantly Long-tails (*Ptilotus polystachyus*), Narrow Thread-petal (*Stenopetalum lineare*), Cannonball Burr (*Dissocarpus paradoxus*), Gall Weed (*Zygophyllum apiculatum*) and Speargrass (*A. nitida*). The dominant introduced species were Saffron Thistle (*Carthamus lanatus*), Maltese Cockspur *(Centaurea melitensis*), Hairy Rupture-wort (*Herniaria cinerea*), French Catchfly (*Silene gallica* var. *gallica*) and Sandspurrey (*Spergularia rubra*).

Vegetation Community 5 – Turpentine Shrubland

Benson Vegetation Community equivalent: Narrow-leaved Hopbush-Shrub Turpentine-Senna shrubland on semi-arid and arid sandplains and dunes (Benson 143)

A small area of shrubland dominated by Turpentine (*Eremophila sturtii*) occurs in the south-east of the study area adjacent to the patch of vegetation community 4 (Figure 7). Low native shrubs included Ruby Saltbush (*Enchylaena tomentosa* var. *tomentosa*), Yanga Bush (*Maireana brevifolia*), Erect Mallee Bluebush (*M. pentatropis*) and Tar Bush (*Eremophila glabra*). Native ground covers included Crimson Foxtail (*Ptilotus sessilifolius*), Ground-heads (*Chthoncephalus*

pseudevax), Fuzzweed (*Vittadinia cuneata* var. *cuneata* forma *cuneata*), Short Cress (*Harmsiodoxa brevipes*), Cannonball Burr *Dissocarpus paradoxus*), Limestone Copperburr (*Sclerolaena obliquicuspis*), Spear-fruit Copperburr (*Sclerolaena patenticuspis*), Speargrass (*Austrostipa nitida*) and Sand Brome (*Bromus arenarius*). Introduced ground cover species included mainly Burr Medic (*Medicago polymorpha*), Northern Barley Grass (*Hordeum glaucum*) and Arabian Grass (*Schismus barbatus*) with small amounts of Winged Sea Lavender (*Limonium lobatum*), Wild Sage (*Salvia verbenaca*), Hairy Rupture-wort (*Herniaria. cinerea*), French Catchfly (*S. gallica* var. *gallica*), Sandspurrey (*Spergularia rubra*) and Smooth Mustard (*Sisymbrium erysimoides*).

Vegetation Community 6 – Bluebush Shrubland

Benson Vegetation Community equivalent: Pearl Bluebush low open shrubland of the arid and semi-arid plains (Benson 154)

Natural communities dominated by Black Bluebush (*Maireana pyramidata*) and/or Pearl Bluebush (*M. sedifolia*) occur on calcareous soils in south western NSW (Porteners *et al.,* 1997; Benson *et al.,* 2006), and Black Bluebush is also known to occur commonly in the shrub layer of Black Oak-Rosewood-Wilga Woodland (vegetation community 2) (Porteners *et al.,* 1997). On the study area both Black and Pearl Bluebushes originally occurred as part of the understorey of vegetation community 2. Most, if not all, Bluebush Shrubland in the study area (Figure 7 and Figure 8) is regeneration following clearing of the overstorey trees from areas of vegetation community 2. Evidence of past clearing activities was observed in many parts of the study area where fallen Black Oak (*Casuarina pauper*) logs were common on the ground in bluebush dominated areas. The main bluebush in the study area is Pearl Bluebush (*M. sedifolia*) closely followed by Black Bluebush (*M. pyramidata*). Vegetation community 6 areas may have remnant isolated trees of Black Oak, Rosewood, Wilga, and occasional Sugarwood (*Myoporum platycarpum*).

The native ground cover in vegetation community 6 was more diverse than in the original vegetation community 2 owing to the removal of the canopy, and comprised mainly daisies, chenopods, and some other herbs and grasses. The dominant species included Hard-headed Daisy (*Brachyscome lineariloba*), Bogan Flea (*Calotis hispidula*), Soft Billy-buttons (*Pycnosorus pleiocephalus*), Clay Sunray (*Rhodanthe stuartiana*), Fuzzweed (*Vittadinia cuneata* var. *cuneata* forma *cuneata*), Woolly New Holland Daisy (*Vittadinia gracilis*), Short Cress (*Harmsiodoxa brevipes*), Narrow Thread-petal (*Stenopetalum lineare*), Cannonball Burr (*Dissocarpus paradoxus*), Limestone Copperburr (*Sclerolaena obliquicuspis*), Speargrass (*Austrostipa nitida*) and Sand Brome (*Bromus arenarius*). Introduced ground cover species were common in this vegetation community and included mainly Maltese Cockspur (*Centaurea melitensis*), Stinkwort (*Dittrichia graveolens*), Flax-leaf Alyssum (*Alyssum linifolium*), Ward's Weed (*Carrichtera annua*), Smooth Mustard (*Sisymbrium erysimoides*), Hairy Rupture-wort (*Herniaria cinerea*), French Catchfly (*Silene gallica* var. *gallica*), Burr Medic (*Medicago polymorpha*), Winged Sea Lavender (*Limonium lobatum*), Northern Barley Grass (*Hordeum glaucum*) and Arabian Grass (*Schismus barbatus*).

Vegetation Community 7 – *Austrostipa* Grassland

Benson Vegetation Community equivalent: Derived corkscrew grass/grassland/forbland on sandplains and plains in the semi-arid (warm) climate zone (Benson 165)

Austrostipa Grassland represents the final stage in the clearing of vegetation community 2, in which the Bluebush shrub component is lost in addition to the original tree cover. However, it is possible that some patches dominated by Speargrass *(A. nitida)* have been grasslands since the time of white settlement, particularly in the far north of the study area (Figure 3). Remnant

bluebushes, mainly Black Bluebush (*M. pyramidata*) and Pearl Bluebush (*M. sedifolia*) are present in some grassland patches. Very high levels of weeds occur in the mostly pure grassland areas in the north of the study area and may dominate. Apart from Speargrass, native groundcover species in the grassland areas include Clay Sunray (*Rhodanthe stuartiana*), Fuzzweed (*Vittadinia cuneata* var. *cuneata* forma *cuneata*), Burr Stickseed (*Omphalolappula concave*), Copperburr (*Dissocarpus biflorus* var. *cephalocarpa*), Cannonball Burr (*D. paradoxus*), Limestone Copperburr (*Sclerolaena obliquicuspis*) and Spear-fruit Copperburr (*S. patenticuspis*). The dominant introduced species include Ward's Weed (*Carrichtera annua*), Mediterranean Turnip (*Brassica tournefortii*), Burr Medic (*Medicago polymorpha*), Wild Sage (*Salvia verbenaca*) and Arabian Grass (*Schismus barbatus*).

Appendix H Crayfish flora and fauna species (all species recorded in EA surveys)

Table 23 Flora species recorded at Crayfish and surrounds

Scientific Name	Common Name
CLASS FILICOPSIDA	
Marsileaceae	
Marsilea drummondii	Common Nardoo
CLASS MAGNOLIOPSIDA	
SUBCLASS MAGNOLIIDAE	
Aizoaceae	
**Psilocaulon tenue*	Wiry Noon-flower
Tetragonia eremaea	Native Spinach
Tetragonia moorei	Native Spinach
Amaranthaceae	
Alternanthera nodiflora	Common Joyweed
Ptilotus exaltatus var. exaltatus	Tall Mulla Mulla
Ptilotus gaudichaudii var. parviflorus	Paper Foxtail
Ptilotus seminudus	Rabbit Tails
Ptilotus spathulatus	Pussytails
Apiaceae	
Daucus glochidiatus	Form C Native Carrot
Apocynaceae	
Marsdenia australis	Doubah
Asteraceae	
Actinobole uliginosum	Flannel Cudweed
Brachyscome ciliaris var. lanuginosa	Variable Daisy
Brachyscome lineariloba	Hard-headed Daisy
Calotis hispidula	Bogan Flea
**Centaurea melitensis*	Maltese Cockspur
Centipeda crateriformis subsp. compacta	A Sneezweed
Centipeda crateriformis subsp. crateriformis	A Sneezweed
Centipeda cunninghamii	Common Sneezeweed
Centipeda thespidioides	Desert Sneezeweed
**Cirsium vulgare*	Spear Thistle
**Conyza bonariensis*	Flaxleaf Fleabane
**Dittrichia graveolens*	Stinkwort
Elachanthus pusillus	Elachanth
Euchiton sphaericus	Common Cudweed
Gnephosis tenuissima	Dwarf Cup-flower
**Hypochaeris glabra*	Smooth Catsear
**Hypochaeris radicata*	Catsear
Isoetopsis graminifolia	Grass cushions
Lemooria burkittii	Wires-a-wool

Scientific Name	Common Name
Myriocephalus pluriflorus	Woolly-heads
Olearia pimeleoides	Showy Daisy-bush
**Onopordum acaulon*	Stemless Thistle
Podolepis capillaris	Invisible Plant
Pogonolepis muelleriana	Stiff Cup-flower
Polycalymma stuartii	Poached Eggs
Pseudognaphalium luteoalbum	Jersey Cudweed
Pterocaulon sphacelatum	Fruit-salad Plant
**Reichardia tingitana*	False Sowthistle
Rhodanthe floribunda	Common White Sunray
Rhodanthe stuartiana	Clay Sunray
**Sonchus oleraceus*	Common Sowthistle
Triptilodiscus pygmaeus	Common Sunray
Vittadinia cervicularis var. cervicularis	A Fuzzweed
Vittadinia cervicularis var. subcervicularis	A Fuzzweed
Vittadinia cuneata var. hirsuta	Fuzzweed
Vittadinia cuneata var. morrisii	Fuzzweed
Vittadinia dissecta var. hirta	A Fuzzweed
Vittadinia eremaea	A Fuzzweed
Vittadinia gracilis	A Fuzzweed
**Xanthium spinosum*	Bathurst Burr
Boraginaceae	
Halgania cyanea	Rough Halgania
**Heliotropium curassavicum*	Smooth Heliotrope
**Heliotropium supinum*	Prostrate Heliotrope
Brassicaceae	
**Alyssum linifolium*	Flax-leaf Alyssum
Arabidella trisecta	Shrubby Cress
**Brassica tournefortii*	Mediterranean Turnip
**Carrichtera annua*	Ward's Weed
Phlegmatospermum cochlearinum	Oval-podded Cress
**Sisymbrium erysimoides*	Smooth Mustard
Stenopetalum lineare	Threadcress
Campanulaceae	
Wahlenbergia gracilenta	Annual Bluebell
Wahlenbergia tumidifructa	A Bluebell
Caryophyllaceae	
Gypsophila tubulosa	Chalkwort
**Herniaria cinerea*	Dense Mat-plant
**Polycarpon tetraphyllum*	Four-leaf Allseed
**Silene apetala*	A Catchfly
**Spergularia rubra*	Sandspurry
Casuarinaceae	
Casuarina pauper	Belah

Scientific Name	Common Name
Chenopodiaceae	
Atriplex acutibractea subsp. acutibractea	A Saltbush
Atriplex stipitata	Bitter Saltbush
Chenopodium cristatum	Crested Goosefoot
Chenopodium curvispicatum	Cottony Saltbush
Chenopodium desertorum subsp. desertorum	Desert Goosefoot
**Chenopodium murale*	Nettle-leaf Goosefoot
Chenopodium nitrariaceum	Nitre Goosefoot
Dissocarpus biflorus var. cephalocarpa	Copperburr
Dissocarpus paradoxus	Cannonball Burr
Enchylaena tomentosa	Ruby Saltbush
Einadia nutans subsp. nutans	Climbing Saltbush
Maireana astrotricha	Low Bluebush
Maireana brevifolia	Yanga Bush
Maireana decalvans	Black Cotton Bush
Maireana georgei	Slit-wing Bluebush
Maireana pentagona	Hairy Bluebush
Maireana pentatropis	Erect Mallee Bluebush
Maireana pyramidata	Black Bluebush
Maireana sedifolia	Pearl Bluebush
Maireana sclerolaenoides	Woolly-fruit Copperburr
Maireana trichoptera	Pink-seeded Bluebush
Maireana triptera	Three Wing Bluebush
Maireana turbinata	Satiny Bluebush
Osteocarpum acropterum var. deminuta	Water Weed
Salsola kali	Buckbush
Salsola kali var. strobilifera	Buckbush
Salsola tragus	Buckbush
Scleroblitum atriplicinum	Purple Goosefoot
Sclerolaena diacantha	Grey Copperburr
Sclerolaena obliquicuspis	Limestone copperburr
Sclerolaena parviflora	Mallee Copperburr
Sclerolaena patenticuspis	Spear-fruit Copperburr
Convolvulaceae	
Convolvulus clementii	Desert Bindweed
Convolvulus crispifolius	A Bindweed
Convolvulus remotus	A Bindweed
Crassulaceae	
Crassula colorata var. acuminata	Dense Stonecrop
Cucurbitaceae	
**Citrullus colocynthis*	Colocynth
**Cucumis myriocarpus*	Paddy Melon
Elatinaceae	
Bergia trimera	Small Water-fire

Scientific Name	Common Name
Euphorbiaceae	
Chamaesyce drummondii	Caustic Weed
Fabaceae: Caesalpinioideae	
Senna artemisioides subsp. x coriacea	Desert Cassia
Fabaceae: Faboideae	
**Medicago minima*	Woolly Burr Medic
**Medicago polymorpha*	Burr Medic
**Medicago truncatula*	Barrel Medic
Swainsona microphylla	Poison Swainson-pea
Fabaceae: Mimosoideae	
Acacia colletioides	Spine Bush
Acacia ligulata	Sandhill Wattle
Acacia loderi	Nealie
Acacia oswaldii	Umbrella Wattle
Acacia victoriae	Elegant Wattle
Gentianaceae	
**Centaurium tenuiflorum*	Branched Centaury
Geraniaceae	
Erodium crinitum	Blue Storksbill
Goodeniaceae	
Goodenia heteromera	Spreading Goodenia
Goodenia pinnatifida	Scrambled Eggs
Goodenia pusilliflora	Small-flowered Goodenia
Lamiaceae	
**Marrubium vulgare*	White Horehound
**Salvia verbenaca*	Wild Sage
Teucrium racemosum	Forest Germander
Loranthaceae	
Amyema linophyllum	Belah Mistletoe
Amyema preissii	Wireleaf Mistletoe
Lysiana exocarpi subsp. exocarpi	Harlequin mistletoe
Malvaceae	
Abutilon halophilum	Plains Lantern-bush
**Malva parviflora*	Small Flowered Mallow
Sida ammophila	Sand Sida
Sida corrugata	Corrugated Sida
Sida intricata	Twiggy Sida
Myoporaceae	
Eremophila longifolia	Emubush
Eremophila sturtii	Turpentine Bush
Myoporum platycarpum subsp. platycarpum	Sugarwood
Myrtaceae	
Eucalyptus dumosa	Congoo mallee
Eucalyptus gracilis	Yorrell

Scientific Name	Common Name
Eucalyptus largiflorens	Black Box
Eucalyptus socialis	Pointed Mallee
Oxalidaceae	
Oxalis perennans	Creeping Oxalis
Pittosporaceae	
Pittosporum angustifolium	Weeping Pittosporum
Plantaginaceae	
Plantago turrifera	Small Sago-weed
Polygonaceae	
Rumex crystallinus	Shiny Dock
Portulacaceae	
Calandrinia eremaea	Small Purslane
Rubiaceae	
Synaptantha tillaeacea	Native Madder
Rutaceae	
Geijera parviflora	Wilga
Santalaceae	
Exocarpos aphyllus	Leafless Ballart
Sapindaceae	
Alectryon oleifolius subsp. canescens	Western Rosewood
Dodonaea viscosa subsp. angustissima	Narrow-leaf hopbush
Scrophulariaceae	
Stemodia florulenta	Bluerod
Solanaceae	
Lycium australe	Australian Boxthorn
Nicotiana goodspeedii	Small-flowered Tobacco
Solanum esuriale	Quena
**Solanum nigrum*	Black-berry Nightshade
Thymelaeaceae	
Pimelea trichostachya	Spiked Rice-flower
Verbenaceae	
**Verbena officinalis*	Common Verbena
**Verbena supina*	Trailing Verbena
Zygophyllaceae	
Zygophyllum ammophilum	Sand Twinleaf
Zygophyllum apiculatum	Gallweed
Zygophyllum eremaeum	Climbing Twinleaf
Zygophyllum glaucum	Pale Twinleaf
Zygophyllum iodocarpum	Violet Twinleaf
Zygophyllum ovatum	Dwarf Twinleaf
Zygophyllum simile	A Twinleaf
SUBCLASS LILIIDAE	
Anthericaceae	
Thysanotus baueri	Mallee Fringe Lily

Scientific Name	Common Name
Asphodelaceae	
Bulbine semibarbata	Native Leek
Lomandraceae	
Lomandra leucocephalasubsp. robusta	Woolly-head Matrush
Poaceae	
Austrostipa nitida	Variable Speargrass
**Bromus rubens*	Red Brome
Enneapogon avenaceus	Bottle Washers
Eragrostis dielsii	Mallee Lovegrass
Eragrostis eriopoda	Woollybutt Grass
Eragrostis falcata	Sickle Lovegrass
**Hordeum sp.*	Barley Grass
Lachnagrostis filiformis	Blown Grass
Paspalidium constrictum	Knottybutt Grass
Rhytidosperma caespitosum	Ringed Wallaby Grass
**Schismus barbatus*	Arabian Grass
Triodia scariosa subsp. scariosa	Porcupine Grass
**Vulpia myuros*	Rat's Tail Fescue
Total Native Species	**145**
Total Introduced Species	**38**
Total Species	**183**

Table 24 Fauna species recorded at Crayfish and surrounds by Biodiversity Monitoring Services 2012.

Common name	Scientific name	BC Act	EPBC Act
Mammals			
Cat *	*Felis catus **		Invasive
Dog*	*Canis familiaris **		
European cattle*	*Bos taurus **		
Feral Pig *	*Sus scrofa **		Invasive
Forest Bat	*Vespadelus sp.*		
Goat*	*Capra hircus **	Pest Species	Invasive
Gould's Wattled Bat	*Chalinolobus gouldii*		
House Mouse	*Mus musculus*		
Inland Broad-nosed Bat	*Scotorepens balstoni*		
Inland Forest Bat	*Vespadelus baverstocki*	Vulnerable	
Inland Freetail Bat	*Mormopterus sp 3*		
Little Forest Bat	*Vespadelus vulturnus*		
Little Pied Bat	*Chalinolobus picatus*	Vulnerable	
Long-eared Bat	*Nyctophilus geoffroyi*		
Rabbit*	*Oryctolagus cuniculus **	Pest Species	
Red Fox *	*Vulpes vulpes **		Invasive
Red Kangaroo	*Macropus rufus*		
Sheep*	*Ovis aries **		
Short-beaked Echidna	*Tachyglossus aculeatus*		
Southern Freetail Bat	*Mormopterus sp 4*		
Western Grey Kangaroo	*Macropus fuliginosus*		
White-striped Mastiff Bat	*Tadarida australis*		
Birds			
Apostlebird	*Struthidea cinerea*		
Australasian Grebe	*Tachybaptus novaehollandiae*		
Australasian Pipit	*Anthus australis*		
Australian Hobby	*Falco longipennis*		
Australian Magpie	*Gymnorhina tibicen*		
Australian Owletnightjar	*Aegotheles cristatus*		
Australian Raven	*Corvus coronoides*		
Australian Ringneck	*Barnardius zonarius*		
Australian Wood Duck	*Chenonetta jubata*		
Barn Owl	*Tyto alba*		
Black-faced Cuckooshrike	*Coracina novaehollandiae*		
Black-faced Woodswallow	*Artamus cinereus*		
Black-fronted Dotterel	*Elseyornis melanops*		
Black-shouldered Kite	*Elanus axillaris*		
Black-tailed Native-hen	*Tribonyx ventralis*		
Bluebonnet	*Northiella haematogaster*		
Brown Falcon	*Falco berigora*		
Brown Treecreeper	*Climacteris picumnus*		

Brown-headed Honeyeater	*Melithreptus brevirostris*		
Chestnut-crowned Babbler	*Pomatostomus ruficeps*		
Chestnut-rumped Thornbill	*Acanthiza uropygialis*		
Collared Sparrowhawk	*Accipiter cirrocephalus*		
Common Bronzewing	*Phaps chalcoptera*		
Crested Bellbird	*Oreoica gutturalis*		
Crested Pigeon	*Ocyphaps lophotes*		
Diamond Dove	*Geopelia cuneata*		
Emu	*Dromaius novaehollandiae*		
Galah	*Eolophus roseicapillus*		
Grey Butcherbird	*Cracticus torquatus*		
Grey Fantail	*Rhipidura albiscapa*		
Grey Shrike-thrush	*Colluricincla harmonica*		
Grey Teal	*Anas gracilis*		
Hardhead	*Aythya australis*		
Hooded Robin	*Melanodryas cucullata*		
Jacky Winter	*Microeca fascinans*		
Little Crow	*Corvus bennetti*		
Little Eagle	*Hieraaetus morphnoides*	Vulnerable	
Little Pied Cormorant	*Phalacrocorax melanoleucos*		
Little Raven	*Corvus mellori*		
Magpie-lark	*Grallina cyanoleuca*		
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	Vulnerable	
Masked Woodswallow	*Artamus personatus*		
Mistletoebird	*Dicaeum hirundinaceum*		
Mulga Parrot	*Psephotus varius*		
Nankeen Kestrel	*Falco cenchroides*		
Peregrine Falcon	*Falco peregrinus*		
Pied Butcherbird	*Cracticus nigrogularis*		
Rainbow Bee-eater	*Merops ornatus*		
Red-capped Robin	*Petroica goodenovii*		
Restless Flycatcher	*Myiagra inquieta*		
Rufous Songlark	*Cincloramphus mathewsi*		
Rufous Whistler	*Pachycephala rufiventris*		
Singing Honeyeater	*Lichenostomus virescens*		
Southern Boobook	*Ninox novaeseelandiae*		
Southern Whiteface	*Aphelocephala leucopsis*		
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*		
Spotted Nightjar	*Eurostopodus argus*		
Striated Pardalote	*Pardalotus striatus*		
Striped Honeyeater	*Plectorhyncha lanceolata*		
Tawny Frogmouth	*Podargus strigoides*		
Tree Martin	*Petrochelidon nigricans*		
Varied Sittella	*Daphoenositta chrysoptera*	Vulnerable	
Wedge-tailed Eagle	*Aquila audax*		

Weebill	*Smicrornis brevirostris*		
Welcome Swallow	*Hirundo neoxena*		
Whistling Kite	*Haliastur sphenurus*		
White-browed Babbler	*Pomatostomus superciliosus*		
White-browed Woodswallow	*Artamus superciliosus*		
White-fronted Honeyeater	*Purnella albifrons*		
White-necked Heron	*Egretta pacifica*		
White-plumed Honeyeater	*Lichenostomus penicillatus*		
White-winged Chough	*Corcorax melanorhamphos*		
Willie Wagtail	*Rhipidura leucophrys*		
Yellow-plumed Honeyeater	*Lichenostomus ornatus*		
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*		
Yellow-throated Miner	*Manorina flavigula*		
Reptiles			
Barred Wedgesnout Ctenotus	*Ctenotus schomburgkii*		
Beaded Gecko	*Diplodactylus damacus*		
Beaked Gecko	*Rhynchoedura ornata*		
Carnaby's Wall Skink	*Cryptoblepharus carnabyi*		
Central Bearded Dragon	*Pogona vitticeps*		
Common Dwarf Skink	*Menetia greyii*		
Desert Skink	*Liopholis inornata*		
Dull Morethia	*Morethia obscura*		
Eastern Brown Snake	*Pseudonaja textilis*		
Eastern Robust Slider	*Lerista punctatovittata*		
Gould's Goanna	*Varanus gouldii*		
King Brown Snake	*Pseudechis australis*		
Mallee Dragon	*Ctenophorus fordi*		
Marbled-headed Delma	*Delma australis*	Endangered	
Murray Striped Skink	*Ctenotus brachyonyx*		
Nobbi	*Amphibolurus nobbi*		
Prickly Gecko	*Heteronotia binoei*		
Saltbush Morethia Skink	*Morethia adelaidensis*		
Shingle-back	*Tiliqua rugosa*		
South-eastern Morethia Skink	*Morethia boulengeri*		
Southern Mallee Ctenotus	*Ctenotus atlas*		
Tree Dtella	*Gehyra variegata*		
Amphibians			
Green Tree Frog	*Litoria caerulea*		
Long-thumbed Frog	*Limnodynastes fletcheri*		
Spotted Marsh Frog	*Limnodynastes tasmaniensis*		
Sudell's Frog	*Neobatrachus sudelli*		

Table 25 Threatened Fauna species recorded or with potential to occur at Crayfish and surrounds, from BCD Wildlife Atlas.

Class	Common Name	Scientific Name	Exotic	NSW status	Comm. status
Amphibia	Painted Burrowing Frog	*Neobatrachus pictus*		E1,P	
Amphibia	Southern Bell Frog	*Litoria raniformis*		E1,P	V
Aves	Australasian Bittern	*Botaurus poiciloptilus*		E1,P	E
Aves	Australian Bustard	*Ardeotis australis*		E1,P	
Aves	Australian Painted Snipe	*Rostratula australis*		E1,P	E
Aves	Barking Owl	*^^Ninox connivens*		V,P,3	
Aves	Black Falcon	*Falco subniger*		V,P	
Aves	Black-breasted Buzzard	*^^Hamirostra melanosternon*		V,P,3	
Aves	Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*		V,P	
Aves	Black-eared Miner	*Manorina melanotis*		E4A,P	E
Aves	Black-tailed Godwit	*Limosa limosa*		V,P	C,J,K
Aves	Blue-billed Duck	*Oxyura australis*		V,P	
Aves	Broad-billed Sandpiper	*Limicola falcinellus*		V,P	C,J,K
Aves	Brolga	*Grus rubicunda*		V,P	
Aves	Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*		V,P	
Aves	Bush Stone-curlew	*Burhinus grallarius*		E1,P	
Aves	Chestnut Quail-thrush	*Cinclosoma castanotum*		V,P	
Aves	Curlew Sandpiper	*Calidris ferruginea*		E1,P	CE,C,J,K
Aves	Diamond Firetail	*Stagonopleura guttata*		V,P	
Aves	Eastern Osprey	*^^Pandion cristatus*		V,P,3	
Aves	Freckled Duck	*Stictonetta naevosa*		V,P	
Aves	Gilbert's Whistler	*Pachycephala inornata*		V,P	
Aves	Grey Falcon	*^Falco hypoleucos*		E1,P,2	
Aves	Hooded Robin (south-eastern form)	*Melanodryas cucullata cucullata*		V,P	
Aves	Lesser Sand-plover	*Charadrius mongolus*		V,P	C,J,K
Aves	Little Eagle	*Hieraaetus morphnoides*		V,P	
Aves	Magpie Goose	*Anseranas semipalmata*		V,P	
Aves	Major Mitchell's Cockatoo	*^Lophochroa leadbeateri*		V,P,2	
Aves	Malleefowl	*Leipoa ocellata*		E1,P	V
Aves	Painted Honeyeater	*Grantiella picta*		V,P	V
Aves	Pied Honeyeater	*Certhionyx variegatus*		V,P	
Aves	Plains-wanderer	*Pedionomus torquatus*		E1,P	CE
Aves	Purple-crowned Lorikeet	*^^Glossopsitta porphyrocephala*		V,P,3	
Aves	Purple-gaped Honeyeater	*Lichenostomus cratitius*		V,P	
Aves	Red-lored Whistler	*Pachycephala rufogularis*		E4A,P	V
Aves	Red-tailed Black-Cockatoo (inland subspecies)	*^Calyptorhynchus banksii samueli*		V,P,2	
Aves	Redthroat	*Pyrrholaemus brunneus*		V,P	
Aves	Regent Parrot (eastern subspecies)	*^^Polytelis anthopeplus monarchoides*		E1,P,3	V
Aves	Sanderling	*Calidris alba*		V,P	C,J,K
Aves	Scarlet-chested Parrot	*Neophema splendida*		V,P	

Aves	Shy Heathwren	*Hylacola cautus*		V,P	
Aves	Southern Scrub-robin	*Drymodes brunneopygia*		V,P	
Aves	Spotted Harrier	*Circus assimilis*		V,P	
Aves	Square-tailed Kite	*^^Lophoictinia isura*		V,P,3	
Aves	Varied Sittella	*Daphoenositta chrysoptera*		V,P	
Aves	White-fronted Chat	*Epthianura albifrons*		V,P	
Mammalia	Bilby	*Macrotis lagotis*		E4,P	V
Mammalia	Bolam's Mouse	*Pseudomys bolami*		E1,P	
Mammalia	Boodie, Burrowing Bettong (mainland)	*Bettongia lesueur graii*		E4,P	X
Mammalia	Brush-tailed Bettong (South-East Mainland)	*Bettongia penicillata penicillata*		E4,P	X
Mammalia	Corben's Long-eared Bat	*Nyctophilus corbeni*		V,P	V
Mammalia	Crescent Nailtail Wallaby	*Onychogalea lunata*		E4,P	X
Mammalia	Eastern Hare-wallaby	*Lagorchestes leporides*		E4,P	X
Mammalia	Gould's Mouse	*Pseudomys gouldii*		E4,P	X
Mammalia	Greater Stick-nest Rat	*Leporillus conditor*		E4,P	V
Mammalia	Inland Forest Bat	*Vespadelus baverstocki*		V,P	
Mammalia	Koala	*Phascolarctos cinereus*		V,P	V
Mammalia	Kultarr	*Antechinomys laniger*		E1,P	
Mammalia	Little Pied Bat	*Chalinolobus picatus*		V,P	
Mammalia	Mitchell's Hopping-mouse	*Notomys mitchellii*		E4,P	
Mammalia	Numbat	*Myrmecobius fasciatus*		E4,P	V
Mammalia	Pig-footed Bandicoot	*Chaeropus ecaudatus*		E4,P	X
Mammalia	Southern Hairy-nosed Wombat	*Lasiorhinus latifrons*		E1,P	
Mammalia	Southern Ningaui	*Ningaui yvonneae*		V,P	
Mammalia	Western Pygmy Possum	*Cercartetus concinnus*		E1,P	
Mammalia	Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*		V,P	
Reptilia	Bardick	*Echiopsis curta*		E1,P	
Reptilia	Crowned Gecko	*Lucasium stenodactylum*		V,P	
Reptilia	Jewelled Gecko	*Strophurus elderi*		V,P	
Reptilia	Mallee Slender Blue-tongue Lizard	*Cyclodomorphus melanops elongatus*		E1,P	
Reptilia	Mallee Worm-lizard	*Aprasia inaurita*		E1,P	
Reptilia	Marble-faced Delma	*Delma australis*		E1,P	
Reptilia	Western Blue-tongued Lizard	*Tiliqua occipitalis*		V,P	
Reptilia	Yellow-tailed Plain Slider	*Lerista xanthura*		V,P	

Key:

V – Vulnerable, E1 – Endangered, E4 – Extinct in Wild, P – Protected

CE – Critically Endangered C – CAMBA, J – JAMBA, K – KAMBA X - Extinct

Appendix I Vegetation descriptions for Crayfish and surrounds

Descriptions of the nine vegetation communities occurring in the project area based on assessments conducted by FloraSearch (2012) are provided below.

Community 1 - Black Box Woodland

Benson Vegetation Community equivalent: Black Box grassy open woodland of rarely flooded depressions in south western NSW (Benson 16).

Landscape Position: Confined to a large depression in the south east of mining lease.

General comments: The Black Box forms an open, semi-cleared woodland in a seasonally waterlogged depression with brown clay loam soil. Tall shrubs were absent and many of the scattered low chenopod shrubs had died, possibly drowned by prolonged waterlogging in summer 2010/11. The ground cover was predominantly herbaceous rather than grassy. The margins of the depression were lined by a broad band of dense juvenile Black Box saplings that germinated and grew in the extremely wet conditions of the previous summer.

Dominant and Characteristic Species

Trees: A monoculture of Black Box (*Eucalyptus largiflorens*).

Shrubs: Only Spine Bush (*Acacia colletioides*) with dead specimens of Ruby Saltbush (*Enchylaena tomentosa*) and a Bluebush (*Maireana sp*.).

Vines / creepers: No vines or creepers were observed.

Ground Covers: The ground cover was dominated by Nardoo (*Marsilea drummondii*) and Sneezeweeds, *Centipeda thespidioides* and *C. crateriformis* subsp. *compacta*, with various low growing herbs, including Cannonball Burr (*Dissocarpus paradoxus*), Crested Goosefoot (*Chenopodium cristatum*), *Tetragonia moorei*, Jersey Cudweed, *Pseudognaphalium luteoalbum*, Chalkwort (*Gypsophila tubulosa*) and Small Waterfire (*Bergia trimera*).

Introduced Species: This community supported a number of introduced herbaceous species and grasses including Stemless Thistle (*Onopordum acaulon*), Smooth Mustard (*Sisymbrium erysimoides*), *Herniaria cinerea*, Burr Medic (*Medicago polymorpha*), Centaury (*Centaurium tenuiflorum*), Blackberry Nightshade (*Solanum nigrum*) and Arabian Grass (*Schismus barbatus*).

Community 2 - Black Oak – Western Rosewood Woodland

Benson Vegetation Community equivalent: Black Oak – Western Rosewood open woodland on deep sandy loams of the Murray-Darling Depression and Riverina Bioregions (Benson 58)

Landscape Position: This community is confined mostly to the flat parts of a few of the larger dune swales and sand plains on the Study area. One occurrence is on a sloping area with clay soils.

General comments: This community has largely been cleared from the Study area to encourage the growth of grasses, herbs and shrubs for grazing by domestic stock. Remnants are small, fragmented and highly disturbed. Much of the former area of this community on the Study area is now derived grassland or shrubland (Communities 5 and 6).

Dominant and Characteristic Species

Trees: The dominant and most characteristic species is Black Oak (*Casuarina pauper*). The main associated species is the low tree Western Rosewood (*Alectryon oleifolius* subsp. *canescens*). Occasional associates are Sugarwood (*Myoporum platycarpum* subsp. *platycarpum*) and Wilga (*Geijera parviflora*).

Shrubs: Tall shrubs in Community 2 include Leafless Ballart (*Exocarpos aphyllus*) and Turpentine (*Eremophila sturtii*). A wide variety of low shrubs, mainly Saltbushes and Bluebushes, was found in remnants of this community, the most common being Bitter Saltbush (*Atriplex stipitata*), Ruby Saltbush (*Enchylaena tomentosa*), Slit-wing Bluebush (*Maireana georgei*), Erect Mallee Bluebush (*Maireana pentatropis*) and Black Bluebush (*Maireana pyramidata*).

Vines / creepers: Doubah (*Marsdenia australis*) was the only vine recorded.

Ground Covers: The ground cover was dominated by the chenopods Cannonball Burr (*Dissocarpus paradoxus*) and Limestone Copperburr (*Sclerolaena obliquecuspis*). A variety of herbs and grasses made up a much smaller proportion of the ground cover including *Tetragonia moorei*, Native Carrot (*Daucus glochidiatus* Form C), Flannel Cudweed (*Actinobole uliginosum*), Bogan Flea (*Calotis hispidula*), Crested Goosefoot (*Chenopodium cristatum*), Spiked Rice-flower (*Pimelea trichostachya*) and a Speargrass (*Austrostipa nitida*).

Introduced Species: A low number of introduced species was recorded, mainly ephemeral herbs including Maltese Cockspur (*Centaurea melitensis*), Smooth Mustard (*Sisymbrium erysimoides*), Nettle-leaf Goosefoot (*Chenopodium murale*) and Arabian Grass (*Schismus barbatus*).

Community 3 - Black Oak (Belah) – Pearl Bluebush Woodland

Benson Vegetation Community equivalent: Black Oak (Belah) – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones (Benson 221)

Landscape Position: This community is confined to the western extremity of the haul road route on a relatively flat sand plain.

General comments: This is a minor community on the Study area, comprising a sparse overstorey of Black Oaks over a uniform layer of compact and densely foliaged Pearl Bluebushes.

Dominant and Characteristic Species

Trees: The dominant and most characteristic species is Black Oak (*Casuarina pauper*).

Shrubs: Western Rosewood (*Alectryon oleifolius* subsp. *canescens*) in relatively low densities may or may not be present. The low shrub layer is heavily dominated by Pearl Bluebush (*Maireana sedifolia*) and Black Bluebush (*Maireana pyramidata*). Other shrubs include Spinebush (*Acacia colletioides*), Ruby Saltbush (*Enchylaena tomentosa*), Erect Mallee Bluebush (*Maireana pentatropis*), a Bluebush (*Maireana trichoptera*) and Slit-wing Bluebush (*Maireana georgei*).

Vines / creepers: Doubah (*Marsdenia australis*).

Ground Covers: The ground cover is dominated by the chenopods Cannonball Burr (*Dissocarpus paradoxus*), Limestone Copperburr (*Sclerolaena obliquecuspis*) and Woolly-fruit Copperburr (*Maireana sclerolaenoides*). A variety of herbs and grasses make up a much smaller proportion of the ground cover including *Tetragonia eremaea*, Native Carrot (*Daucus glochidiatus* Form C), Crested Goosefoot (*Chenopodium cristatum*), a Fuzzweed (*Vittadinia gracilis*), Dwarf Twinleaf (*Zygophyllum ovatum*) and a Speargrass (*Austrostipa nitida*).

Introduced Species: Introduced species are generally sparse, mainly the ephemeral herbs Small Woolly Burr Medic, (*Medicago minima*), Barrel Medic (*Medicago truncatula*), Ward's Weed, (*Carrichtera annua*), Smooth Mustard (*Sisymbrium erysimoides*) and Wild Turnip (*Brassica tournefortii*).

Community 4 – Chenopod Mallee Woodland / Shrubland

Benson Vegetation Community equivalent: Chenopod sand mallee woodland/shrubland of the arid and semi-arid (warm) zones (Benson 170)

Landscape Position: This community occurs on the lower slopes of the higher dunes and on gently sloping sand masses.

General comments: The soils have higher clay contents and are more cohesive than for Community 5. Parts of this community have been cleared or semi-cleared historically through much of the Study area, especially in the swales between dunes. The most heavily cleared examples of this community comprise parts of Community 6.

Dominant and Characteristic Species

Trees*:* The dominant tree species are mallee eucalypts, mainly Congoo Mallee (*Eucalyptus dumosa*) and Pointed Mallee (*Eucalyptus socialis*). On some quadrats Yorrell (*Eucalyptus gracilis*) was also a dominant.

Shrubs*:* Community 4 generally lacked tall shrubs. However, there is a diverse layer of low shrubs, mainly Bluebushes (*Maireana* spp.), the dominant species in order of importance being Erect Mallee Bluebush (*Maireana pentatropis*), Slit-wing Bluebush (*Maireana georgei*) and Three-wing Bluebush (*Maireana triptera*). Ruby Saltbush (*Enchylaena tomentosa*) is also common.

Vines / creepers*:* Doubah (*Marsdenia australis*) was recorded occasionally.

Ground Covers: The ground cover was dominated by the chenopods Cannonball Burr (*Dissocarpus paradoxus*), Limestone Copperburr (*Sclerolaena obliquecuspis*), Grey Copperburr (*Sclerolaena diacantha*) and Desert Goosefoot (*Chenopodium desertorum* subsp. *desertorum*). Herbs and grasses comprised a small proportion of the ground cover and included mainly a Fuzzweed (*Vittadinia cervicularis* subsp. *subcervicularis*), Gallweed (*Zygophyllum apiculatum*) and a Speargrass (*Austrostipa nitida*).

Introduced Species*:* Introduced species were rare and included Stemless Thistle (*Onopordum acaulon*) and Maltese Cockspur (*Centaurea melitensis*).

Community 5 – Dune Mallee Shrubland

Benson Vegetation Community equivalent: Spinifex linear dune mallee mainly of the Murray-Darling Depression Bioregion) (Benson 171)

Landscape Position: This community occurs on the crests and upper slopes of sand dunes.

General comments: The loose sandy soils have low clay contents and poor coherence relative to Community 3. Owing to poor soil stability, very little of this community has been cleared or semi-cleared historically.

Dominant and Characteristic Species

Trees*:* The dominant tree species are mallee eucalypts, predominantly Pointed Mallee (*Eucalyptus socialis*) which forms monospecific stands over large areas. Congoo Mallee (*Eucalyptus dumosa*) is the main co-occurring species, usually at lower densities than Pointed Mallee. In some parts of the Study area large stands of Western Rosewood (*Alectryon oleifolius* subsp *canescens*) occurred within Community 5.

Shrubs*:* Community 5 generally lacked tall shrubs; only occasional Sandhill Wattle (*Acacia ligulatata*) and Narrow-leaf Hopbush (*Dodonaea viscosa* subsp. *angustissima*) occurred. Among the low shrubs, Bluebushes (*Maireana* spp.) were much less prominent than in Community 4, the main species was Erect Mallee Bluebush (*M. pentatropis*) with small amounts of Slit-wing Bluebush (*M. georgei*). Ruby Saltbush (*Enchylaena tomentosa*) also occurred less frequently than in community 4.

Vines / creepers: Doubah (*Marsdenia australis*) was recorded occasionally.

Ground Covers*:* The ground cover was dominated by Porcupine Grass (*Triodia scariosa* subsp. *scariosa*) and the chenopods Grey Copperburr (*Sclerolaena diacantha*) and Desert Goosefoot (*Chenopodium desertorum* subsp. *desertorum*). In areas of open sand the Mallee Copperburr (*Sclerolaena parviflora*) was a common and characteristic species of Community 5. Characteristic herbs included Mallee Fringe-lily (*Thysanotus baueri*), Spiked Rice-flower (*Pimelea trichostachya*), a Fuzzweed (*Vittadinia cervicularis* subsp. *cervicularis*), Invisible Plant (*Podolepis capillaris*) and Rabbit Tails (*Ptilotus seminudus*). Apart from Porcupine Grass, the only other common grass was the Speargrass (*Austrostipa nitida*).

Introduced Species*:* Introduced species were rare and included only Arabian Grass (*Schismus barbatus*) and Smooth Catsear (*Hypochaeris glabra*).

Community 6 - Pearl Bluebush Shrubland

Benson Vegetation Community equivalent: Pearl Bluebush low open shrubland of the arid and semi-arid plains (Benson 154)

Landscape Position: This community is confined to a small area at the western end of the haul road route on flat sand plain.

General comments: This is a minor community on the Study area, comprising an open low shrubland dominated by Pearl Bluebush. This is likely to be a secondary community resulting from the clearing of the tree layer from areas of Community 3, Black Oak – Pearl Bluebush Woodland.

Dominant and Characteristic Species

Trees: Nil

Shrubs: The dominant and most characteristic species in this community on the study area is Pearl Bluebush (*Maireana sedifolia*). Other bluebushes include Black Bluebush (*Maireana pyramidata*) and Slit-wing Bluebush (*Maireana georgei*). Other shrubs are ruby Saltbush (*Enchylaena tomentosa*), Australian Boxthorn (*Lycium australe*) and Cottony Saltbush (*Chenopodium curvispicatum*).

Vines / creepers: N/A

Ground Covers: The ground cover is dominated by the chenopods Cannonball Burr (*Dissocarpus paradoxus*), Limestone Copperburr (*Sclerolaena obliquecuspis*) and Woolly-fruit Copperburr (*Maireana sclerolaenoides*). Speargrass (*Austrostipa nitida*) is also common. A variety of herbs and grasses may also be frequent including the Fuzzweeds (*Vittadinia cuneata* varieties *hirsuta* and *morrisii*), *Vittadinia eremaea*, Woolly New Holland Daisy (*Vittadinia gracilis*), The Twinleaves (*Zygophyllum ammophilum, Z. iodocarpum* and *Z. glaucum*), Grey Copperburr (*Sclerolaena diacantha*), Bitter Saltbush (*Atriplex stipitata*), Native Spinach (*Tetragonia eremaea*) and Small-flowered Tobacco (*Nicotiana goodspeedii*).

Introduced Species: Introduced species may be common and include Small Woolly Burr Medic (*Medicago minima*), Wild Sage (*Salvia verbenaca*), Flax-leaf Alyssum (*Alyssum linifolium*) and Maltese Cockspur (*Centaurea melitensis*).

Community 7 – *Austrostipa* Grassland

Benson Vegetation Community equivalent: Corkscrew grass grassland/forbland on sandplains and plains in the semi-arid (warm) zone (Benson 165)

Landscape Position: Community 7 occurs mainly on sand plains.

General comments: On the Study area Community 7 appears to have been derived as one of the outcomes from clearing chenopod mallee (Community 4). This community is a grassland formation lacking trees and shrubs, but with low chenopods and herbs in a predominantly grassy ground cover.

Dominant and Characteristic Species

Trees: By definition this community is treeless.

Shrubs: Community 7 generally lacked tall shrubs. Low shrubs were sparse and included only Bluebushes (*Maireana* spp.), the main species being Erect Mallee Bluebush (*M. pentatropis*) with some Slit-wing Bluebush (*M. georgei*) and Pearl Bluebush (*M. sedifolia*).

Vines / creepers: None recorded.

Ground Covers: The ground cover was dominated by Speargrass (*Austrostipa nitida*) and the chenopods Grey Copperburr (*Sclerolaena diacantha*), Limestone Copperburr (*Sclerolaena obliquecuspis*), Woolly-fruit Copperburr (*Maireana sclerolaenoides*), Cannonball Burr (*Dissocarpus paradoxus*) and Bitter Saltbush (*Atriplex stipitata*). Other characteristic herbaceous species in this community included a Fuzzweed (*Vittadinia gracilis*), Variable Daisy (*Brachyscome ciliaris* var. *lanuginosa*), Chalkwort (*Gypsophila tubulosa*) and a Goodenia *(Goodenia heteromera*). Associated grasses included Bottle Washers (*Enneapogon avenaceus*) and Woollybutt Grass (*Eragrostis eriopoda*).

Introduced Species: Introduced species were uncommon and included Common Sowthistle (*Sonchus oleraceus*), Burr Medic (*Medicago polymorpha*) and Wild Sage (*Salvia verbenaca*).

Community 8 – *Turpentine Tall Open Shrubland*

Benson Vegetation Community equivalent: Community 8 is not directly comparable to any NSWVCA community. However, it shares species with NSWVCA communities 58 (Black Oak – Western Rosewood open woodland on deep sandy loams of the Murray-Darling Depression and Riverina Bioregions) and 170 (Chenopod sand mallee woodland/shrubland of the arid and semi-arid (warm) zones) from which it has been derived (Benson 58 and 170)

Landscape Position: Community 8 occurs mainly in larger cleared or semi-cleared swales between sand dunes, and in sand plain areas in the north of the Study area.

General comments: On the Study area Community 8 appears to have been derived from clearing Black Oak – Rosewood Woodland (Community 2) or Chenopod Mallee Woodland / Shrubland (Community 4). This community comprises a sparse to dense shrubland formation with a predominantly low chenopod ground cover layer. Flora diversity was relatively high in this community and appears to be related to more fertile soil and higher moisture retention in the swales.

Dominant and Characteristic Species

Trees: This community is largely treeless, although sometimes including scattered remnant trees of the original communities, especially Western Rosewood (*Alectryon oleifolius* subsp. *canescens*).

Shrubs: Community 8 is dominated by Turpentine (*Eremophila sturtii*) which may be scattered or quite dense. Other tall shrubs include occasional Spine Bush (*Acacia colletioides*) and Weeping Pittosporum (*Pittosporum angustifolium*). A variety of low shrubs occurred at low to moderate densities and included the Bluebushes (*Maireana* spp.), Slit-wing Bluebush (*M. georgei*), Erect Mallee Bluebush (*M. pentatropis*), Black Bluebush (*M. pyramidata*) and Three-wing Bluebush (*M. triptera*). Ruby Saltbush (*Enchylaena tomentosa*) occurred regularly in the shade of the taller shrubs.

Vines / creepers: Doubah (*Marsdenia australis*) was occasional.

Ground Covers: The ground cover comprised a wide variety of low chenopods, herbs and grasses. The dominant species were the low chenopods Cannonball Burr (*Dissocarpus paradoxus*) and Limestone Copperburr (*Sclerolaena obliquecuspis*). Other common chenopods were Bitter Saltbush (*Atriplex stipitata*), Desert Goosefoot (*Chenopodium desertorum* subsp. *desertorum*), Crested Goosefoot (*Chenopodium cristatum*) and Spear-fruit Copperburr (*Sclerolaena patenticuspis*). The most common small herbs were *Tetragonia moorei*, Native Carrot (*Daucus glochidiatus* Form C), Flannel Cudweed (*Actinobole uliginosum*), Bogan Flea (*Calotis hispidula*), a Fuzzweed (*Vittadinia eremaea*), Blue Storksbill (*Erodium crinitum*), Spiked Rice-flower (*Pimelea trichostachya*) and Gallweed (*Zygophyllum apiculatum*). Grasses generally occurred in low densities and included Speargrass (*Austrostipa nitida*) and Knottybutt Grass (*Paspalidium constrictum*).

Introduced Species: Introduced species were more numerous and common than for most other communities, and included Maltese Cockspur (*Centaurea melitensis*), Flax-leaf Alyssum (*Alyssum linifolium*), Smooth Mustard (*Sisymbrium erysimoides*), Dense Mat-plant (*Herniaria cinerea*), Burr Medic (*Medicago polymorpha*), Wild Sage (*Salvia verbenaca*) and Arabian Grass (*Schismus barbatus*).

Community 9 - *Depression Herbfield*

Benson Vegetation Community equivalent: Community 9 is not directly comparable to any NSWVCA community. However, its understory has most in common with NSWVCA community 16 (Black Box grassy open woodland of rarely flooded depressions in south western NSW). (Benson 16)

Landscape Position: Community 9 occurs in seasonally wet depressions in dune swales, sometimes with sink holes.

General comments: Community 9 appears to have been derived as an outcome of clearing Chenopod Mallee Woodland / Shrubland (Community 4) in dune swales. It comprises an open ephemerally wet herbfield with or without some grasses and residual shrubs. Flora diversity was relatively high owing to sporadically high moisture levels on these sites. Similar vegetation occurs as part of the understory of Black Box Woodland in playa depressions (Community 1).

Dominant and Characteristic Species

Trees: This community is largely treeless, although sometimes including scattered remnant trees of the original communities.

Shrubs: Community 9 may include scattered Spine Bush (*Acacia colletioides*) and Turpentine (*Eremophila sturtii*), especially around the margins. By contrast to other communities, Bluebushes are infrequent in Community 7, only an occasional Slit-wing Bluebush (*M. georgei*) was recorded. Ruby Saltbush(*Enchylaena tomentosa*) occurred in the shade of Spine Bushes.

Vines / creepers: None recorded.

Ground Covers: The ground cover comprised a variety of herbs and grasses, while chenopods were relatively scarce. The dominant herbaceous species were the aquatic fern Nardoo (*Marsilea drummondii*), Native Carrot (*Daucus glochidiatus* Form C), Bogan Flea (*Calotis hispidula*), a Sneezeweed (*Centipeda crateriformis* subsp. *crateriformis*), Desert Sneezeweed (*Centipeda thespidioides*), Common Sunray (*Triptilodiscus pygmaeus*), Annual Bluebell (*Wahlenbergia gracilenta*), Climbing Saltbush (*Einadia nutans* subsp. *nutans*), Small Water-fire (*Bergia trimera*), Caustic Weed (*Chamaesyce drummondii*), Creeping Oxalis (*Oxalis perennans*), Bluerod (*Stemodia florulenta*) and Spiked Rice-flower (*Pimelea trichostachya*). The main grasses were Mallee Lovegrass (*Eragrostis dielsii*), Woollybutt Grass (*Eragrostis eriopoda*), Sickle Lovegrass (*Eragrostis falcata*), Blown Grass (*Lachnagrostis filiformis*) and Knottybutt Grass (*Paspalidium constrictum*).

Introduced Species: Introduced species were relatively more common than for most other communities, and included Maltese Cockspur (*Centaurea melitensis*), Spear Thistle (*Cirsium vulgare*), Smooth Mustard (*Sisymbrium erysimoides*), Burr Medic (*Medicago polymorpha*), White Horehound (*Marrubium vulgare*), Wild Sage (*Salvia verbenaca*), Red Brome (*Bromus rubens*), a Barley Grass (*Hordeum* sp.), Arabian Grass (*Schismus barbatus*) and Rat's Tail Fescue (*Vulpia myuros*).

Appendix J Vegetation Clearing Protocol

This summary of the Vegetation Clearance Protocol aims to be a stand-alone document that provides all information needed to complete vegetation clearing activities. It includes requirements for assessing what steps need to be taken, and guides the use of activities in steps, from pre-clearance surveys, clearance techniques to animal welfare and translocation protocols, and managing captured, injured or deceased fauna.

Tronox Vegetation Clearance Protocol

This Vegetation Clearance Protocol has been developed to minimise the impacts of vegetation removal activities at Tronox Mining's Murray Basin mines on flora and fauna values, and address Tronox's ecological requirements of the Development Consent (DA 251-09-01) made under section 75W of the *Environmental Planning and Assessment Act 1979*.

This Vegetation Clearance Protocol is applicable to all native species of flora and fauna, and is focussed primarily on threatened species, being those listed under the National *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999* and NSW *Biodiversity and Conservation* (BC) *Act 2016*.

The requirements of this protocol are shown as the flowchart below.

The most critical factor in the successful implementation of vegetation clearing, and this protocol, is the timing of all activities in order to avoid impacting on breeding populations of threatened bats, reptiles and birds, and minimise impacts and maximise the opportunity for dispersal of these threatened species away from the clearing areas at a time when they are mobile and not hibernating.

The following is a brief summary of the key steps for the successful implementation of this protocol, which are also outlined in the flowchart, are subsequently explained in detail.

Clear delineation of disturbance areas

Remnant native vegetation immediately adjacent to areas proposed for clearing must be clearly marked and/or fenced to prevent accidental damage, or clearing of incorrect areas during vegetation clearance and construction activities.

Pre-clearance surveys

Flora Prior to any vegetation and habitat removal, targeted surveys for threatened flora species are to be undertaken for two species; Violet Swainson-Pea (*Swainsona adenophylla*) and Yellow-Keeled Swainsona (*Swainsona flavicarinata*) as per the consent conditions.

If these species are detected, Protocol 1 – threatened flora targeted surveys will be implemented.

Fauna

Spinifex dependent threatened fauna Prior to any vegetation and habitat removal, Protocol 2 – spinifex dependent fauna will be implemented. This aims to minimise impacts to threatened fauna species including Marble-faced Delma (*Delma australis*) and Western Blue-tongue (*Tiliqua occipitalis*).

This will involve the completion of a slow, cool, fuel-reduction burn to be completed in autumn or spring to remove habitats for these threatened species and encourage their dispersal out of the area. If timing and conditions do not allow this, other translocation techniques may be considered.

Hollow bearing and large old tree dependent fauna Prior to any vegetation and habitat removal, Protocol 3 - Hollow bearing and large old tree dependent fauna will be implemented. This aims to minimise direct impacts and mortality to threatened fauna species including: Little Pied Bat (*Chalinolobus picatus*), Inland Forest Bat (*Vespadelus baverstocki*), Corben's Long-eared Bat

(*Nyctophilus corbeni*) and Major Mitchell's Cockatoo, (*Lophochroa leadbeateri*), by removing key habitat features and encouraging their dispersal out of the development area.

An ecologist experienced in the requirements of spinifex and hollow bearing dependent species should be involved to assist in the salvage and translocation of any non-dispersing or injured animals during these processes.

Tronox Vegetation Clearance Protocols Requirements

Clear delineation of disturbance areas

Remnant native vegetation immediately adjacent to areas proposed for clearing must be clearly marked and/or fenced to prevent accidental damage during vegetation removal and construction activities.

Pre-clearance Surveys

Flora

Prior to any vegetation removal, engage a qualified ecologist to complete targeted flora surveys for threatened flora species *Swainsona flavicarinata* and *Swainsona adenophylla* following Protocol 1 - threatened flora targeted surveys.

Threatened Species detected at any point

Fauna

Does the approved clearing area contain areas of *Triodia* spp. (spinifex)?

Yes

No

Threatened Species Management Protocol

Implement Threatened Species Management guidelines provided.

No *Triodia* spp. present

Yes *Triodia* spp. present

Prior to vegetation removal – undertake prescribed burning of spinifex habitats to encourage fauna to disperse out of the area.

If timing does not allow burning, consider translocation.

Follow detailed method provided in Protocol 2 – spinifex dependent threatened fauna.

Does the approved clearing area contain areas of large old or hollow bearing trees?

No threatened flora detected

No

Yes

Yes large old or hollow bearing trees present

At least two days and no more than seven days prior to vegetation removal – complete tree falling and targeted hollow inspection to allow threatened species of bat and bird to disperse from these habitats. Following two to seven day period, complete vegetation clearance. Must not be completed in spring-early summer to avoid impacting breeding bats and birds.

Follow detailed method provided in Protocol 3 – hollow bearing and large old tree removal.

Complete vegetation clearing following flora and fauna management guideline implementation

Engage a qualified ecologist to supervise all vegetation clearing works, and salvage and translocate fauna found during works. Undertake chaining of remnant trees at least two days and no more than seven days before woody debris is pushed up into piles, windrows etc to allow for fauna to exit these habitats and move out of the clearing area.

Follow detailed method provided in Protocol 4 – Vegetation Clearing Protocol.

Salvaged fauna to be translocated following procedures set out in Appendix J-7.

Protocol 1 for targeted threatened flora surveys

Targeted surveys for threatened flora species Violet Swainson-Pea (*Swainsona adenophylla*) and Yellow-Keeled Swainsona (*Swainsona flavicarinata*) are required, as per the approval for Crayfish. Although these species appear in the conditions, neither species has been detected in the area. Suitable habitat for both species does not present in the impact area. *S. adenophylla* in particular is considered highly unlikely to occur in the area, with just one previous record from NSW.

Surveys must be carried out by a suitably qualified ecologist, at least one week prior to the commencement of vegetation removal, to allow detection and documentation of these, or potentially other threatened flora species, and possible translocation of individuals to a suitable area following consultation with the NSW DPIE Biodiversity Conservation Division (BCD). If either of these or other threatened flora species are recorded, details including population size will be submitted to the Atlas of NSW Wildlife.

Targeted survey would nclude random meander transects through potential habitat for these species.

A more detailed flora translocation procedure will be developed in consultation with BCD in the highly unlikely even that either of these species are found on site. This procedure will vary depending upon the species detected during pre-clearance threatened flora surveys, and would follow other similar translocation management plans for these or similar species produced previously, with individuals photographed, location recorded with GPS, and details documented and submitted to BCD.

Target Flora Species:

Violet Swainson-Pea (*Swainsona adenophylla*)

NSW BC Act – Endangered

Slender perennial forb to 30 cm high, sparsely downy and with numerous stems. Leaves mostly 3-5 cm long, composed of 3-9 narrow leaflets, each with a gland at the tip. The plant is distinguished by the swollen leaflets and conspicuous glands. Flowers purple or pink, pea-like, 6-9 mm long. Pod narrow-oblong, 10-20 mm long, hairy.

Distribution: This species is most widespread in central South Australia, with records from one location in both New South Wales and Victoria. Was collected in 1979 from Barmah SF, near Echuca, in Victoria but has not been located since. In NSW it is known from one collection in Kinchega National Park, south west of Menindee, where it was described as 'common'.

Habitat and ecology: Grows on red sandy or stony flats, especially near lake margins. Associated species in South Australia include *Eucalyptus microtheca* and *Acacia* species. The records from Victoria were on higher River Red Gum (*Eucalyptus camaldulensis*) terraces, well away from the main river channel. Flowering period is June to September (or summer after good rains). Recorded in the Menindee area growing on sandy soil in a year of high winter rainfall. Most *Swainsona* species are erratic in occurrence, carpeting the landscape after significant rain in areas of low and irregular rainfall. Abundance in populations has been recorded as common and dominant.

Yellow-Keeled Swainsona (*Swainsona flavicarinata*)

NSW BC Act Endangered

Greyish-green forb to about 45 cm high, the stems bearing coarse white hairs. Leaves composed of 5-9 leaflets, each 10-15 mm long, 5-10 mm wide, hairless above, softly downy beneath. Flowers pea-like, purple, red or pink with a greenish-yellow keel. Pod 10-15 mm long, softly downy.

Distribution: Not common in NSW, having an outlier population in the Broken Hill-Menindee district in the far western plains. More common in the southern parts of the NT and inland SA.

Habitat and ecology: Grows in deep red sand, recorded from a roadside on a treeless plain in NSW. In central Australia, the species grows in Mulga communities on red earths and on stony soils supporting Bladder Saltbush. Also found on sandy plains and ridges, in grassland, and in watercourses and floodplains near creeks or rock holes. Associated species include *Acacia murrayana*, *A. aneura*, *Maireana aphylla*, *Atriplex vesicaria*, *Triodia*, *Solanum* and *Euphorbia* spp. Flowers from June to

October. Recorded as infrequent to locally common in populations. It is not known if fire is influential in promoting germination, although the species has been recorded in burnt areas in SA.

Protocol 2 for spinifex dependent targeted fauna surveys

This protocol aims to minimise impacts from vegetation clearance to threatened fauna species including Marble-faced Delma (Delma australis) and Western Blue-tongue (Tiliqua occipitalis), which rely on spinifex for their survival.

Where areas of *Triodia* spp. (spinifex) cover is found, Tronox will endeavour to complete slow, cool, fuel-reduction burns. Ideally these burns will be conducted in autumn, outside of the main breeding season for birds, bats and reptiles, but while conditions allow movement of these species before winter hibernation begins. If this is not possible, spring may be suitable. Fire weather conditions will also be a critical factor to allow the removal of ground and spinifex habitats, encouraging the dispersal of these threatened species out of the impact area and into the adjoining areas of remnant native vegetation.

During the conduct of burns, an appropriately qualified ecologist should be engaged to oversee and where necessary capture and translocate fauna which does not or is unable to disperse themselves, or is injured. Capture and translocation of all animals will follow the translocation protocol outlined in Appendix J2.

If timing and conditions do not allow burning to be carried out, other translocation techniques may be considered, such as targeted trapping, spotlighting, or observation of clearing. Captured animals would be translocated to nearby suitable habitats or to the Offset area, following the translocation protocol outlined in Appendix J2.

Target Fauna Species:

Western Blue-tongued Lizard (*Tiliqua occipitalis*)

Listed as Vulnerable under the NSW BC Act, this species has scattered records across central western and western NSW. It diurnally forages for insects, snails, native vegetation and carrion.

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. Preferred vegetation type appears to be mixed mallee/*Triodia* communities. Terrestrial, and known to utilise rabbit warrens for shelter.

Marble-faced Delma (*Delma australis*)

The Marble-faced Delma is listed as Endangered under the NSW BC Act, and is also known as the Southern Legless Lizard is a slender pygopid (legless lizard) that has an average snout-vent length of about nine centimetres, with the tail twice as long as the body. It is brown to reddish brown above, while the undersurface and lips are off-white or greyish. The top and sides of the head, throat and ventral surface is covered in vertical black bars, while the snout is short and rounded.

This species is widely distributed from Western Australia, through much of South Australia extending in to the southern Northern Territory and in north western Victoria and south western NSW. In NSW, most records are either from the Scotia mallee west of the Darling River in the far south west or from the central Murray centred on Round Hill and Nombinnie Nature Reserves. Recent surveys have detected this species east of the Darling River to the north of Wentworth and, more surprisingly, in spinifex occurring on rocky hillsides to the north west of Broken Hill.

In NSW this species appears to be restricted to temperate mallee woodlands or spinifex grasslands but elsewhere is also found in chenopod shrublands, heathlands and buloke associated with mallee habitats or eucalypt lined watercourses. The species occupies areas with a sandy substrate but may also utilise cracking red loam soils, but has also recently been recorded in spinifex on rocky hillsides. Found in deep leaf litter, under rocks, logs, fallen timber or in grass clumps such as spinifex. They are considered to be terrestrial although they may climb into hummock grass and even sleep in the branches of small shrubs. They are generally active during the day but have been observed being active at night or around sunrise and sunset. They are active hunters and their main food consists of

various types of insects and spiders. Lays two eggs in November or December which hatch after approximately 70 days.

Other potential spinifex dependent threatened fauna that may occur include Southern Ningaui (*Ningaui yvonneae*) listed as Vulnerable under the NSW BC Act, Mallee Slender Blue-tongue Lizard (*Cyclodomorphus melanops elongatus*) listed as Endangered under the NSW BC Act, and Jewelled Gecko (*Strophurus elderi*) listed as Vulnerable under the NSW BC Act.

Marble-faced Delma (*Delma australis*), trapped in western NSW, 2014.

Western Blue-tongued Lizard (*Tiliqua occipitalis*), observed in Western NSW, 2011.

Jewelled Gecko (*Strophurus elderi*) trapped in western NSW, 2014.

Protocol 3 for Hollow bearing and large old tree dependent targeted fauna surveys

A number of threatened fauna species which are reliant on large old and hollow-bearing trees either as refuge or for breeding purposes, are likely to occur in the vegetation clearing areas. Large old trees provide critical habitat in the form of hollows, deep cracks and crevices, and accumulations of loose bark which are used as roosting and breeding sites for a range of species of native microbats and birds. The size of tree, typically measured as diameter at breast height (DBH), at which hollows, cracks and crevices are likely to form, varies greatly between tree species, but is likely in mallee eucalypts over 15cm DBH, Black Box (*Eucalyptus largiflorens*) over 40cm DBH, and Belah (*Casuarina pauper*) over 40cm DBH (taken from Victorian EVC benchmarks for 'large old trees' in neighbouring Murray Mallee bioregion, part of the same Murray Darling Depression IBRA region).

Prior to any vegetation and habitat removal, Protocol 3 - Hollow bearing and large old tree dependent fauna will be implemented for trees equal to or greater than the DBH benchmarks mentioned above. This aims to minimise direct impacts and mortality to threatened fauna species including: Little Pied Bat (*Chalinolobus picatus*), Inland Forest Bat (*Vespadelus baverstocki*), Corben's Long-eared Bat (*Nyctophilus corbeni*) and Major Mitchell's Cockatoo, (*Lophochroa leadbeateri*), by removing key habitat features and encouraging their dispersal out of the development area.

A major factor in the successful mitigation of impacts on threatened species from the clearing of hollow bearing and large old trees is the timing of these works. It is critical that clearing of hollow bearing and large old trees must not be completed between spring and early summer (September to January inclusive) to avoid impacting on threatened species of breeding bats and birds that are likely to be using these habitats. Hollow bearing and large old trees should also not be fallen in winter (June-August inclusive), when bats may be hibernating and have greater difficulty moving to neighbouring areas.

Previous pre-clearance surveys of remnant vegetation at the nearby Snapper mine site involved the thorough assessment of all trees on site (primarily Belah (*Casuarina pauper*)), targeting threatened bats in particular. During three surveys, 2,492 trees were assessed, with a total of 270 bats recorded in 128 trees, averaging a bat tree encounter rate of 5.1% (Ogyris 2013, 2014a, 2014b). Of the 270 bats recorded in fallen trees, 12 were threatened species, and of these, two mortalities of threatened species were recorded, of a total of 5 bat mortalities. This represents a residency rate of 0.5% and a mortality rate of 0.08% for threatened hollow dependent bat species. The low residency and mortality rates of bats in fallen trees suggests that the need to comprehensively examine each fallen tree is unlikely to be necessary or an effective mitigation measure, and that provided trees are fallen and left *in situ* for a sufficient period, resident animals should disperse of their own accord. The impacts to threatened bat species is likely to be minimal, as animals will be highly unlikely to return to hollows in fallen trees, and will move to neighbouring areas of habitat.

Within the Crayfish site, the abundance of large old trees including Belah, Black Box and mallee appears less than previous areas that have been cleared. However, the Crayfish site generally appears to support smaller trees predominantly comprised of mallee, many of which appear to contain smaller hollows, but this is widespread across the site thus requiring a broader approach to pre-clearance rather than the inspection of every tree and associated hollows.

Clearing of hollow bearing and large old trees will ideally involve the falling of these trees by chainsaw, as opposed to by chaining, which is more destructive to the trees and hollows, and more likely to cause direct mortality to resident fauna. Areas of hollow bearing and large old tree are relatively small, and could easily be targeted for falling by chainsaw, a few days before remaining trees are fallen by chaining.

Clearing of trees, both hollow bearing and large old trees, and areas of smaller trees, must be completed two to five days immediately prior to the further clearance of remaining vegetation (i.e. pushing vegetation into heaps and windrows) to allow time for fauna to vacate these habitats, but not left for so long that other fauna may re-colonise them.

During the conduct of tree clearing, an appropriately qualified ecologist should be engaged to oversee and where necessary capture and translocate fauna which does not or is unable to disperse themselves, or is injured. Capture and translocation of all animals will follow the translocation protocol outlined in Appendix J2.

Target Fauna Species:

Bolam's Mouse (*Pseudomys bolami*)

Listed as Endangered under the NSW BC Act

Bolam's Mouse is a small rodect wighing between 9 and 21 grams. The head and body length is between 50 – 80 mm and tail length 71 – 103 mm. The fur is a dull amber-brown to olive-brown with dark tips above, and white below. It has large ears and hind feet and a long, heavily furred tail.

Distribution: Bolam's Mouse is found in southern Western Australia and South Australia, extending east into the south-western corner of NSW.

Habitat and Ecology: This species occurs in a chenopd shrubland plains or low mallee woodland where there is a developed understorey of *Acacia, Dodonaea* or *Eremophila* species. It tends to favour plains areas, spillways and along valley bottoms where loam or clay soils occur. Bolam's Mouse is a nocturnal species and utilised burrows for shelter. Diet consists of seeds, fruits, blossoms, grasses and herbs as well as invertebrates such as beetles and spiders. Breeding usisally occurs in spring and early summer with a maximum litter size of six.

Bolam's Mouse (*Pseudomys Bolami*)

Little Pied Bat (*Chalinolobus picatus*)

Listed as Vulnerable under the NSW BC Act.

The Little Pied Bat is a distinctive black and white bat that weighs four to eight grams. The head and body are about 4.5 cm in length; the tail 3.5 cm. The fur is glossy black on the back, grey on the belly, with white fur along the flanks forming a 'V' in the pubic area.

Distribution: The Little-Pied Bat is found in inland Queensland and NSW (including Western Plains and slopes) extending slightly into South Australia and Victoria.

Habitat and ecology: This species occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest and mallee and Bimbil box woodlands. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. Can tolerate high temperatures and dryness but need access to nearby open water. Feeds on moths and possibly other flying invertebrates.

Inland Forest Bat (*Vespadelus baverstocki*)

Listed as Vulnerable under the NSW BC Act.

One of a number of small (3 to 7 grams) insectivorous bats in the genus Vespadelus. It is generally sandy-brown above, with the underparts being paler (cream to pale brown). Identification is difficult, with overlap in size and fur colouration with some species occurring in the same area, particularly Southern Forest Bat *V. regulus* and Little Forest Bat *V. vulturnus*. These species can be separated by cranial measurements, genetic typing, or for males, glans penis morphology. Identification based on echolocation calls is also difficult, as there is considerable overlap in the frequency of the calls, particularly with the Little Forest Bat.

Distribution: Because of the difficulty of identification, the distribution of this species, particularly in NSW, is very poorly known. Believed to occur widely in all the mainland states, generally in areas with annual rainfall less than 400 millimetres. In Victoria it is confined to the extreme north west. In NSW it has been most regularly captured in the far south west, north from the Murray River to Menindee, and at least as far east as the Balranald-Ivanhoe Road. There is some evidence to suggest that this species also occurs in the central NSW mallee, centred on Nombinnie Nature Reserve, although there has been very little recent survey in this part of the state. There are also records just south of the Queensland border around the Culgoa River, though whether this connects with other NSW populations, or is the southern extent of a northern population is unknown. There are records further east in NSW but the identification of these records have not been confirmed. There are relatively few records of any *Vespadelus* species in the northwest of NSW and so whether this species does occur here is unknown. Some of the gaps in knowledge on the distribution of this and other bat species in western NSW probably reflects the lack of survey effort in most of this region.

Habitat and ecology: This species is known to roost in tree hollows and abandoned buildings. Known to roost in very small hollows in stunted trees only a few metres high. The habitat requirements of this species are poorly known but it has been recorded from a variety of woodland formations, including Mallee, Mulga and River Red Gum. Most records are from drier woodland habitats with riparian areas inhabited by the Little Forest Bat. However, other habitats may be used for foraging and/or drinking. Colony size ranges from a few individuals to more than sixty. Females congregate to raise young in November and December, with young carried for the first week following birth. Young are independent by January. These bats fly rapidly and cover an extensive foraging area and are presumed to feed on flying insects.

Corben's Long-eared Bat (*Nyctophilus corbeni*) (listed by Commonwealth as Greater Long-eared Bat (*Nyctophilus timoriensis*)

Listed as vulnerable under both the NSW BC Act and EPBC Act

The south eastern form of the Greater Long-eared Bat is also known as Eastern Long-eared Bat and has recently been described as new species Corben's Long-eared Bat (*N. corbeni*). It is uniformly dark grey-brown. The ears are about 3 cm long and larger than the head. It has a low ridge of skin running between the eyes and across the nose. It has a head and body length of 5 - 7 cm and weighs about 14 grams.

Distribution: Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species.

Habitat and ecology: Inhabits a variety of vegetation types, including mallee, bulloke *Allocasuarina leuhmanni* and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark. Slow flying agile bat, utilising the understorey to hunt non-flying prey - especially caterpillars and beetles - and will even hunt on the ground. Mating takes place in autumn with one or two young born in late spring to early summer

Major Mitchell's Cockatoo, (*Lophochroa leadbeateri*)

Listed as Vulnerable under the NSW BC Act.

This unmistakable cockatoo of the dry inland, Major Mitchell's Cockatoo is the only Australian cockatoo that is salmon-pink below and white above. It is also called the Pink Cockatoo, and until recently was listed under the name of *Cacatua leadbeateri*. It is smaller than the Sulphur-crested Cockatoo *C. galerita*, but slightly larger than a Galah *Eolophus roseicapillus*. Its most prominent feature is its large white-tipped crest that is banded in red and gold. Its call is a distinctive stammering whinny.

Distribution: Found across the arid and semi-arid inland, from south-western Queensland south to north-west Victoria, through most of South Australia, north into the south-west Northern Territory and across to the west coast between Shark Bay and about Jurien. In NSW it is found regularly as far east as about Bourke and Griffith, and sporadically further east than that.

Habitat and ecology: Inhabits a wide range of treed and treeless inland habitats, always within easy reach of water. Feeds mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of species of saltbush, wattles and cypress pines. Normally found in pairs or small groups, though flocks of hundreds may be found where food is abundant. Nesting, in tree hollows, occurs throughout the second half of the year; nests are at least 1 km apart, with no more than one pair every 30 square kilometres.

Protocol 4 for vegetation clearing

1 Pre-clearance Flora and Fauna Surveys and Activities

Timing of vegetation clearance, and completion of pre-clearance activities is the single most important factor in the mitigation of impacts to threatened species.

Where areas of *Triodia* spp. will be treated with slow, cool, fuel-reduction burns, ideally these burns will be conducted in autumn, outside of the main breeding season for birds, bats and reptiles, but while conditions still allow movement of these species before winter hibernation begins. If this is not possible, spring may be suitable. Fire weather conditions will also be a critical factor to allow the removal of ground and spinifex habitats, encouraging the dispersal of these threatened species out of the impact area and into the adjoining areas of remnant native vegetation.

It is also critical to the successful mitigation of impacts from the clearing of hollow bearing and large old trees that clearing must not be undertaken between spring and early summer (September to January inclusive) to avoid impacting on threatened species of breeding bats and birds that are likely to be using these habitats. Hollow bearing and large old trees should also not be fallen in winter (June-August inclusive), when bats may be hibernating and have greater difficulty moving to neighbouring areas.

Pre-clearance surveys must be undertaken by suitably qualified ecologists, the 'Project Ecologist', and are to be undertaken in three Stages – Stage 1, will involve fauna pre-clearance surveys when controlled burning of spinifex is completed (possibly weeks or months before stage 2), and while selected large old and hollow bearing trees are felled by chainsaw (beginning 2 to 5 days prior to remaining native vegetation removal. Stage 2 will involve the chaining of vegetation, including most tree removal, a minimum of 2 days but no more than 5 days before the further removal of remaining native vegetation in Stage 3; and Stage 3 will involve the subsequent removal of all remaining native vegetation, for example by pushing of all cleared vegetation into heaps and windrows.

Stage 1 – Flora and fauna pre-clearance survey:

xv. Flora and fauna pre-clearance surveys must be completed following the methods and timelines summarised in Protocol 1, 2 and 3. Burning of spinifex may be completed, subject to seasonal requirements, up to 3 years ahead of clearing, as this removal of spinifex habitat will not regenerate in this time, avoiding issues with re-colonisation by fauna. Falling of hollow bearing and large old trees should be completed in the two to five days immediately preceding the clearance of remaining vegetation by chaining to allow fauna to move from the clearance area into the surrounding remnant native vegetation. It is critical that these timelines are followed to allow enough time for fauna to move out of these higher quality habitats, but not so long after that fauna may begin to re-colonise the habitats.

xvi. Prior to falling any targeted hollow-bearing trees or logs, a hard object (e.g., hammer, crowbar, excavator bucket – depending on size and strength of tree, limb or log) will be used to knock on the tree, limb or log for a period of 2-3 minutes, to encourage fauna to exit. Sticks, poles or other similar hand-held objects will also be used to hit the trunk of the tree at various points, to encourage animals to vacate the tree;

xvii. When targeted hollow-bearing and old trees are being cut down, Project Ecologists will be nearby (but at a safe distance). When the hollow-bearing section is down, and the contractor says that it is safe to proceed, the Project Ecologists will examine the fallen hollow-bearing section for any animals that may be present, and in the case of injured or deceased animals, will apply the capture and removal protocol outlined in Appendix J2 if necessary;

xviii. All hollow-bearing sections are to remain *in situ* for a minimum period of at least 48 hrs (but not more than a period of five days) prior to being moved to the storage area. Allowing the hollow section to remain on the ground for a restricted period will provide fauna the opportunity to vacate of their own accord (e.g. insectivorous bats), and will minimise the risk of subsequent re-colonisation by ground-dwelling fauna. All of these activities would be undertaken in consultation with the Project Ecologist;

xix. If threatened species are detected during this process, they will be recorded and reported to BCD, following Appendix J2 and J3;

Stage 2 – Removal of trees and vegetation, primarily by chaining:

xx. Following pre-clearance flora and fauna surveys, when prioritised high quality spinifex areas have been potentially burnt, and prioritised large old and hollow-bearing trees have been fallen and left in place for a minimum of two and no more than five days (to provide fauna the opportunity to vacate of their own accord, and minimise the risk of subsequent re-colonisation by ground-dwelling fauna), the chaining of vegetation will be completed to lay over all trees and large shrubs. Chaining of vegetation should be done at least two and no more than five days before the final stage 3 of pushing vegetation into heaps and windrows for storage, again to provide fauna the opportunity to vacate of their own accord, and minimise the risk of subsequent re-colonisation by ground-dwelling fauna. An ecologist will be available during this process to capture and salvage any injured fauna that are observed during this process.

Stage 3 – Remove Native Vegetation and pushing into heaps and windrows for storage

xxi. Following pre-clearance flora and fauna surveys, and the removal of trees and vegetation, primarily by chaining, at least two and no more than five days should elapse before trees, limbs and logs are pushed into heaps and windrows for storage of woody debris, again providing fauna the opportunity to vacate of their own accord, and minimise the risk of subsequent re-colonisation by ground-dwelling fauna.

2. Storage and replacement of removed trees, limbs and logs (including hollow bearing)

All cleared woody vegetation and timber (including hollowing bearing trees, logs and limbs) would be stored as follows:

xxii. Rootballs, tree trunks and limbs, logs and woody debris greater than 5cm in diameter should be pushed into heaps or windrows and stored, along with topsoil, for later use during the rehabilitation process. Coarse woody debris provides a critical habitat feature to fauna that takes many years to develop in a rehabilitated area from regenerating vegetation, and can assist in reducing soil erosion from wind and water flow.

3. Pre-works Sites Surveys for Ground-dwelling fauna

xxiii. Each morning, prior to the commencement of clearing, the ‘clearance area’ will be thoroughly searched by the Project Ecologist for the presence of native fauna;

xxiv. This will include a brief ‘walk-over’ of the site to check for fauna activity. This check will be more focussed at ground-dwelling fauna species that are less mobile, and therefore less able to avoid injury or death during the clearance process;

xxv. Captured native fauna will be moved to suitable adjacent habitat using the protocols outlined in Appendix A;

4. Identification of native fauna

xxvi. The Project Ecologist will be immediately informed of the presence of native fauna in or within close proximity to the vegetation clearance area. The Project Ecologist will determine if the animal is at any risk of injury or mortality from clearing activities;

xxvii. If it is determined by the Project Ecologist that none of the construction activities are likely to increase the risk of injury, mortality or stress to the animal, the construction activities can continue and the fauna species will be monitored to make sure it doesn’t enter parts of the clearance area that could potentially result in the injury or death of the animal;

xxviii. If the Project Ecologist determines that some or all of the construction activities are likely to increase the risk of injury, mortality or stress to the animal, then the Project Ecologist would ‘capture and translocate’ the animal in accordance with the measures identified in Appendix A. Vegetation clearing activities will be monitored closely to ensure that it does not impact the animal at risk in the time leading up to its capture and removal from site

With all stages of the vegetation clearing process it is important that contractors should not handle any fauna at all, but should contact the Project Ecologist to attend the site and carry out the capture and removal protocols outlined in Appendix A;

Monitoring

Post clearance monitoring will focus on areas of surrounding remnant vegetation, and the area of Offset linked to this area of clearing. This monitoring is detailed in the Offset management Plan, which is being developed in concurrence with this Flora and Fauna Management plan by Tronox. Monitoring of flora, fauna, and ecological condition and function will focus on the improvement of the offset area from its baseline levels, and of any changes in the neighbouring clearance area.

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Appendix J-2 managing captured, injured and deceased animals

Animal Welfare Handling and Translocation Protocols

Protocol for all Animals

All native animals encountered during the Project will be treated humanely, ethically, and in accordance with relevant codes under the NSW *Prevention of Cruelty to Animals Act 1979*, including:

- Australian code of practice for the care of animals for scientific purposes (NHMRC 20048);
- Code of practice for injured, sick and orphaned protected fauna (110004, BCD 2013); and
- Animal ethics considerations and protocols outlined in this document.

For any native terrestrial fauna that are found within the Vegetation Clearance Area, and considered to be at risk of injury, mortality or stress by on-going construction activities, a Project Ecologist will 'capture and release' this animal according to the following protocol:

- All vegetation clearing activities that are considered by the Project Ecologist to be likely to increase the risk of injury, mortality or stress to the animal will be halted until the animal has been removed, which will be enforced with the co-operation of the site vegetation clearing Manager. Clearing native vegetation should not occur during the winter and spring hibernation and breeding seasons for many species (May to September inclusive). Vegetation clearing activities that are not likely to increase the risk of injury, mortality or stress to the animal can continue (as determined by the Project Ecologist).
- Only qualified ecologists with the correct permits from BCD will be allowed to handle animals, except under exceptional circumstances where the animal's welfare is put at risk;
- Animals will be captured by the Project Ecologist using a safe and ethical technique, as is appropriate for the species. For mobile uninjured animals, this may include safe and ethical actions such as encouraging the animals to depart the vegetation clearing area by themselves (without physical capture of the animal). Animals that are unable to depart of their own accord will be captured and held in an appropriate receptacle until release. All captive held animals will be provided with food, water and heat as is appropriate for the species (as outlined in Appendix C. Each receptacle will only hold one animal at a time and will be cleaned and disinfected between uses to avoid the spread of disease (Appendix C). (See Appendix C for description of containers for holding animals that are likely to be detected within the project area).
- Uninjured captured individuals are to be immediately released at the nearest suitable habitat away from the vegetation clearing area;
    - 'Suitable locations' will include habitats that are considered appropriate for the species, as determined by the Project Ecologist (e.g. sufficient protective cover, habitat features likely to support adequate food and water;
    - If the Project Ecologist is not trained to handle snakes, then either another Project Ecologist who is trained and experienced handling snakes will be brought to the site, or a licensed snake catcher will be engaged. Licensed snake handlers in the local area should be identified and alerted before the commencement of vegetation clearing activities. Efforts will be made to prevent snakes entering the vegetation clearing area. Project Ecologists will be trained and experienced in determining the differences between legless lizards (such as *Delma* spp. and *Pygopus* spp.) and snakes (particularly juvenile snakes); and
    - For particular species (e.g., nocturnal species), the Project Ecologist may also determine that it is beneficial to hold the animal/s safely in an appropriate receptacle until (or after) sunset to reduce risks to the animal such as disorientation or attack from predators. The receptacle will be kept in a shaded or otherwise suitable location during the day so that the temperatures experienced by the animals are well within safe ranges. At all times, the container will be kept in a secure location, under the responsibility of the Project Ecologist
- If an injured animal is found within the Vegetation clearing Area, then a Project Ecologist will immediately take this animal to a nearby veterinarian for assessment (Appendix J4);
    - For animals whose injuries can be repaired with a good chance of a successful return to the wild (as determined by the veterinarian), they will be placed into the care of a local and 'accredited party' if they are experienced in the care of that particular animal species. The 'accredited party' only includes person(s) authorised under the Wildlife Act as a wildlife shelter operator, foster carer or holder of an appropriate research permit number or an authorised officer under the Act to handle animals. For particular

species of injured animals where the local 'accredited party' is not qualified in their care and recovery (in accordance with the Veterinary Practice Act 1997), alternative 'accredited party(s)' will be arranged from a wider area; In consultation with BCD, a suitable solution will be determined prior to the commencement of vegetation clearing if there are animals for which no suitable 'accredited parties' can be found. If injured animals are found which were not anticipated prior to vegetation clearing, advice from BCD will be sought on an appropriate solution.
    - When injured animals have recovered sufficiently, they will be released safely at the point of capture by the Project Ecologist in suitable habitat;
    - Animals whose injuries have a poor chance of repair or for which a successful return to the wild is considered unlikely (as determined by the veterinarian - and as specified in the *Prevention of Cruelty to Animals Act 1979*) will be euthanised humanely by the veterinarian (Appendix J4); and
    - The Project Ecologists will offer deceased animal individuals to the Museum of NSW. If the Museum is not interested in taking some or all of the specimens, then the specimens will be offered to BCD as a second option. If both the Museum and BCD are not interested in the specimen, then it must be disposed of thoughtfully and hygienically – either buried, burned or securely wrapped and disposed of in the waste collection. The latter would not be appropriate for large animals (e.g. kangaroos).
- Threatened animals or other captured fauna are not to be released to sites far away from their capture point. If a circumstance arises that an animal cannot be released within 1000 metres of their capture point (e.g. due to lack of habitat or other risks), then a Senior BCD Flora and Fauna Officer will be consulted prior to release of the animal in the next nearest appropriate habitat. Written consent will be required (including email) to release the animal at a distance greater than the distances specified for that species. The Wildlife Act permit for the Project must allow sufficient flexibility that the distances that animals can be released from their point of capture can be increased beyond the specified distances at the discretion of Senior BCD Flora and Fauna Officers; and
- The time, location, Project Ecologist's name that captured the animal and other relevant details will be marked on a recording sheet.

If any threatened species are captured and released, then the Project Ecologist will inform BCD using the prepared form in Appendix J3 to make them aware of the actions undertaken. The technique and timeframe for notifying BCD will be agreed with BCD. Records of all animals that are handled, or otherwise managed, within the Vegetation clearing Area will be maintained on a Project register or database (including both dead and alive individuals). Data to be recorded includes the animal species and number, location, date and collector. Along with an interim report, this data will be supplied to BCD quarterly for inclusion on the NSW Wildlife Atlas.

Holding Containers for Fauna

Appropriate containers for temporarily holding various types of animals include:

- Small calico bag (~ 20 cm x 30 cm with cord to secure the opening): Lizards, dragons, microchiropteran bats. Bag then slung from beam in a holding box until the time of release;
- Large calico bag or pillow slip (~ 60 cm x 90 cm with cord to secure the opening): Snakes, medium-sized arboreal mammals. Bag then stored in a cardboard box with padding if required for transport;
- Cage trap (~ 30 cm x 30 cm x 60 cm): medium sized mammals. Trap to be covered with bag to reduce stress;
- Elliot trap: small mammals (e.g. Pygmy Possum) and reptiles (e.g. lizards);
- Plastic 'lunch-box'- style container (~ 10 cm x 10 cm x 20 cm) with appropriate habitat features, some water (or dampened cloth) and air holes: frogs;
- Sealable containers (~ 1-2 litres): tadpoles;
- Small box/open container with appropriate material for nestlings.
- Capture and temporary holding of feral animals (cats and foxes), large native mammals (kangaroo, wallaby and mega-chiropteran bats) and injured animals will be discussed with BCD on a case-by case basis.

Every trap/device/container used in connection with this project must be clearly labelled, showing the "Flora and Fauna Permit number". This is in accordance with the permit conditions on the Wildlife Act Management Authorisation.

If any threatened species is captured and released, BCD has to be informed using the form titled “Form to Report to BCD of Captured, Injured or Deceased Threatened Fauna Species” (Appendix B).

Appendix J-3 Form to report to BCD of Captured, Injured or Deceased Threatened Fauna Species

Form to Report to BCD of Captured, Injured or Deceased Threatened Fauna Species			
If a threatened species is captured and released, then the Project Ecologist(s) will inform BCD in writing within two working days to make them aware of the actions undertaken.			
CAPTURE DETAILS			
Project Ecologist(s):		Contact No:	
Date of Capture:		Time of Capture:	AM / PM
Location of Capture:		Easting:	Northing:
Number and Species of Animal Captured:			
Condition of Animal (circle)	Uninjured	Injured	Deceased
Comments: If injured, provide details of veterinary outcome. If deceased, provide details of lodgement with the Australian Museum, BCD or other appropriate disposal techniques if not taken by the Museum or BCD.			
RELEASE DETAILS			
Project Ecologist(s):		Contact No:	
Date of Capture:		Time of Capture:	AM / PM
Location of Capture:		Easting:	Northing:
Details of the Release Location (proximity to capture point, habitat type, features, etc.).			
Further details of release site if >150 m from capture site (e.g. pre-release approval from BCD, reasoning, etc.).			
Further Details / Mud Map:			

Appendix J-4 NSW Code of practice for injured sick and orphaned protected fauna

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Appendix J-5 Translocation Process

The translocation of any threatened flora and fauna species will be conducted in accordance with the Vegetation Clearing Protocol, and the guidelines provided throughout Appendix J, which includes:

- NSW Code of practice for injured sick and orphaned protected fauna;
- NPWS (2001b) Policy for the Translocation of Threatened Fauna in NSW;
- Australian Network for Plant Conservation (ANPC) (2004) Guidelines for the Translocation of Threatened Plants in Australia;
- IUCN (1987) Position Statement on Translocation of Living Organisms; and
- IUCN (1998) Guidelines for Re-Introductions.

Definitions of 'translocation'

Translocation of Threatened Flora Species (Australian Network for Plant Conservation, 2004)	Translocation of Threatened Fauna Species (NPWS, 2001b)
Translocation: is the deliberate transfer of plants or regenerative plant material from one place to another, including existing or new sites or those where a taxon is now extinct. There are four types of translocation: Re-stocking: an attempt to increase population size or diversity by adding further individuals to an existing population. Re-introduction: an attempt to establish a population in a site where it formerly occurred, but where it can now reasonably be held to be extinct. Introduction: an attempt to establish a population in a site where it is not known either to occur now or to have occurred in historical times, but which is within the known distribution range and habitat type of the taxon. Conservation introduction: an attempt to establish a taxon, for the purpose of conservation, in an area that is outside the known distribution range of the taxon, but which is an appropriate habitat for the taxon.	Translocation: is the movement of living organisms from one area with free release in another. There are three types of translocation: Introduction: the release of an organism outside its historically known range. Re-introduction: the release of an organism into part of its historically known range from which it has become extinct. Supplementation: addition of individuals to an existing population of the same species.

The translocation process involves the following components:

- *Feasibility Assessment* - including a biological and ecological assessment of the species, an environmental assessment of the translocation site and a logistical assessment. This assessment will be conducted prior to the threatened species being translocated.
- *Translocation Protocol* consisting of:
  - *Translocation Proposal* - to be prepared utilising the information obtained by the feasibility assessment and submitted to the NPWS for approval. The Translocation Proposal will be prepared in accordance with the NPWS (2001c) *Guidelines for the Contents of a Translocation Proposal*.

- *Pre-translocation Preparation* – the implementation of actions outlined in the Translocation Proposal required prior to translocation of the species (eg. marking out boundaries of the translocation habitat for flora species, experimental trials, appropriate regeneration/restoration of habitat and amelioration or removal of uncontrolled threats).
- *Translocation* – implementation of the translocation program to suitable, secure areas as close as possible to their point of origin.
- *Post-translocation* – short-term and long-term management, as well as monitoring and evaluation programs.

All stages of the translocation process are documented.

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https://projects.ghd.com/oc/Victoria1/Tronoxenvironmental/Delivery/Documents/3136479_DRAFT_Flora and Fauna MP.docx

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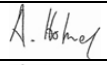
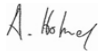
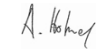
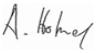
C	D. Eyles	A Holmes	*	A Holmes	*	07/12/2015
D	D. Eyles	A. Holmes		A Holmes		22/12/2015
E	S. Thompson	A. Holmes		A Holmes		23/08/2018
F	S. Thompson	A. Holmes		A Holmes		20/06/2019

*Denotes original signed

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