Appendix D

Matters of National Environmental Significance report

Matters of national environmental significance

Cobbora Coal Project

Prepared for Cobbora Holding Company Pty Limited | 17 September 2012

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Matters of national environmental significance

Final

Report J11030RP4 | Prepared for Cobbora Holding Company Pty Limited| 17 September 2012

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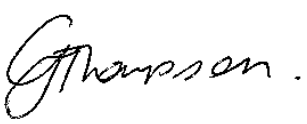
Signature		Signature	
Date	17 September 2012	Date	17 September 2012

Document Control

Version	Date	Prepared by	Reviewed by
V1	28 June 2012	Katie Whiting	Cassandra Thompson and Alison Hunt
V2	24 August 2012	Cassandra Thompson	Phil Towler
V3	17 September 2012	Katie Whiting	Phil Towler

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Executive Summary

ES1 Introduction

The Cobbora Coal Project (the Project) is an open cut coal mine proposed by Cobbora Holding Company Pty Limited (CHC). The Project will supply thermal coal, primarily to power stations in New South Wales (NSW). In addition, some coal will be produced for a combination of the export and spot domestic markets. Construction is planned to commence in mid-2013, with mine operations starting in the first half of 2015. A mine life of 21 years is proposed.

The study area encompasses a project application area (PAA) of 24,600 hectares (ha), with a Project footprint of up to 4,700 ha. Six areas protected under the NSW *National Parks and Wildlife Act* 1974 (NPW Act) occur within, or in close proximity to, the study area. These are the Goodiman State Conservation Area (SCA); Yarrobil National Park (NP); Cobbora SCA and surrounding land vested under the NPW Act; Dapper Nature Reserve (NR); and Goonoo SCA. Tuckland State Forest (SF) also occurs within the study area.

The Project is being assessed under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), with an environmental assessment (EA) being prepared by EMGA Mitchell McLennan Pty Ltd (EMM). The Project was referred to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) in December 2011 and was declared a 'controlled action' under the *Environment Protection and Biodiversity Conservation Act 199*9 (EPBC Act).

ES2 Methods

Terrestrial and aquatic ecology assessments have been undertaken to investigate the impacts of the Project on biodiversity values, including threatened species, populations and ecological communities. The assessment also addresses the impacts on matters of National Environmental Significance (NES) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Field investigations were carried out over a number of seasons to survey the biodiversity of the Project area from 2009 to 2012. Surveys were completed in accordance with the *Draft Guidelines for Threatened Species Assessment* and the *EIA Guideline Series: Aquatic Ecology in Environmental Impact Assessment*, and aimed to identify the occurrence of threatened species, populations and ecological communities within the Project area.

ES3 Results

The Project area lies in a transition zone between eastern, western and northern biotic elements and is an important area for biodiversity. However, the region has a history of clearing and agricultural land use with over 60% of the woody native vegetation estimated to have been cleared in the project application area (PAA). The PAA has been highly disturbed by agricultural land uses including intensive grazing, fire wood collection and pasture improvement. Remnant and regenerating woodland covers 36% of the PAA, including protected areas.

The Project will require clearing of native pasture (967 ha) and remnant and regenerating woodland (1,867 ha). Three percent (67 ha) of the remnant and regenerating woodland to be removed contains threatened ecological communities listed under the EPBC Act: Box Gum Woodland (12 ha) and Inland Grey Box Woodland (54 ha).

The native pasture is either poor condition and low diversity, or improved pastures dominated by exotic species. Native pasture areas were not representative of vegetation communities that would have occurred prior to clearing and agricultural activities, and were not considered to be consistent with the definition of any derived native grassland listed under the EPBC Act.

Two EPBC Act listed threatened bat, two threatened bird and three migratory bird species were identified within the PAA. Three threatened plant species were also identified.

ES4 Environmental management

CHC has incorporated a range of controls into the design and implementation of the Project, which will minimise potential impacts on threatened species, populations and ecological communities through avoidance, minimisation and mitigation. A detailed biodiversity management plan will be prepared to implement best practice management measures during progressive clearing, operation and rehabilitation for the Project. The efficacy of the plan will be monitored using an adaptive management approach.

Assessments in accordance with *Significant Impact Guidelines: Matters of National Environmental Significance* determined that after avoidance, minimisation and mitigation, the Project may significantly impact on some of the threatened species and ecological communities recorded within the PAA. Compensatory measures will be implemented to offset these impacts, particularly the loss of threatened species habitat and ecological communities.

Progressive rehabilitation will re-instate more than 1,900 ha of woodland representative of the existing vegetation types. A Biodiversity Offset Strategy has also been prepared for the Project that will provide important net benefits for biodiversity in the medium to long term within the region.

The connectivity of remnant habitat within the locality will be improved through the Project offsets, linking Cobbora SCA and Goonoo SCA in the north-west, through Tuckland State Forest and Goodiman SCA, to Yarrobil National Park in the south-east of the PAA. Offset to impact ratios of 40:1 for Box Gum Woodland and 8.4:1 for Grey Box Woodland including rehabilitation within the offset areas (discounted to 50% of the area) will be achieved.

The Large-eared Pied Bat and Keith's Zieria have been recorded within the offset areas. Potential habitat for the Large-eared Pied Bat and the Southern Long-eared Bat has also been identified. Additional surveys within the offset areas are planned in spring/summer to identify the presence and distribution of threatened species within the offset areas. If land-based offsets are not available for threatened species, indirect offsets will be provided to ensure the Project results in a net gain outcome. This may involve investment in threatened species management within the region according to species recovery plans.

The rehabilitation works and offset package will improve the connectivity of remnant habitat within the locality and the Project will result in a net gain in the quality, quantity and protection of biodiversity within the region in the medium to long term.

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Definitions and abbreviations

anabat	an ultrasonic microphone used to record microbat calls
annual	a plant completing its life cycle within one year from germination to fruiting and then dying
ANZECC	Australian and New Zealand Environment Conservation Council – published guidelines for water quality in aquatic ecosystems
AusRivAS	protocol for sampling aquatic macroinvertebrates
BMP	biodiversity management plan
CE	critically endangered species listed under the EPBC Act
CHC	Cobbora Holding Company Pty Limited
CHPP	coal handling and preparation plant
CMA	catchment management authority - thirteen CMAs have been established across New South Wales to ensure that regional communities have a say in how natural resources are managed in their catchments
DEC	NSW Department of Environment and Conservation - a former NSW environment department
DECC	NSW Department of Environment and Climate Change - a former NSW environment department
DECCW	NSW Department of Environment, Climate Change and Water - the former NSW environment department
DEWHA	Department of Water, Heritage and the Arts – the former Commonwealth environment department
DGRs	Director General's environmental assessment requirements
DLWC	Department of Land and Water Conservation
DPI	Department of Primary Industries
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
E	endangered species listed under the EPBC Act
EA	environmental assessment under Part 3A of the EP&A Act
EL	exploration license
EEC	endangered ecological community
EMM	EMGA Mitchell McLennan Pty Ltd
EMP	environmental management plan
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ERM	Environmental Resource Management (Australia) Pty Ltd
FM Act	NSW *Fisheries Management Act 1994*
forb	a herbaceous flowering plant that is not a graminoid
GIS	geographic information system
graminoids	grasses, sedges and rushes
granivorous	an animal that eats grains and seeds
ha	hectare/s
IBRA	interim biogeographic regionalisation of Australia - an IBRA region is a large geographically distinct area of similar climate, geology, landform, vegetation and animal communities. IBRA is the National Reserve System's planning framework, the fundamental tool for identifying land for conservation
IR camera	infrared, motion detecting cameras
km	kilometres
km^2	square kilometres
m	metres
Mi	migratory species listed under the EPBC Act
mNES	matters of national environmental significance listed under the EPBC Act
Mtpa	million tonnes per annum

Definitions and abbreviations

NP	National Park declared under the NPW Act
NPW Act	*National Parks and Wildlife Act 1974*
NPWS	NSW National Parks and Wildlife Service
NR	Nature Reserve declared under the NPW Act
NSW	New South Wales
NSWSC	New South Wales Scientific Committee
OEH	NSW Office of Environment and Heritage - the current NSW environment department
offset strategy	strategy prepared to offset impacts after avoidance, minimisation and mitigation have been applied
Part 3A	a part of the EP&A Act that determines the assessment requirements for developments that in the opinion of the Planning Minister, are of state or regional environmental planning significance. While Part 3A of the EP&A Act has now been repealed, the Project will be assessed under Part 3A as it entered the planning system prior to this repeal
PB	Parsons Brinkerhoff Pty Ltd
perennial	a plant whose life-span extends over more than one growing season
Project	the Cobbora Coal Project including areas required for the open cut mine; a coal handling and preparation plant (CHPP); a train loading facility and rail spur; a mine infrastructure area and associated supporting infrastructure
Project Application Area (PAA)	construction and operations activities that will cause physical land disturbance will generally be contained within the Project application area. Exceptions may include infrastructure upgrades, eg road improvements that will be approved outside of the *Environmental Planning and Assessment Act 1979* Part 3A process
Project footprint	the area of direct impact from construction and operation of the proposed Cobbora Coal Mine
SCA	State Conservation Area declared under the NPW Act
SF	State Forest
SPRAT	species profiles and threat database under the EPBC Act
study area	the area that has been surveyed and assessed for this ecological assessment. The study area for the Project is roughly bound by the Project Application Area (PAA), however some areas outside the PAA have been surveyed and assessed for offsetting and where unique habitat features were identified. Conversely, not all areas within the PAA were surveyed, particularly if these areas were not in proximity to the impact areas.
TEIA	terrestrial ecology impact assessment. A supporting document to the EA report
TEC	threatened ecological community
TSC Act	NSW *Threatened Species Conservation Act 1995*
TSSC	Threatened Species Scientific Committee
V	vulnerable species listed under the EPBC Act

1 Introduction

1.1 Background

The Cobbora Coal Project (the Project) is an open cut coal mine proposed by the Cobbora Holding Company Pty Limited (CHC). The mine will supply thermal coal, primarily to power stations in New South Wales (NSW). In addition, some coal will be produced for a combination of the export and spot domestic markets.

The Project is located approximately 5 km south of Cobbora, 22 km south-west of Dunedoo, 64 km north-west of Mudgee and 60 km east of Dubbo in the central west of NSW. The Project will include an open cut mine; a coal handling and preparation plant (CHPP); a train loading facility and rail spur; and a mine infrastructure area. Supporting infrastructure will include access roads; water supply and storage; and electricity supply. Construction is planned to commence in mid-2013. Mine operations will start in the first half of 2015 and a mine life of 21 years is proposed.

A Major Project application under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) was submitted to the NSW Department of Planning on 5 January 2010 (application number MP 10_0001). The Director General's environmental assessment requirements (DGRs) for the Project were issued on 4 March 2010. In response to changes in the proposed Project and government assessment requirements, revised DGRs were issued for the Project on 23 December 2011.

The Commonwealth Minister for the Department Sustainability, Environment, Water, Populations and Communities (SEWPaC) has determined the Project to be a controlled action under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as it is likely to have a significant impact on a number of matters of National Environmental Significance (NES) related to biodiversity.

A 2009-2011 Baseline Survey was undertaken by ERM (2012) across the original project application area (PAA). Since this survey was completed, the design of the Project has changed substantially. Ecological surveys were required for those areas not already assessed. These surveys (2011-2012 Surveys) were completed by EMGA Mitchell McLennan (EMM) from late 2011 to early 2012. The terrestrial ecology impact assessment (TEIA) incorporates the work undertaken during the 2009-2011 Baseline Survey and the 2011-2012 Surveys. It assesses the potential impacts of the Project on terrestrial ecology and provides recommendations to mitigate and/or offset remaining impacts.

An aquatic ecology impact assessment (AEIA) was also undertaken by Cardno Ecology Lab. This was undertaken to characterise aquatic biodiversity and determine the potential occurrence of threatened aquatic species, populations and communities.

1.2 Objectives

This report provides a summary of the TEIA and AEIA and highlights the potential Project impacts to matters of National Environmental Significance (mNES). Specifically, it addresses matters of NES in line with Commonwealth's assessment requirements for the Project.

1.3 The Project

1.3.1 Regional perspective

The Project Application Area (PAA) occurs within the Central West Catchment Management Authority (CMA) area and the boundary of the Talbragar Valley and Upper Slopes CMA subregions (Figure 1.1). The total PAA is 24,600 hectares (ha). It extends over two interim biogeographic regionalisation of Australia (IBRA) regions; Brigalow Belt South and South Western Slopes.

Five areas protected under the NSW *National Parks and Wildlife Act* (1974) (NPW Act) occur within or in proximity to the study area (Figure 1.1). These are:

- Goodiman State Conservation Area (SCA);
- Yarrobil National Park (NP);
- Cobbora SCA and surrounding land vested under the NPW Act;
- Dapper Nature Reserve (NR); and
- Goonoo SCA.

Tuckland State Forest (SF) is the only area reserved under the NSW *Forestry Act 1916* within or in close proximity to the study area (Figure 1.1).

1.3.2 Study area

The study area is bound by the Golden Highway in the north and the Cudgegong River in the south (Figure 1.2). The western and eastern parts contain agricultural land and woodland areas, with the study area bound by Avonside Road and the Castlereagh Highway to the east and Sweenys Lane and Sandy Creek Road in the west. Spring Ridge Road runs through the centre of the study area.

Narrow corridors extend from the proposed mine site, one to the south, providing a water pipeline for the Project from the Cudgegong River, and another to the east providing a rail spur for transport of the coal (Figure 1.2).

For the purposes of the ecological assessment, the study area is defined as the area that is bound by the PAA. Additional areas outside the PAA have been surveyed and assessed to assist with identifying areas for potential biodiversity offsets, as required.

1.3.3 Project description

The Project is a new open cut coal mine with the primary purpose of providing coal for five major NSW power stations. The mine will extract around 20 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal. From this, approximately 9.5 Mtpa of product coal will be sold to Macquarie Generation, Origin Energy and Delta Electricity under long term contract. In addition, approximately 2.5 Mtpa will be produced for export or for the spot domestic market.

The Project's key elements are:

- an open cut mine;

- a coal handling and preparation plant (CHPP);
- a train loading facility and rail spur;
- a mine infrastructure area; and
- supporting infrastructure including access roads; water supply and storage; and electricity supply (Figure 1.2).

It is envisaged that construction activities will commence in mid-2013 with coal supplied to customers from the second half of 2015. The mine life will be 21 years.

1.4 Consideration of alternatives

The Project's ongoing design has considered the following constraints:

- physical, such as the location of coal and landscape elements;
- environmental, such as ecological sensitivities;
- social, such as the community's expectations and concerns; and
- economic, such as constraints on economic extraction and processing of the coal.

This section describes the alternatives that were considered, rejected or accepted during this process.

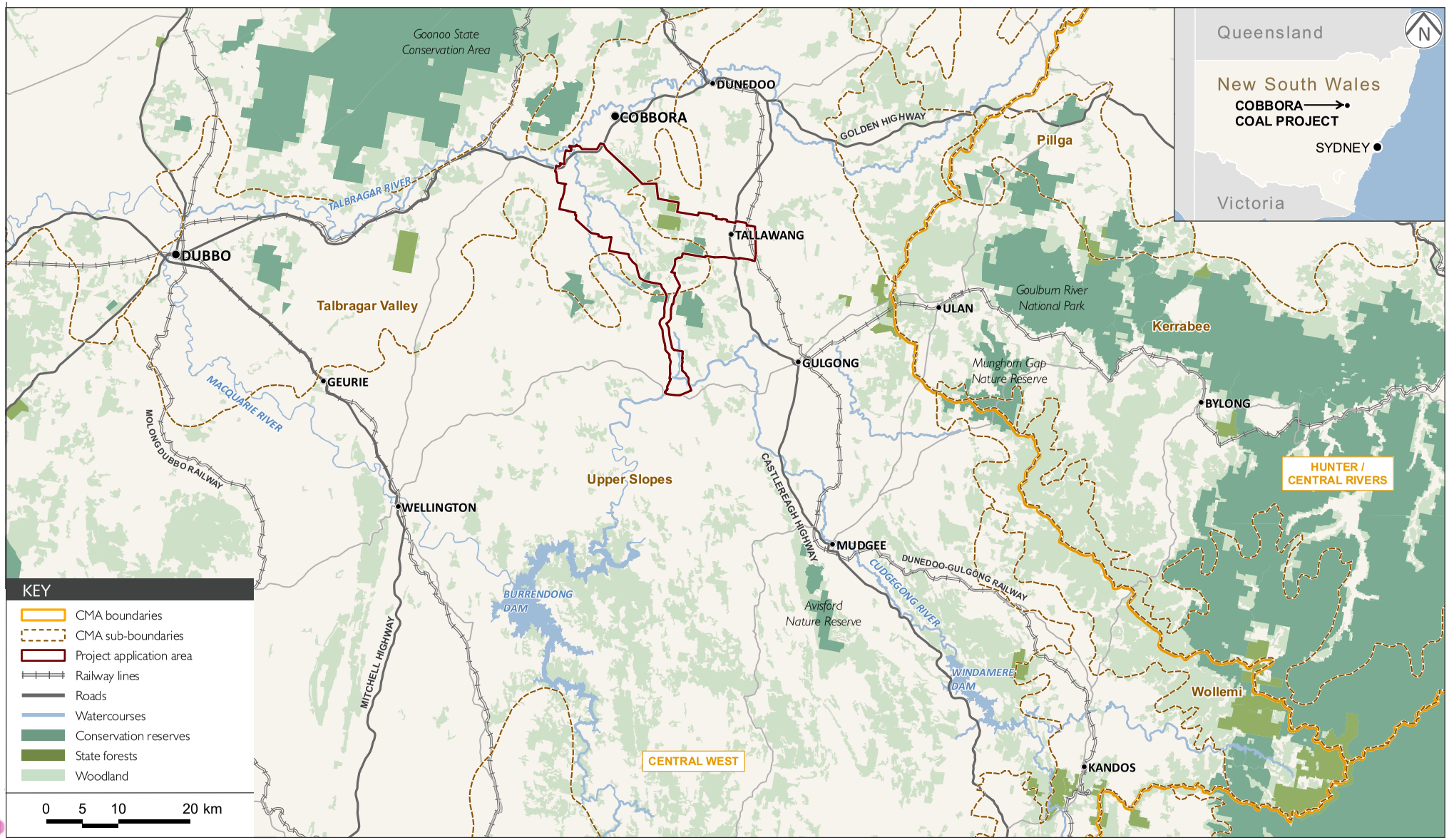
1.4.1 Alternatives considered

i Project location

The coal resource is located within EL 7394. The geology and orientation of the coal resource within EL 7394 is fixed and is therefore the primary consideration governing the development of the Project design, particularly the mining area layout. However, since the Project's inception, the design continues to be refined to minimise the potential environmental impacts.

There is no alternative to locating the mine in EL 7394 as there are no other mining titles in NSW dedicated to domestic coal supply. However, this location provides a number of benefits compared with sourcing coal for NSW power stations from other areas in NSW:

- most of the coal from the resource in EL 7394 cannot be economically extracted for export but is an economic supply for NSW power stations. Therefore, the Project represents an opportunity for NSW to maximise the benefits it realises from the export of coal from other mines that would otherwise be used domestically;
- only a small area of high quality agricultural land is situated on the resource and it will be avoided. No Rural Land Capability Class I or II land will be disturbed as a result of the Project while about 780 ha of Class III land will be removed temporarily and replaced by about 1,100 ha of Class III land;
- there are no towns in the PAA and the population is sparsely distributed;
- most impacts can be contained to land owned by CHC;



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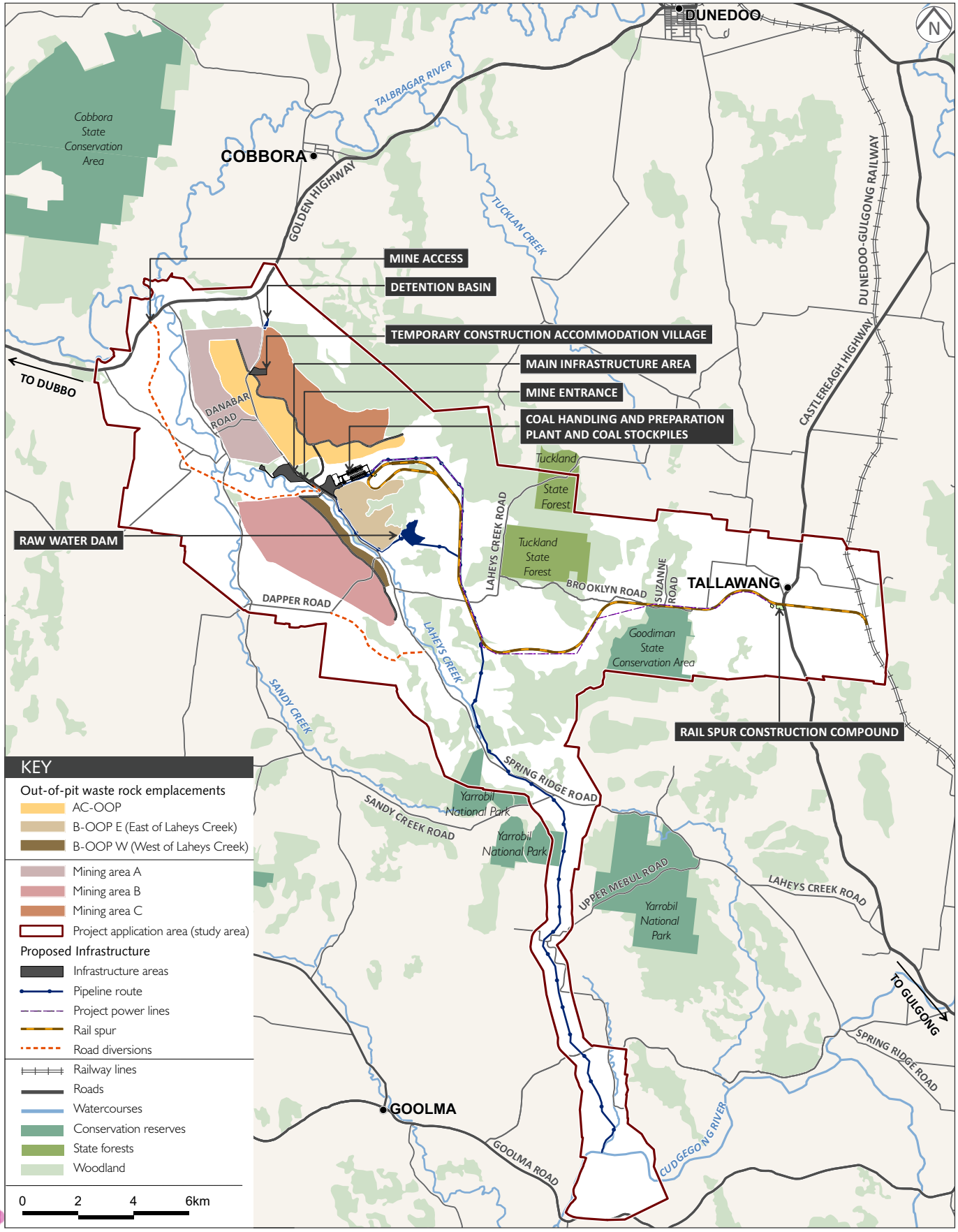
Cobbora Holding Company Pty Limited

Location of the Study Area

Cobbora Coal Project - Matters of NES Report

Figure 1.1



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Conceptual Project Layout

Cobbora Coal Project - Matters of NES Report

Figure 1.2

- the Golden Highway is close enough to the Project to minimise Project-related traffic from using local roads but is far enough away that there is no requirement to alter the alignment of the highway; and
- only a small number of local roads will need to be closed and alternative roads can be provided.

ii Mining method

Coal is generally mined using open cut or underground mining methods or a combination of both. It is proposed to develop an open cut mine as the strip ratio (ie the thickness of overburden:coal) is 2:1, which is low compared to many coal mines in NSW. It would not be economic to extract the coal by underground mining methods. Further, with this low strip ratio there would be substantial subsidence if an underground mine was developed.

iii Project design

Since its inception in 2009, the Project's design has continued to be refined to meet its customers' requirements, to minimise its environmental impacts, and in response to stakeholder concerns.

The alternatives considered during Project design are documented in a series of reports which are publically available on the DP&I website. The development of the design is described in these reports and is summarised below.

a. Original 2009 proposal

The original Project description was provided in the *Preliminary Environmental Assessment* (ERM 2009). The original mine layout was based on a single large mine pit covering about 3,900 ha. The pit was to begin with a central box cut and progress from east to west. The mine was between Laheys and Sandy creeks and included diverting these creeks. A rail spur 28 km long was proposed.

A ROM coal extraction rate of up to 30 Mtpa was originally proposed.

b. Updated 2011 proposal

The design was updated in 2011, as described in the *Project Update Report* (EMM 2011) to:

- decrease its scale, including the mining rate and total volume of coal mined;
- reduce the extent of the mining area;
- avoid the requirement to divert Laheys and Sandy creeks;
- avoid sensitive environmental areas, including riparian areas and agriculturally valuable land;
- remove delivery of coal to the Mt Piper and Wallerawang power stations along the Gwabegar line, which passes through Mudgee, Kandos and Rylestone;
- improve the efficient recovery of coal by optimising the pit design relative to overburden stripping ratios; and
- address the concerns of neighbouring landowners and other stakeholders in relation to visual and noise impacts.

The updated design contained four pits around the mine infrastructure area. The extraction rate was reduced from 30 Mtpa to 20 Mtpa of run-of-mine (ROM) coal. These changes remain part of the Project.

It was originally proposed to transport product coal from the CHPP to a train loader on the rail spur balloon loop using a short conveyer.

In early 2011, the design was amended to include a rail spur 10 km long from the Dunedoo–Gulgong Railway and an overland conveyor 12 km long. A ROM hopper in the centre of the main infrastructure area was to feed the coal conveyor. The conveyor would have transported coal to a ROM coal stockpile west of Suzanne Road. The CHPP, train loader and rail loop would have been built in this area. In late 2011, more detailed information on the potential environmental impacts of the overland conveyor option became available. The environmental impacts were found to be higher, particularly as a result of the fragmentation of sensitive ecological habitat.

Consequently, CHC redesigned the Project to replace the overland coal conveyor with an extended rail spur line. As a result, the product coal stockpile will be moved back to the main infrastructure area. The extended rail spur line will run to the south of the Tuckland State Forest in a semi-circular arc, then back up into the main infrastructure area.

It was originally proposed that around 4 GL of water would be used annually in the coal handling and preparation plant (CHPP) and for dust suppression. The following water sources were proposed:

- surface water and groundwater entering the pit (large annual groundwater inflows to the pit were predicted);
- Cudgegong River from high security water licences and a pipeline 25 km long; and
- a pipeline 50 km long using excess groundwater mine inflows from the Ulan Coal Mine.

The updated (and current) design requires less make-up water than the original proposal principally because of reduced mining and coal preparation rates. Water sources for the Project will be:

- surface water and groundwater that enters the mine pit; and
- a pipeline 25 km long from the Cudgegong River to convey 3.3 GL of water annually from high security water access licences that CHC has bought.

The Project will not divert Sandy or Laheys creeks and the annual groundwater inflows are much less than the original proposal.

The pipeline that runs for 50 km from the Ulan Coal Mine is not viable and was removed from the Project to avoid construction impacts and uncertainties associated with the ongoing supply of water from the Ulan Mine.

The locomotive provisioning facility owned and operated by a third party was also added to the Project to allow improved fuelling and servicing efficiency for trains carrying coal from the Project.

c. Updated 2012 proposal

The Project design was updated in 2012 as described in the *Project Update* (EMM 2012) to:

- remove the conveyor that is 12 km long, as described above;

- move the CHPP and associated coal stockpiles about 1 km to the east to be next to the rail loop and away from Laheys Creek;
- include road diversions to replace sections of roads that will be removed;
- include the temporary construction village; and
- refine the water pipeline corridor from the Cudgegong River to minimise archaeological impacts and to avoid unavailable land.

These elements remain part of the proposed Project.

iv Alternatives to proposed mine layout and infrastructure footprint

The mining area has been developed to efficiently extract the coal while providing multiple mining pits to provide operational flexibility. In particular, this allows coal with different characteristics to be extracted simultaneously and blended in the CHPP, to produce coal to meet customer specifications. The alternative mine layouts and infrastructure footprints to avoid or minimise impacts are described below.

a. Agricultural land

The extent of the mining areas has been reduced to avoid Rural Land Suitability Class II agricultural land west of Mining Area C and to minimise the area of Rural Land Suitability Class III within the disturbance footprint.

b. Creeks and riparian zones

The extent of the mining areas has been reduced to avoid creek diversions by reducing the scale of the Project and reconfiguring the mining area. This has minimised:

- clearing riparian vegetation;
- impacts to large areas of terrestrial and aquatic TECs; and
- impacts to threatened species habitat, particularly for the freshwater catfish population.

v Threatened flora species and TECs

There are a number of areas containing threatened flora species or TECs in the mining area, MIA and surrounds. Alternatives considered to avoid impacts to these are summarised in Table 1.1.

Table 1.1 Alternatives to avoid or minimise impacts to threatened flora species and EECs

Project component	Alternative[1]	Comment
1.Footprint at the southern end of AC-OOP and north of the MIA	1.1 Economically optimised design	A sub-population of Ingram's zieria containing a large number of individuals in the PAA (340 individuals) is immediately south of AC-OOP, in the footprint of part of the previously proposed coal conveyor, and MIA. This sub-population would need to be removed to construct the most economically efficient design.
	1.2 Reconfigured design to avoid sub-population of Ingram's Zieria	The AC-OOP and MIA was redesigned to avoid this sub-population. This will avoid removing 340 Ingram's Zieria.
2. B-OOP E location and design	**2.1 Centrally located out of pit emplacement for Mining Area C (B-OOP E)**	B-OOP E will be used when developing Mining Area B. The out of pit emplacement will be used when mining starts in the eastern side of the area to extract the shallowest coal first. The out of pit emplacement has been redesigned to minimise the removal of Ingram's Zieria. However, given that the majority of the sub-populations of Ingram's Zieria are in the centre of B-OOP E, it is not possible to avoid the majority of individuals without completely relocating the out of pit emplacement. It is not possible to develop Mining Area B without placing B-OOP E in its proposed location (see rows below). Offsets will be provided to compensate for the Ingram's Zieria sub-populations removed.
	2.2 Expanded out of pit emplacement for Mining Area C (B-OOP W)	The size of B-OOP W has been maximised to minimise the footprint of B-OOP E. It cannot be expanded further because it is constrained by the requirement to protect the riparian zone along Laheys Creek to the east and by active mining areas to the west. Therefore, this is not a feasible alternative to reduce impacts to Ingram's Zieria in the footprint of B-OOP E.
	2.3 Placing out of pit emplacement for Mining Area C west of Mining Area C	It is not economically feasible to place the out of pit emplacement on the eastern side of Mining Area B because of haul distances. Placing out of pit emplacements here would also sterilise coal resources.
3. Footprint of Mining Area A, Mining Area C, AC-OOP and MIA	3.1 Economically optimised design	There are sub-populations of Ingram's Zieria (sub-populations 1, 2, 4, 5, 6, 7 and 15 in Figure 4.2) in the footprint of Mining Area A, Mining Area C, AC-OOP and MIA. There are 50 ha of TECs within these areas. Removal of these sub-populations of Ingram's Zieria and areas of TEC could only be avoided if Mining Area C was not developed.
	3.2 Reconfigured design to minimise impacts to threatened flora species and TECs	Impacts to Ingram's Zieria sub-population 2 have been avoided by reconfiguring the MIA footprint. Impacts to Ingram's Zieria sub-population 1 have been minimised by reconfiguring the south-western extent of Mining Area A footprint. The western and northern extent of Mining Area A, Mining Area C, and AC-OOP have been reduced to avoid or minimise impacts on EECs.

Table 1.1 Alternatives to avoid or minimise impacts to threatened flora species and EECs

Project component	Alternative[1]	Comment
4. Footprint of Mining Area B and B-OOP W	4.1 Economically optimised design	There are two sub-populations of *Tylophora linearis* in the centre of the northern section of the footprint of Mining Area B (see Figure 4.2). There are 20 ha of TECs within the footprint of Mining Area B and B-OOP W. Removal of these sub-populations of *Tylophora linearis* and areas of EEC could only be avoided if much of Mining Area B was not developed.
	4.2 Reconfigured design to minimise impacts to threatened flora species and TECs	Mining Area B has been reconfigured to avoid removing TECs west of the area.

*1. The proposed alternative is highlighted in **bold**.*

The economically optimised mine layout and MIA have been reconfigured to minimise impacts on threatened flora species or TECs. Large areas of the mine would have to remain undeveloped if further impacts are to be avoided.

a. Aboriginal heritage

The distribution of Aboriginal sites has been an important consideration in mine planning. The extent of the mining areas has been reduced, particularly along creeks and riparian areas where the majority of Aboriginal sites were found during archaeological surveys. The design has been modified to avoid known sites where possible, particularly along Sandy Creek.

b. Historic heritage

The extent of the mining areas has been reduced to avoid Laheys Creek cemetery, Dapper Union Church, the Potential Cobb and Co stopping place, and a brick clamp that would have been removed as part of the original Project design.

vi Final voids

There will be three final voids post-mining. CHC does not believe that accumulating large volumes of highly saline water is environmentally acceptable and neither are periodic releases to limit salt build-up. However, given uncertainties associated with water quality modelling so far into the future, CHC does not yet have enough information to decide the best way to manage the voids.

CHC will produce a final void management plan in Year 15, when there will be some 20 years of groundwater monitoring data, which will describe the best configuration of the final voids so no unacceptable environmental impacts occur. The closure plan will consider a number of alternatives so that water quality in the final voids does not influence the quality of local water resources:

- reducing the void depth and volume by infilling to levels required to prevent permanent void lakes from forming;
- creating landforms during rehabilitation that result in frequent overflows from the voids to the creek system, and establishing an equilibrium salt concentration in the lakes that would have little environmental impact on local water resources; and

- providing controlled outlets from the void lakes to promote regular flushing of the lakes.

vii Coal conveyor

As discussed above, an alternative Project design with a coal conveyor 11 km long and a rail spur 10 km long was examined. This option would have:

- required clearing part of the largest sub-population of Ingram's Zieria recorded in the PAA (sub-population 3);
- required clearing a corridor in woodland areas, some of which contain threatened fauna species, and clearing 6 ha of TEC. The corridor would have passed between the two sections of Tuckland State Forest, degrading this wildlife corridor;
- the ROM coal stockpile, CHPP and rail loop would have been within about 1,500 m of 11 residences on Suzanne Road and would have required more acquisitions to ensure noise and dust criteria were not exceeded at private residences;
- the conveyor and ROM coal stockpile would have extended above the ridge that prevents views of the Project from the north, increasing the visual impacts of the Project; and
- the conveyor and ROM coal stockpile would have been in the catchment of Tuckland Creek, increasing the number of water sub-catchments potentially disturbed by the Project.

The coal conveyor is no longer part of the Project.

viii Rail spur

The rail spur route 28 km long was selected to minimise woodland clearance and avoid two properties not available for purchase. The rail spur will pass largely through cleared agricultural areas (Agricultural Suitability Class 3 and 4). It was moved to the north to avoid impacts on Ausfeld's Wattle (*Acacia ausfeldii*) growing on the northern boundary of Goodiman SCA.

A rail bridge (viaduct) and rail cutting were considered for crossing the Castlereagh Highway. A viaduct would avoid the need to alter the surface of the Castlereagh Highway which is maintained by RMS. A viaduct could be removed at the end of the mine life (if the rail spur is removed) without affecting the highway. A viaduct would require a clearance from the road surface of 6.5 m and therefore would be approximately 2.2 km long. Raising the rail spur on a viaduct would increase noise levels from trains at approximately six residences (residences 3021, 3022, 3024, 3035 3043 and 4026) within 1 km of the viaduct. The viaduct would be visually intrusive in an area where, otherwise, there will be no significant visual impacts from the Project.

The proposed rail cutting under the Castlereagh Highway will minimise noise and visual impacts. The responsibility for the bridge supporting the highway will have to be demarcated between CHC and RMS, including after mine closure.

ix Roads

A series of alternatives were considered for mine access, including access from the south along Spring Ridge Road and from the north along the Spring Ridge Road realignment. Workforce recruitment (and therefore accommodation) will be largely from the west and south-west of the mining area. Therefore, the road upgrades and realignments have been designed to accommodate Project-related traffic accessing the mine from the Golden Highway.

Alternative access from the south along Spring Ridge Road would not meet the requirements of the Project, would require widening the southern sections of Spring Ridge Road and would require much more travel along local roads rather than along the Golden Highway and purpose-built Spring Ridge Road realignment. The verges of the southern sections of Spring Ridge Road contain native vegetation, including TECs in many of the areas. Widening Spring Ridge Road would require clearing vegetation on one or both sides of the road.

Three road realignments will be constructed to replace sections of Spring Ridge Road, Dapper Road and Brooklyn Road. A range of alternative realignments was considered that either widened existing local roads or created new road sections. Given that the verges of existing local roads often contain remnant vegetation, including TECs, new road diversions will be constructed in preference to widening existing local roads.

x Water supply

As discussed above, a series of water supplies alternatives were considered as the Project design progressed. The selected water supply arrangement will ensure the mine has enough water to continue operations in all but extreme dry years. It will maximise water reuse on site to reduce water discharge requirements and will not reduce the water availability to other uses, including town, and stock and domestic supplies.

1.4.2 No project alternative

There are no other mining titles in NSW dedicated to domestic coal supply. If the Cobbora resource is not developed:

- the NSW electricity generators will be more exposed to the volatile thermal coal price on the international market;
- electricity generation in NSW will become increasingly dependent on interstate electricity transfers, with attendant higher environmental and financial costs; and
- substantial social costs would occur if NSW experiences disproportionate increases in electricity prices compared to other parts of Australia or its peer economies internationally.

1.4.3 Project optimisation

There are no alternatives to developing the Project in EL 7394. However, developing the Project in this area is desirable as it provides many benefits over sourcing coal for electricity generation from other areas in NSW that are more suited to the export market. As the mine design progressed, a wide range of alternatives were considered to efficiently extract the coal while avoiding or minimising disturbance to native vegetation, habitat, creeks, high value agricultural land and cultural heritage sites wherever possible. The Project, as described in this section is optimised to meet these demands.

1.5 The proponent

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1.5.1 Environmental record of proponent

The Cobbora Holding Company (CHC) was formed in January 2011 to develop the Cobbora Coal Project. The company is currently developing a Health Safety and Environment Policy and an environmental management system as part of the Project. Construction and operation of the Project will be in accordance with the policy and environmental management plans.

2 Approval requirements

2.1 Overview

Approval requirements/elements of the Project include:

- a referral to the Minister for SEWPaC (commonly known as an EPBC referral);
- Project requirements (Commonwealth) issued by SEWPaC following the submission of the EPBC referral; and
- DGRs under Part 3A of the EP&A Act and other requirements under the EP&A Act.

2.1.1 EPBC referral

A Project referral was submitted to SEWPaC on 21 October 2011. The Project was considered to constitute a controlled action in the referral. A controlled action is defined as '*an activity that is likely to have a significant impact on one or more Matters of National Environmental Significance*', which is protected under the EPBC Act. The Project was considered a controlled action due to potential impacts to EPBC Act listed flora, fauna and ecological communities.

Following consideration of the referral, the Project was declared a controlled action under Section 75 of the EPBC Act by the Commonwealth Minister on 29 November 2011 due to the following relevant controlling provisions:

- listed threatened species and communities (sections 18 and 18A); and
- listed migratory species (sections 20 and 20A).

2.1.2 Commonwealth environmental assessment requirements

DGRs were received from the Commonwealth on 23 December 2011. The Minister stipulated that impacts to the matters of NES listed in Table 2.1 were to be addressed. The following was also requested to be included in the assessment:

- general information regarding the controlled action – included as Chapter 1 of this document;
- description of the controlled action – included as Section 1.2.2 of this document;
- description of the existing environment – included as Chapter 4 of this document;
- description of relevant impacts of the controlled action – included as Chapter 5 of this document;
- proposed safeguards and mitigation measures – included as Chapter 6 of this document; and
- offsets – included as Chapter 7 of this document.

In addition to the Minister's requirements, migratory species and threatened fish listed as natters of NES under the EPBC Act were also considered within the environmental assessment and are included in this report (see Table 3.1).

Table 2.1 Matters of NES relevant to the Project

MNES	EPBC Act status	Description
Threatened ecological communities	CE	Box Gum Woodland
	CE	Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland
	E	Weeping Myall Woodlands
	E	Coolibah-Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South
Threatened flora species	E	*Digitaria porrecta*
	CE	*Euphrasia arguta*
	V	*Homoranthus darwinioides*
	E	Ingram's Zieria
	V	*Philotheca ericifolia*
	V	*Rulingia procumbens*
	E	*Tylophora linearis*
Threatened fauna species	V	Brush-tailed Rock Wallaby (*Petrogale penicillata*);
	V	Grey-headed Flying-fox (*Pteropus poliocephalus*);
	V	Large-eared Pied Bat
	V	New Holland Mouse (*Pseudomys novaehollandiae*);
	V	Painted Snipe (*Rostratula australis*); and
	E	Regent Honeyeater
	V	South-eastern Long-eared Bat (*Nyctophilus corbeni*).
	E	Swift Parrot (*Lathamus discolor*);
	V	Superb Parrot (*Polytelis swainsonii*);

Notes: 1.V-vulnerable, E-endangered, CE-critically endangered

2. EPBC Act – Environment Protection and Biodiversity Conservation Act 1999

3 Method

3.1 Overview

The following tasks were used to investigate biodiversity and the likely ecological impacts associated with the Project:

- literature and database review;
- terrestrial flora surveys;
- terrestrial fauna surveys;
- aquatic surveys; and
- impact assessment and mitigation.

The field investigations undertaken for the purposes of this study were conducted in accordance with the NSW *Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005). Information from the guidelines was complemented by threatened species profiles, and the NSW *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - working draft* (DEC, 2004). Where appropriate and available for the investigations, the DEWHA threatened species survey guidelines (DEWHA 2011a; 2011b; 2011c and 2011d) were also used. Survey methods and timing requirements for the target matters of NES are summarised in Table 3.1.

Table 3.1 Target threatened species survey requirements

Species	EPBC Act status	Survey method requirements	Survey timing requirements
Threatened ecological communities			
Coolibah-Black Box Woodlands	E	Plot surveys and rapid assessment surveys	Year round
Grey Box Grassy woodlands and Derived Native Grasslands of South-eastern Australia	E	Plot surveys and rapid assessment surveys	Year round
Natural grasslands on basalt and fine-textured alluvial plains	CE	Plot surveys and rapid assessment surveys	Year round
Weeping Myall Woodlands	E	Plot surveys and rapid assessment surveys	Year round
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	Plot surveys and rapid assessment surveys	Year round
Plants			
Austral Toadflax (*Thesium australe*)	V	Targeted threatened flora search	Spring (when flowering)
Digitaria porrecta	E	Targeted threatened flora search	Late summer to autumn (when flowering and seeding)

Table 3.1 Target threatened species survey requirements

Species	EPBC Act status	Survey method requirements	Survey timing requirements
Euphrasia arguta	CE	Targeted threatened flora search	Late summer to autumn (when flowering)
Homoranthus darwinioides	V	Targeted threatened flora search	Year round
Ingram's Zieria (*Zieria ingramii*)	E	Targeted threatened flora search	Year round
Philotheca ericifolia	V	Targeted threatened flora search	Spring (when flowering)
Rulingia procumbens	V	Targeted threatened flora search	Year round
Tylophora linearis	E	Targeted threatened flora search	Year round
Zieria obcordata	E	Targeted threatened flora search	Year round
Birds			
Australasian Bittern (*Botaurus poiciloptilus*)	E	Timed area search, targeted search, spotlighting	Year round
Cattle Egret (*Ardea ibis*)	Mi	Timed area search, targeted search	Year round
Great Egret (*Ardea modesta*)	Mi	Timed area search, targeted search	Year round
Malleefowl (*Leipoa ocellata*)	V, Mi	Timed area search, targeted search, search for mounds and tracks	Year round
Painted Snipe (*Rostratula australis*)	V, Mi	Timed area search, targeted search	Year round
Rainbow Bee-eater (*Merops ornatus*)	Mi	Timed area search, targeted search	Year round
Regent Honeyeater (*Anthochaera phrygia*)	E, Mi	Timed area search, targeted search	Late autumn to early spring
Superb Parrot (*Polytelis swainsonii*)	V	Timed area search, targeted search	Winter
Swift Parrot (*Lathamus discolor*)	E	Timed area search, targeted search	Winter
Amphibians			
Booroolong Frog (*Litoria booroolongensis*)	E	Targeted search	Spring to early summer
Mammals			
Brush-tailed Rock Wallaby (*Petrogale penicillata*)	V	Spotlighting, baited infrared camera, hair tubes	Year round
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	Spotlighting, targeted search	Year round
Koala (*Phascolarctos cinereus*)	V	Spotlighting, call playback, scat search using spot assessment technique (Phillips and Callaghan, 2011)	Year round
Large-eared Pied Bat (*Chalinolobus dwyeri*)	V	Anabat detection, harp trapping, searches for roosts in sandstone overhangs	October to March

Table 3.1 Target threatened species survey requirements

Species	EPBC Act status	Survey method requirements	Survey timing requirements
New Holland Mouse (*Pseudomys novaehollandiae*)	V	Spotlighting, baited infrared camera, hair tubes	Year round
Southern Long-eared Bat (*Nyctophilus corbeni*)	V	Harp trapping	October to March
Spotted-tail Quoll (SE mainland population) (*Dasyurus maculatus maculatus*)	E	Spotlighting, IR cameras, searches for latrine sites in rocky outcrops	Year round
Fish			
Murray Cod (*Maccullochella peelii peelii*)	V	Electrofishing, bait traps, seine nets, plankton nets	Year round
Trout Cod (*Maccullochella macquariensis*)	E	Electrofishing, bait traps, seine nets, plankton nets	Year round

Notes: 1. CE-critically endangered, E-endangered, V-vulnerable, Mi-migratory

3.2 Terrestrial ecology

The 2009-2011 Baseline Surveys (ERM 2012) concentrated on Laheys and Sandy creeks and the surrounding agricultural areas. Design changes were made after the 2009-2011 Baseline Surveys were undertaken, changing the location of the disturbance areas. A gap analysis was used to determine the requirements and locations for additional surveys for the new proposed Project footprint. The 2011-2012 Survey methods were developed to fill the identified gaps.

3.2.1 Terrestrial flora surveys

Flora surveys were undertaken to identify and characterise the vegetation types occurring in the PAA and to identify threatened species, populations and ecological communities present or potentially occurring in the PAA.

Flora surveys and vegetation mapping consisted of:

- reviewing vegetation mapping projects previously undertaken within the PAA;
- aerial photograph interpretation;
- field validation of spatial vegetation patterns using rapid assessments;
- quantitative plot-based surveys (400 m^2) of each vegetation type; and
- targeted flora searches for rare and/or threatened flora using formal transect surveys and the random meander method.

Vegetation plots were placed in areas indicative of each vegetation type present to ensure that the composition and condition of the vegetation present was appropriately represented. The number of plots surveyed complied with requirements according to site stratification (DEC and DPI, 2005). Plot data was used for the identification of threatened ecological communities in accordance with SEWPaC and OEH identification guidelines.

i Terrestrial fauna surveys

Fauna surveys were undertaken to determine the faunal assemblages occurring in the PAA and to identify threatened species and populations present or potentially occurring in the PAA. Habitat for threatened fauna species was identified based on mapped vegetation types, landscape position and species records for the area. Methods used to identify fauna of the PAA included:

- review of database records and existing literature;
- fauna habitat assessments;
- active diurnal and nocturnal searches for reptiles and amphibians;
- diurnal and nocturnal bird surveys and call broadcasting;
- microbat echolocation detection, trapping and roost surveys;
- mammal hair sampling, infrared camera surveys, spotlighting and Koala (*Phascolarctos cinereus*) spot assessments; and
- active searches for tracks, scats and signs of use.

Survey effort for threatened fauna generally met or exceeded applicable guidelines. However, Elliot and cage trapping were not undertaken. The mammal species targeted by surveys were considered to be detectable using other methods including hair sampling, scat analysis, infrared cameras, spotlighting and call playback, which had recorded the target species in nearby reserves (NPWS, 2000).

3.3 Aquatic ecology

Aquatic surveys were undertaken to determine the aquatic habitats and species occurring within the study area, and to identify threatened species, populations and ecological communities or their habitats within the study area. Stream characterisation and aquatic habitat assessments were undertaken at each field site to determine the condition and level of disturbance. Habitat descriptors included:

- geomorphological characteristics of the waterway;
- land use along the waterway (eg industries associated with the river, recreational uses);
- riparian vegetation and instream vegetation (eg presence/absence, native or exotic, condition and percent cover); and
- channel substratum type (eg rock, sand, gravel, alluvial substrata).

Water quality testing was undertaken and results were compared with the ANZECC guidelines for upland rivers in south-eastern Australia.

Macroinvertebrates were sampled in pool edge habitat in accordance with the AusRivAS protocol (Turak, Waddell and Johnstone, 2004). Samples collected in the field were identified in the laboratory. Results were fed into the AusRivAS predictive model and compared with freshwater macroinvertebrate assemblages from undisturbed reference sites to provide a basis to assess the health of the stream.

A range of methods were used to sample the fish of the study area. Electrofishing was undertaken at suitable sites in 2009 and 2011. Bait traps and seine nets were also used to sample fish and large mobile macroinvertebrates. Plankton nets were used to sample fish eggs and larvae.

3.4 Survey effort

The study area was surveyed for biodiversity between 2009 and 2012. The survey period spanned several seasons and was undertaken in both dry and wet periods. Terrestrial surveys were undertaken between August 2009 and January 2012. Aquatic surveys were undertaken between October 2009 and November 2011.

Table 3.2 Summary of biodiversity surveys within the PAA

Taxa group	Survey method	Survey timing
Terrestrial flora	Preliminary vegetation surveys	Winter and spring 2009
	Plot surveys	Spring 2009 and 2011
	Rapid vegetation assessments	Spring 2009 and 2011
	Targeted threatened flora searches	Summer–autumn 2010, spring–summer 2011
Terrestrial fauna	Habitat assessments and searches for signs	Spring 2009, summer–autumn 2010, spring–summer 2011
Amphibians	Water body searches	Spring 2009 and spring–summer 2011
Reptiles	Active search	Summer 2011
	Nocturnal search	Summer 2011
Birds	Timed diurnal search	Winter and spring 2009, summer and autumn 2010, winter and summer 2011
Microchiropteran bats	Anabat detection	Spring 2009 and 2011
	Harp trapping	Spring 2011
Non-flying mammals	Arboreal hair tubes	Spring–summer 2011
	Ground hair tubes	Spring 2009, summer 2011
	Koala spot assessment	Summer 2011
	Infrared camera surveys	Spring 2009, summer 2011
Nocturnal birds and mammals	Call broadcasting and spotlighting	Spring and summer 2009, spring and summer 2011
Aquatic	Aquatic habitat assessment	Spring 2009, spring and summer 2011
	Macroinvertebrate sampling	Spring 2009, spring and Summer 2011
	Water quality	Spring 2009, spring and summer 2011
	Fish sampling	Spring 2009, spring and summer 2011

4 Existing environment

4.1 Regional and local setting

4.1.1 Terrestrial

The PAA is on the boundary of the South West Slopes and Brigalow Belt South bioregions, which are characterised by diverse and varied habitat types and an array of flora and fauna assemblages. The Brigalow Belt South Bioregion lies on the transition zone between eastern, western and northern biotic elements and is an important area for biodiversity as it contains unique assemblages of fauna and flora (NPWS 2000).

The PAA is within the Central West Catchment Management Area. The landform changes from tablelands to plains in this region and there is a decrease in rainfall in an east-west gradient, creating an ecological transition area where a number of species converge (Bauer and Goldney 2000). In particular, the eastern part of the region contains the highest diversity of vertebrate fauna species in the region (Goldney *et al.* 2007). However, the region has a history of agricultural land use, with about 60% of woody native vegetation estimated to have been cleared (Benson et al. 2010). This past disturbance has been linked with a vertebrate species decline in the region (Bauer and Goldney, 2000).

An estimated 10% of remnant native vegetation in the Brigalow Belt South Bioregion is within protected areas (Goldney *et al*. 2007). There are three protected areas in the PAA; Yarrobil National Park (NP), Goodiman State Conservation Area (SCA) and Tuckland State Forest, which constitute 10% of the total PAA (Figure 1.2). Large reserves in the study area, but outside the PAA include Cobbora SCA, Goonoo SCA and Dapper Nature Reserve. Threatened species recorded within these large protected areas include the Malleefowl (*Leipoa ocellata*), Glossy Black-cockatoo (*Calyptorhynchus lathami*), Pilliga Mouse (*Pseudomys pilligaensis*), Koala, Eastern Pygmy-possum (*Cercartetus nanus*), Squirrel Glider (*Petaurus norfolcensis*), Barking Owl (*Ninox connivens*), Ingram's Zieria (*Zieria ingramii*) and Ausfeld's Wattle (*Acacia ausfeldii*).

4.1.2 Aquatic

The Project area is in the Macquarie River sub-catchment. There are two river systems in the PAA: the Talbragar drains the northern part of the PAA, and the Cudgegong drains the south along the pipeline corridor (Figure 1.2).

The natural flow regime of the Macquarie River system, including the Cudgegong River, has been disrupted by dams, weirs and the extraction of water. This has altered seasonal patterns and variability of flows, which has reduced the number of large flooding events and the time between inundations. The Talbragar is an unregulated river as it does not contain water storages and is not operated for the purpose of satisfying water requirements. However, extraction and interception of runoff have altered the natural flow regime of the Talbragar.

The main drainage systems within the PAA are Sandy Creek and Laheys Creek. Minor systems occur in the east (Tuckland Creek and Tallawang Creek) and the south (Mebul Creek) (Figure 1.2).

The upstream reaches of Sandy and Laheys creeks are relatively steep, dominated by bedrock, transitioning to a sand substratum 'chain of ponds' reach in the Talbragar floodplain (PB, 2012). Laheys Creek flows into Sandy Creek, converging between the footprint of Mining Area A and Mining Area B. Sandy Creek then discharges into the Talbragar River about 3 km downstream of the PAA's northern boundary.

The Talbragar River, Sandy Creek and Laheys Creek are naturally ephemeral waterways that cease to flow during dry periods. Flows in the Talbragar River are characterised by a seasonal pattern with lower flows over summer and autumn, and flood events throughout winter and spring (PB, 2012).

4.2 Desktop review results

A Protected Matters Search (SPRAT) predicted that 45 matters of NES may occur within 30 km of the study area (SEWPaC, 2012):

- five ecological communities;
- thirteen plant species;
- one amphibian species;
- six mammal species;
- six bird species;
- two fish species; and
- twelve migratory species.

A list of matters of NES likely to occur in the study area was compiled based on the results of the protected matters search, a literature review and consultation. This was used to develop the field methods for threatened flora and fauna.

4.3 Recorded matters of NES

4.3.1 Threatened ecological communities

The following table (Table 4.1) details the TECs identified within the SPRAT search and their potential for occurrence within the study area.

Table 4.1 Threatened ecological communities identified within the SPRAT search

Threatened ecological community	EPBC Act status	Potential for occurrence
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	CEEC	Moderate
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CEEC	High
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	EEC	Low
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	EEC	High
Weeping Myall Woodlands	CEEC	Low

Vegetation types identified within the study area were compared to listings of TECs under the EPBC Act. A comparison was undertaken with published TEC species lists, habitat descriptions and distributions. Two EPBC listed TECs were identified within the study area:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (incorporating the Box Gum Grassy Woodland, Blakely's Red Gum Woodland and Rough-barked Apple Woodland vegetation types); and

- Grey Box Grassy woodlands and Derived Native Grasslands of South-eastern Australia (comprising the mapped Grey Box Woodland vegetation type).

These communities are discussed in the following sections. Figure 4.1 shows the location of TECs within the study area. No other EPBC listed TECs were identified in the study area.

i Box Gum Woodland

White Box Yellow Box Blakeley's Red Gum Grassy Woodland and Derived Native Grasslands (hereafter referred to as Box Gum Woodland) is listed as a critically endangered ecological community under the EPBC Act. The community as listed under the EPBC Act is slightly different to the community listed under the TSC Act.

Under the EPBC Act, Box Gum Woodland is characterised by an understorey of tussock grasses, herbs and shrubs and dominated by White Box, Yellow Box or Blakely's Red Gum. The tree-cover is generally discontinuous and consists of trees of medium height with clearly separated canopies (TSSC, 2006). The listed community occurs in areas where rainfall is between 400 and 1,200 mm per annum, on moderate to highly fertile soils at altitudes of 170 m to 1,200 m (TSSC, 2006).

To qualify as the community under the EPBC Act, patches of woodland must fulfil certain criteria. The criteria includes:

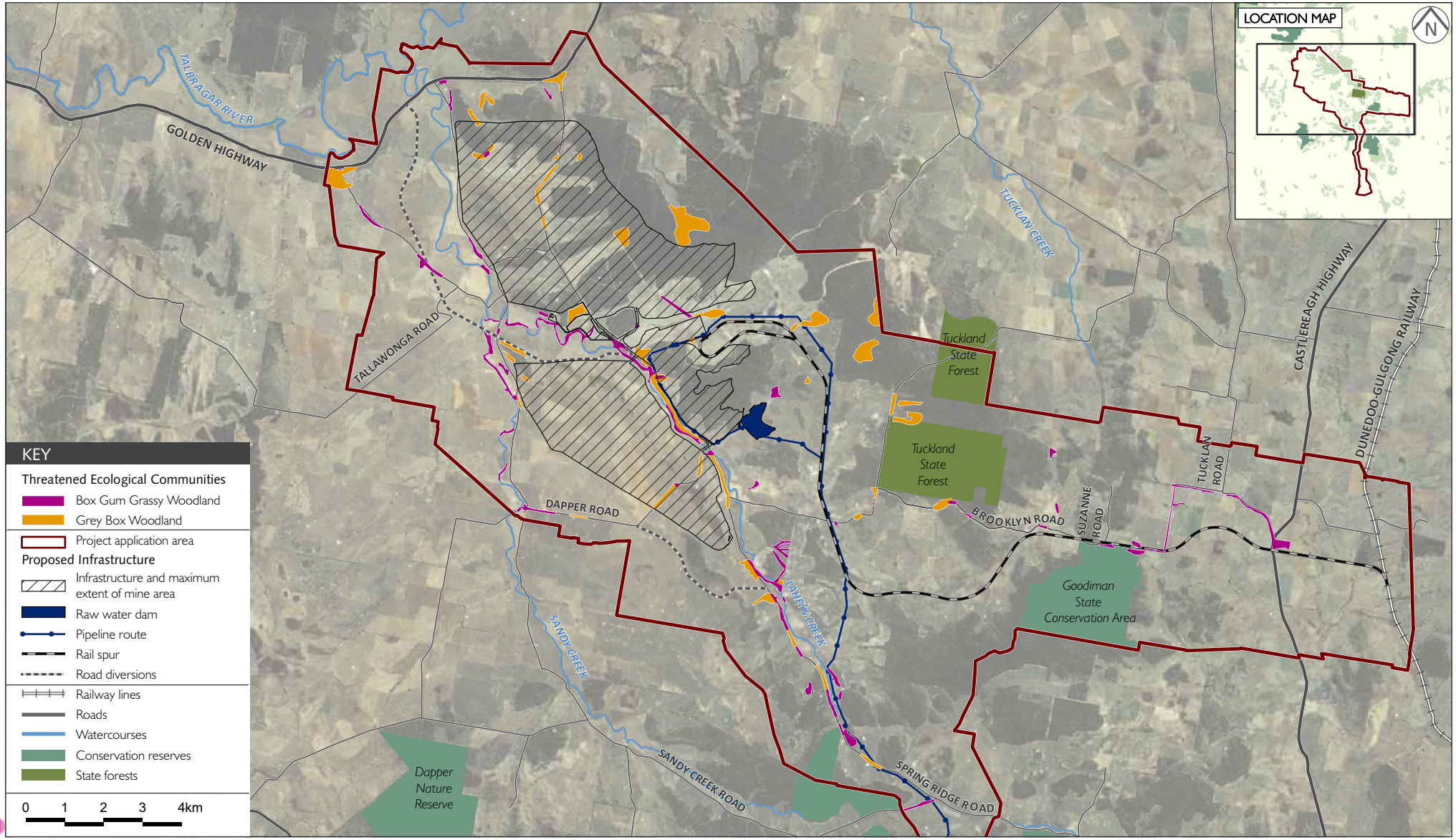
- patches of vegetation where the most common over-storey species are either White Box, Yellow Box or Blakely's Red Gum currently or previously;

- patches of vegetation which have a predominantly native understorey;

- patch size greater than 0.1 ha; and

- 12 or more native understorey species present (excluding grasses) with at least one important species OR a patch size greater than 2 ha (SEWPaC, 2011b).

Indicative vegetation types were assessed under the EPBC Act criteria to see if remnants qualified as Box Gum Woodland. Where assessed, most remnants achieved the EPBC criteria. Where 12 native understorey species (excluding grasses), a judgment was made as to whether this criterion was likely to be achieved during optimal survey conditions. Where this criterion was not achieved, the patch size and number of trees was also used to determine the occurrence of the community. Consequently, all areas dominated by the characteristic tree species Yellow Box and/or Blakely's Red Gum, were found to constitute the threatened Box Gum Woodland community under the EPBC Act.



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EMM

Cobbora Holding Company Pty Limited

Threatened Ecological Communities

Cobbora Coal Project - Matters of NES Report

Figure 4.1

The following vegetation types mapped within the study area were considered to represent Box Gum Woodland critically endangered ecological community:

- Box Gum Woodland (815 ha);
- Blakely's Red Gum Woodland (62 ha);
- White Box Woodland (206 ha); and
- Rough-barked Apple Woodland (226 ha).

The total area of Box Gum Woodland mapped within the study area is 1,309 ha. Condition of Box Gum Woodland remnants within the study area varied with position in the landscape and vegetation type. In general, the remnants along roadsides, which were dominated by Yellow Box with Blakely's Red Gum (and referred to as the 'Box Gum Grassy Woodland' vegetation type), were relatively diverse, with grassy understorey dominated by native species. Exotic species were present but not considered to have impacted these remnants to a high degree.

Blakely's Red Gum Woodland within the study area had a more shrubby/tussock understorey and had not been subject to a high level of clearing or disturbance. It occurred predominantly on drainage lines within Ironbark communities. It is possible that these remnants may be considered too shrubby for the listed community, however using a precautionary approach, these were considered to constitute the TEC.

White Box Woodland areas occurred as monocultures and integrades with Grey Box Woodland. These were mainly in the southern part of the PAA along the roadsides.

It is likely that some of the smaller Rough-barked Apple Woodland remnants would not qualify as the community under the EPBC Act, particularly where they occurred within grazing land. However, not all of these could be ground-verified and in the absence of survey data, a conservative approach was taken and the remnants were considered to be representative of the community.

ii Grey Box Woodland

Under the EPBC Act, Grey Box Woodland is described as woodland to open forest, with a canopy dominated by Grey Box, a moderately dense to sparse shrub layer and a ground layer of perennial and annual native forbs and graminoids. Other tree species are often present and may be co-dominant with Grey Box at some sites. The community includes patches of derived grassland, where the tree canopy and mid-layer has been removed to less than 10% crown cover, but the native ground layer remains largely intact (TSSC, 2010). The EPBC Act prescribes condition thresholds for the community including:

- minimum patch size is 0.5 ha;
- canopy layer contains Grey Box as the dominant or co-dominant tree species; and
- vegetative cover of non-grass weed species in the ground layer is less than 30% at any time of the year (TSSC, 2010).

Additional criteria are also provided for degraded patches including:

- small woodland patches (0.5 to 2 ha in area) with tree crown cover greater than 10%;
- larger woodland patches with a well developed canopy (2 ha or more in area); and

- patches where the canopy is less developed or absent (derived grassland) (TSSC, 2010).

Using the EPBC condition thresholds and listing advice, all remnants mapped as Grey Box Woodland within the study area were considered to constitute the Grey Box Woodland TEC under the EPBC Act.

The total area of NSW and Commonwealth-listed Grey Box Woodland TEC mapped within the study area is 660 ha. The condition of Grey Box Woodland remnants varied with location and the associated landscape in the study area. In general, stands of the woodland to the west of Spring Ridge Road had been heavily impacted by grazing, had little to no native understorey, very few native forbs and low diversity of native grasses (which were typically *Austrostipa* species). Where Grey Box Woodland occurred within a matrix of other vegetation types it had been subject to less disturbance and displayed greater diversity of ground cover species, although shrubs were still sparse to absent.

4.3.2 Threatened flora species

Nine flora species listed as matters of NES are predicted to occur in the study area. Table 4.2 lists these species and their respective conservation status under the EPBC Act. It also provides habitat requirements of these threatened flora species, and a description of their habitats and distribution if recorded within the study area.

Table 4.2 Threatened flora species predicted to occur in the study area

Common name	EPBC Act status	Recorded in the study area?	Likelihood of occurrence
Digitaria porrecta	E	Not recorded.	Low likelihood as the study area is over 200 km from its known distribution.
Euphrasia arguta	CE	Not recorded.	Low likelihood as known populations are over 250 km east of the study area.
Homoranthus darwinioides	V	A population of this species was recorded in the study area.	High.
Philotheca ericifolia	V	Not recorded.	High likelihood as it occurs close by in Goonoo SF and suitable habitat is present within the study area.
Austral Toadflax (*Thesium australe)*	V	Not recorded.	Low likelihood given the large distance of previous records from the study area, and absence of preferred habitat.
Tylophora linearis	E	A population of this species was recorded in the study area.	High.
Dwarf Kerrawang (*Rulingia procumbens)*	V	Not recorded.	Potential habitat exists in Ironbark and *Callitris* vegetation communities.
Ingram's Zieria (*Zieria ingramii)*	E	A population of this species was recorded in the study area.	High.
Zieria obcordata	E	Not recorded.	Low likelihood of occurrence considering its sensitivity to grazing and browsing.

Notes 1. V-vulnerable, E-endangered

Three flora species listed as matters of NES were recorded within the study area. These were *Homoranthus darwinioides, Tylophora linearis* and Ingram's Zieria. Their locations are shown on Figure 4.2.

Two species (*Philotheca ericifolia* and Dwarf Kerrawang) were not recorded in the study area, but have the potential to occur. Four species (*Digitaria porrecta, Euphrasia arguta*, Austral Toadflax, and *Zieria obcordata*) were not recorded in the study area and were considered to have a low likelihood of occurrence given the absence of suitable habitat and the large distance away that they were recorded from the study area. Therefore, these species are not discussed or assessed further in this report.

i Ingram's Zieria

Ingram's Zieria is a small aromatic shrub that grows between 40 cm and 60 cm but may reach up to 1 m in height. Plants are usually slender and spindly but occasionally may be bushy and can develop into a medium-sized shrub. Branches are ridged and slightly hairy with opposite and trifoliolate leaves that appear whorled along the branches.

Prior to surveys being undertaken within the study area, Ingram's Zieria had only been recorded at two other locations; the Goonoo and Cobbora SCAs, where it was recorded on gentle slopes or near the crests of low rises, in undulating terrain on northerly, westerly or southerly aspects (DEC, 2007a). Plants were recorded on light sandy soils described as red-brown to yellow-brown sandy or clay loams, overlying sedimentary rock, which may be outcropping. It has been suggested that particular elements of the soil, such as organic carbon, phosphorous or aluminium levels, may determine where it occurs (DEC, 2007a).

Ingram's Zieria typically occurs in *Eucalyptus-Callitris* woodland or open forest communities containing Black Cypress Pine and Blue-leaved Ironbark and a shrubby to heathy understorey (DEC, 2007a). In Goonoo SCA, Dwyer's Red Gum appears to be a predictor of the species and it has also been noted that it is rare to find Ingram's Zieria without another species of the Rutaceae family present (DEC, 2007a).

DEC (2007) state that other species that have been recorded at most sites include *Allocasuarina diminuta/ Allocasuarina gymnanthera, Acacia triptera* and *Calytrix tetragona.* However, the current assessment found that such species were common across the Blue-leaved Ironbark vegetation type as a whole, and were not particular to areas where Ingram's Zieria was recorded.

In the study area, Ingram's Zieria has been recorded on gentle slopes, and relatively flat topography (Figure 4.2). The species does not appear to prefer a certain aspect, being recorded on slopes of all aspects. It was most commonly recorded in Blue-leaved Ironbark Woodland or Red Stringybark Woodland (Figure 4.2). A population was also recorded within Dwyer's Red Gum Woodland. In Blue-leaved Ironbark Woodland, it sometimes occurred at disturbed track edges in close proximity to fallen timber, which appeared to be affording individual plants a certain degree of protection. This may be an artefact of previous grazing regimes.

A total of 1,255 individual plants in 15 sub-populations were recorded within the study area. Table 4.3 provides a description of the local population within the study area.

Table 4.3 Ingram's Zieria local population in the study area

Population	Number of Individuals	Description of sub-population	Vegetation community
1	48	On a gentle south-west facing slope in an area of open woodland.	Boundary between Red Stringybark Woodland and Cypress Pine Woodland
2	28	On a gentle west facing slope in an area of open woodland at the base of a small hill. Within a grassy understorey with areas of bare ground.	Red Stringybark Woodland
3	340	Located on a small grassy hill surrounded by paddocks. Small rock outcrops occur throughout with the plants generally below these areas on flatter ground. The sub-population ranges from north-facing slopes to south-east facing slopes and flat ground. Open woodland with a high percentage of bare ground. Individuals had set seed in November 2011 in this area.	Blue-leaved Ironbark Woodland and Dwyer's Red Gum Woodland
4	179	A large percentage of bare ground with young plants and a large number of seedlings. The plants occurred in an area of low canopy cover which was dominated by Sifton Bush with scattered fallen timber and surrounded by open Blue-leaved Ironbark Woodland. The sub-population was on a gentle north-facing slope. The sub-population was a mixture of older plants and seedlings.	Blue-leaved Ironbark Woodland
5	63	On a north-facing slope and on the top of the slope in red earth with large and smaller rocks. Occurred within areas where there was a high percentage of fallen timber and bare ground.	Blue-leaved Ironbark Woodland
6	1	On a ridge top in open ironbark forest. This area was recorded during the baseline surveys and the specimens were not able to be located within the 2011-2012 surveys despite targeted searches in the area.	Blue-leaved Ironbark Woodland
7	2	On a ridge top in open ironbark forest. This area was recorded during the baseline surveys but the specimens were not able to be located within the 2011-2012 surveys despite targeted searches in the area.	Blue-leaved Ironbark Woodland
8	25	On a small rise on a north-facing slope in open woodland with abundant rocky areas and bare ground.	Blue-leaved Ironbark Woodland
9	24	In area where there was a large amount of fallen timber (dead *Allocasuarina* spp.) on a north-facing slope. It occurred on the edge of a track in an area with an open canopy. The sub-population contained some older plants and seedlings.	Blue-leaved Ironbark Woodland
10	401	Sub-population began in Red Gum Woodland which graded into Ironbark Woodland and Sifton Bush regrowth. Made up of very young plants with many seedlings present. Plants occurred in an area of low shrubs and open canopy. Some plants were flowering and setting seed in January and August 2012.	Dwyer's Red Gum Woodland and Regrowth
11	18	On an eastern-facing slope in open woodland.	Blue-leaved Ironbark Woodland and Cypress Pine Woodland
12	70	On a relatively flat area to north-facing gentle slope. Adjacent to a population of *Homoranthus darwinioides*. It occurs in a rocky area where there is a low percent canopy cover and a high proportion of open ground. The sub-population contained some older plants and seedlings.	Blue-leaved Ironbark Woodland and Cypress Pine Woodland
13	25	Plants were predominantly located on the midslope with some plants recorded at the base of gentle slopes.	Blue-leaved Ironbark Woodland

Table 4.3 Ingram's Zieria local population in the study area

Population	Number of Individuals	Description of sub-population	Vegetation community
14	23	Plants recorded on the upper parts of south to south east facing slopes. The sub-population contained some older plants and seedlings in open woodland with a low sparse shrub layer and scattered grass tussocks.	Blue-leaved Ironbark Woodland
15	8	On a rocky rise in an open area adjacent to a track, this sub-population contained mainly smaller individuals in open forest and where there was some fallen timber.	Blue-leaved Ironbark Woodland
Total	**1,255**		

ii Homoranthus darwinioides

Homoranthus darwinioides is found on sandy soil on sandstone outcrops and sloping ridges. Vegetation associations where the species has been recorded include *Eucalyptus-Callitris* woodland, consisting of Narrow-leaved Ironbark, Blue-leaved Ironbark, Dwyer's Red Gum and Inland Scribbly Gum. *H. darwinioides* is known from several populations in Goulburn River National Park and two populations in Goonoo State Conservation Area in NSW (TSSC, 2008a).

The main identified threats to *H. darwinioides* are:

- localised extinction due to stochastic events;
- feral animals, in particular rabbits, and feral goats;
- stock impacts from grazing and trampling;
- erosion of sandstone habitat; and
- inappropriate fire regimes (TSSC, 2008a).

A population of *H. darwinioides* was recorded within the study area, occurring as two sub-populations (Figure 4.2). One sub-population was recorded as 227 individuals in Dwyer's Red Gum Woodland, Blue-leaved Ironbark Woodland and surrounding regrowth. *H. darwinioides* was most abundant where the canopy was sparse. In the regrowth areas, it occurred as large solitary plants on bare ground amongst dense patches of Sifton Bush. The sub-population occurs on a light brown sandy loam with loose sandstone rocks at the surface.

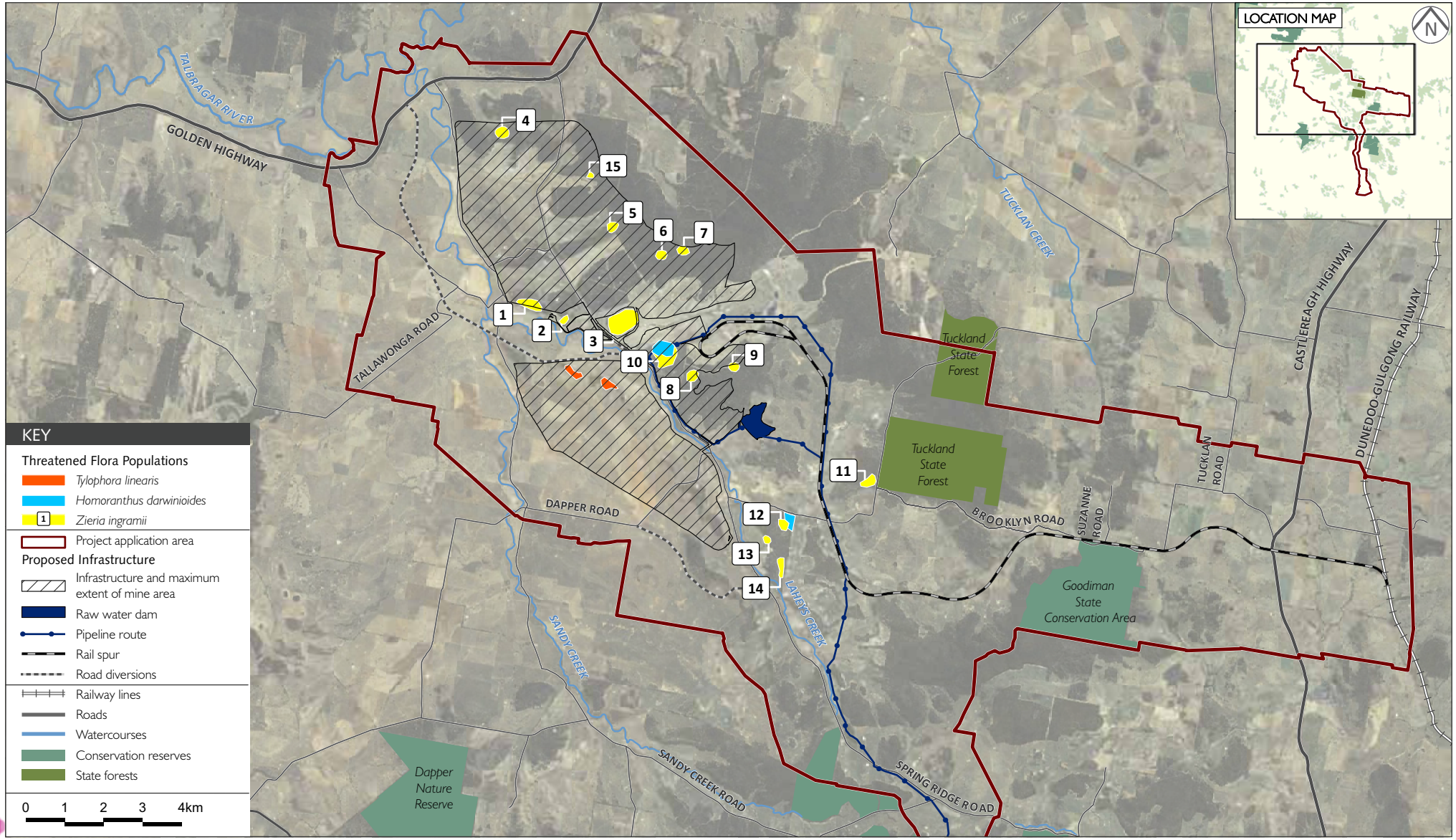
Sub-population two was estimated at greater than 200 individuals (using counts from this study, Irvin and Bartus (2007) and ERM (2012)). This sub-population is located in Blue-leaved Ironbark Woodland. The dominant shrub species was Common Fringe-myrtle. Other species recorded included Silver-leaved Ironbark (*E. melanophloia*), Black Cypress Pine, *Allocasuarina gymanthera, Acacia triptera, Philotheca ciliata, Lomandra filiformis filiformis* and *Platysace linearifolia*. Bare ground in the area was approximately 15%, with canopy cover estimated at 20%, and there was abundant lichen cover on the ground.

iii Tylophora linearis

Tylophlora linearis is an herbaceous climber with a clear latex that grows to about 2 m long (TSSC, 2008b). It has been recorded in dry scrub, open forest and woodlands associated with Broombrush (*Melaleuca uncinata*), Blue-leaved Ironbark, Mugga Ironbark, White Box, Black Cypress Pine, White-Cypress Pine, Buloke, Hakea Wattle (*Acacia hakeoides*) and Streaked Wattle (*A. lineata*).

T. linearis has rarely been collected and is known from eight localities in the Dubbo area and Mt Crow in NSW. The species is conserved within Goobang National Park, Eura State Forest, Goonoo State Conservation Area, Pilliga West State Forest and Coolbaggie Nature Reserve (TSSC, 2008b). The main threats to *T. linearis* include forestry activities, disturbances such as grazing and fire and invasion of habitat by introduced weeds such as Lantana (*Lantana camara*) (TSSC, 2008b).

In the study area, nine individual *T. linearis* were recorded during the baseline survey. Six individuals were recorded in Blue-leaved Ironbark and three were recorded in Red Gum Woodland (Figure 4.2). The individuals were recorded growing amongst *Lepidoseprma* species, where they appeared to be protected from cattle grazing (ERM, 2012).



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EMM

Cobbora Holding Company Pty Limited

Threatened Flora Populations Recorded

Cobbora Coal Project - Matters of NES Report

Figure 4.2

4.3.3 Threatened terrestrial fauna species

Sixteen terrestrial fauna species listed as matters of NES are predicted to occur in the study area. Table 4.4 lists these species and their conservation status under the EPBC Act. It also provides habitat requirements of these threatened fauna species, and a description of their habitats and distribution within the study area.

Two threatened bird species were recorded within the study area, the Australasian Bittern and Superb Parrot. In addition, two threatened mammal species, the Large-eared Pied Bat and Southern Long-eared Bat, were recorded. Potential habitat was also considered to be present for the Regent Honeyeater, Swift Parrot, Koala and Spotted-tail Quoll.

Table 4.4 Threatened fauna species recorded predicted to occur in the study area

Species	EPBC Act status	Recorded in study area?	Likelihood of occurrence
Birds			
Australasian Bittern (*Botaurus poiciloptilus)*	E	One individual recorded	Foraging habitat present around dams and waterways.
Malleefowl (*Leipoa ocellata)*	V, Mi	No individuals recorded. 12 historical mounds observed.	Low potential habitat in Dwyer's Red Gum Woodland.
Painted Snipe (*Rostratula australis)*	V, Mi	Not recorded	No suitable habitat present.
Regent Honeyeater (*Anthochaera phrygia)*	E, Mi	Not recorded	Potential habitat in Box Gum Woodland.
Superb Parrot (*Polytelis swainsonii)*	V	Recorded in Ironbark Woodland	Foraging habitat in Box Gum and Ironbark Woodlands.
Swift Parrot (*Lathamus discolour)*	E	Not recorded	Potential habitat in Box Gum Woodland.
Amphibians			
Booroolong Frog (*Litoria booroolongensis)*	E	Not recorded	No suitable habitat present.
Mammals			
Brush-tailed Rock Wallaby (*Petrogale penicillata)*	V	Not recorded	No suitable habitat present.
Grey-headed Flying-fox (*Pteropus poliocephalus)*	V	Not recorded	No suitable habitat present.
Large-eared Pied Bat (*Chalinolobus dwyeri)*	V	One pass recorded on Anabat detector in Ironbark/Stringybark woodland	Potential cave roosts in sandstone escarpments. Foraging habitat in Box Gum Woodlands and ironbark woodlands.
Koala (*Phascolarctos cinereus)*	V	Not recorded	Potential habitat where feed tree species White Box and River Red Gum are present.
New Holland Mouse (*Pseudomys novaehollandiae)*	V	Not recorded	No suitable habitat present.
Southern Long-eared Bat (*Nyctophilus corbeni)*	V	One individual recorded in Ironbark/Stringybark Woodland	Habitat in Box Gum Woodland and Ironbark Woodland
Spotted-tail Quoll (SE mainland population) (*Dasyurus maculatus maculates)*	E	Not recorded	Potential habitat along creeklines, in gullies and rocky escarpments.

Notes: 1.E-endangered, V-vulnerable, Mi-migratory

4.3.4 Migratory species

Three fauna species listed as migratory under the EPBC Act are predicted to occur in the study area. Table 4.5 lists these species and provides a description of their habitats and distribution within the study area.

The Cattle Egret, Great Egret and Rainbow Bee-eater were recorded within the study area. The threatened Malleefowl and Regent Honeyeater are also listed as migratory species, and while these were not recorded within the study area, the Regent Honeyeater is considered likely to occur due to the presence of its preferred habitat, Box Gum Woodland. In addition, disused Malleefowl mounds were identified within the study area, but is considered unlikely to occur.

Table 4.5 Migratory species recorded in the study area

Species	EPBC Act status	Recorded in study area?	Likelihood of occurrence
Cattle Egret (*Ardea ibis)*	Mi	Recorded near farm dams	Recorded in dams, creeks and drainage lines.
Fork-tailed Swift (*Apus pacificus)*	Mi	Not recorded	Not recorded and considered unlikely to occur. This species is exclusively aerial.
Latham's Snipe (*Gallinago hardwickii)*	Mi	Not recorded	Not recorded and considered unlikely to occur due to the absence of wetlands.
Great Egret (*Ardea modesta)*	Mi	Recorded near farm dams	Recorded in dams, creeks and drainage lines.
Malleefowl (*Leipoa ocellata)*	Mi	Not recorded	Not recorded and considered unlikely to occur due to non-detection in targeted surveys.
Painted Snipe (*Rostratula benghalensis)*	Mi	Not recorded	Not recorded and considered unlikely unlikely to occur due to the absence of wetlands.
Rainbow Bee-eater (*Merops ornatus)*	Mi	Recorded near farm dams	Recorded in dams, creeks and drainage lines.
Regent Honeyeater (*Anthochaera Phrygia)*	Mi	Not recorded	Not recorded, however considered likely to occur in Box Gum Woodland.
Rufous Fantail (*Rhipidura rufifrons)*	Mi	Not recorded	Not recorded and unlikely to occur. This species mainly inhabits dense wet sclerophyll forests.
Satin Flycatcher (*Myiagra cyanoleuca)*	Mi	Not recorded	Not recorded and to occur as this species was not detected during targeted surveys.
White-bellied Sea Eagle (*Haliaeetus leucogaster)*	Mi	Not recorded	Not recorded and unlikely to occur in the study area due to the ephemeral nature of creeks.
White-throated Needletail (*Hirundapus caudacutus)*	Mi	Not recorded	Not recorded and unlikely to occur. This species is exclusively aerial.

Notes: 1.Mi-migratory

4.3.5 Threatened aquatic species

Two fish species listed as matters of NES are predicted to occur in the study area. Table 4.6 lists these species and provides a description of their habitats and distribution within the study area. No threatened fish species were recorded within the study area, however potential habitat is considered to be present in the larger waterways of the study area during peak flow events, as these species are known within the wider catchment.

Table 4.6 Threatened aquatic species predicted to occur in the study area

Species name	EPBC Act status	Notes on population in study area	Habitat in study area
Murray Cod (*Macullochella peelii peelii)*	V	Not recorded	Potential habitat in waterways of study area.
Trout Cod (*Macullochella macquariensis)*	E	Not recorded	Potential habitat in Talbragar River.

Notes: 1.V-vulnerable, E-endangered

4.3.6 Regional distribution of matters of NES

The vegetation and thus habitat for threatened species recorded the study area, is part of a large vegetated corridor that extends along the eastern side of the PAA. This corridor is comprised of protected areas (state conservation areas and nature reserves), state forests and private landholdings. The two recorded TECs occur in the road reserves along much of Spring Ridge Road and the Golden Highway, with remnants varying in width from 100-250 m. TECs also occur in other areas of the landscape associated with the floodplains and more fertile lands which have not been heavily disturbed for agriculture including along the creek lines. These areas provide habitat opportunities for threatened flora, bird and mammal species.

The protected and reserved areas in the PAA and surrounding areas provide suitable and potential habitat for the matters of NES recorded within the study area. An overview of the regional distribution of matters of NES is provided in Table 4.7.

Table 4.7 Regional distribution of matters of NES

Matter of NES	Regional distribution
Threatened ecological communities	
Box Gum Woodland	Along Spring Ridge Rd and the Golden Highway. Also observed along creeks and roadsides between the PAA and Gulgong.
Grey Box Woodland	Along Spring Ridge Rd and the Golden Highway. Also observed along creeks and roadsides between the PAA and Gulgong.
Threatened flora species	
Ingram's Zieria	A large population occurs in Goonoo SCA and Cobbora SCA, with a small population south of Goobang NP.
Homoranthus darwinioides	Found in Goonoo SCA.
Philotheca ericifolia	Found in Goonoo SCA.
Tylophora linearis	Found in Goonoo SCA, Coolbaggie NR, Goobang NP, and Beni SCA.
Rulingia procumbens	Found in Goonoo SCA.
Migratory birds	
Rainbow Bee-eater	Known from Goonoo SCA, Coolbaggie NR, Goulburn River NP and Munghorn Gap NR.
Cattle Egret	There is a paucity of records in the region for these species. It is considered that the region does not provide optimal habitat for egrets during dry periods (such as the last 10 years), and that individuals recorded in the study area were responding to prolonged periods of rainfall in 2011-2012.
Great Egret	
Threatened bird species	
Australasian Bittern	Known from Goonoo SCA.

Table 4.7 Regional distribution of matters of NES

Matter of NES	Regional distribution
Malleefowl	A population occurs in Goonoo SCA and Cobbora SCA.
Superb Parrot	Scattered records exist for this species in the region; however none occur in conservation areas.
Regent Honeyeater	Recorded in Cobbora SCA and east of Cope SF.
Swift Parrot	Recorded north of Cope SF.
Threatened mammal species	
Koala	Recorded previously in Goonoo SCA and near Ulan.
Large-eared Pied Bat	Recorded previously in Yarrobil NP. Also occurs in Goulburn River NP and Ulan.
Southern Long-eared Bat	Known from Goonoo SCA.
Spotted-tail Quoll	Known from Goonoo SCA and Goulburn River NP.
Threatened fish species	
Murray Cod	Known from the Cudgegong River and Macquarie River.
Trout Cod	Known from the Macquarie River.

Notes 1. Source: Australian Government, 2012; NPWS, 2000; NSW DPI, 2002; Paull, 2002.

While the majority of records for matters of NES are from conservation areas, habitat also occurs outside these within the region. In the Central West CMA, more than 318,000 ha of remnant woodland habitat exists, with the majority occurring outside conservation areas. The Talbragar sub-region of the Central West CMA contains more than 28,000 ha of woodland, again with most of this outside conservation reserves (DEC, 2006). The study area therefore occurs in a region where remnant vegetation is abundant.

5 Safeguards and mitigation measures

5.1 Overview of safeguards and mitigation measures

The following section provides a description of the avoidance, mitigation and management measures proposed in order to reduce potential impacts of the Project to biodiversity.

5.1.1 Avoidance

Design changes to avoid sensitive ecological features in the PAA include:

- the diversion of creeks to accommodate the mine has been avoided by reducing and reconfiguring the mining area, which has minimised;
    - clearing riparian vegetation,
    - impacts to large areas of terrestrial and aquatic TECs, and
    - impacts to threatened species habitat, particularly for the freshwater catfish population;
- removing a proposed coal conveyor and thereby minimising clearing requirements (particularly a large sub-population of Ingram's Zieria) and maintaining a wildlife corridor that will be further enhanced as part of biodiversity offset strategy;
- infrastructure and emplacement areas have been moved to avoid impacts to a large sub-population of Ingram's Zieria;
- road diversions have been designed to avoid clearing roadside vegetation, where possible, which consist mainly of TECs;
- waterway crossings will include two bridges, one over Sandy Creek and one over Laheys Creek, designed and constructed according to NSW Fisheries guidelines to ensure that native fish species can navigate road crossings;
- sediment and mine water dams will capture and treat runoff from the mine areas, ensuring water quality is not compromised in surrounding aquatic systems; and
- intake screening in the Cudgegong River water extraction site will minimise the potential for impacts on fish, larvae and eggs.

5.1.2 Mitigation

A biodiversity management plan will be prepared that details measures to minimise the potential impacts on terrestrial and aquatic biodiversity. It will include adaptive management measures, including monitoring to manage, protect and enhance vegetation and fauna habitat within the mine area and its surrounds. A rehabilitation management plan will also be prepared for the Project to detail the progressive rehabilitation methods according to the rehabilitation strategy. The key management measures are described below.

i Mitigation measures – operation

Mitigation measures to minimise biodiversity impacts during operations will include the following:

- before any native vegetation is cleared, an experienced ecologist will complete pre-clearing surveys to identify trees occupied by fauna or that provide fauna habitat, as well as any threatened flora species;
- native vegetation to be retained will be demarcated on site as a 'no-go' zone for clearing and operations;
- weed control will be undertaken in retained vegetation and rehabilitated areas;
- a two-stage clearing protocol will be adopted where non-habitat trees are cleared 24 hours before any habitat trees are cleared, to allow fauna time to move out of an area;
- experienced fauna rescue personnel will be engaged where any habitat trees are to be cleared and will be present during any habitat tree clearing works;
- native, locally sourced seed will be used for rehabilitation activities, where possible;
- clearing works will coincide with tree seeding to maximise seed collection activities, where possible;
- clearing footprints will be minimised during staged clearing works and mined areas will be progressively rehabilitated;
- clearing zones will be demarcated to restrict access to retained vegetation during staged clearing;
- habitat features important to threatened fauna species will be retained and stored for reinstatement within rehabilitated areas;
- habitat features, such as large logs and rocks from cleared areas, will be relocated to rehabilitated areas;
- methods to mitigate the loss of hollow-bearing trees (eg installing nest boxes) and the loss of rocky outcrops (eg installing artificial cave roosts) will be investigated and implemented during the early stages of clearing for the Project;
- methods will be formulated and implemented to minimise potential introduction and spread of soil pathogens and disease before clearing;
- road kill will be monitored on access roads during operation with appropriate actions taken if it is found to be causing a substantial increase in wildlife road kill;
- identified habitat links severed for the Project will be reconnected as part of the rehabilitation;
- feral animal management will be used in areas surrounding the progressive clearing and rehabilitation areas, in coordination with local NSW National Parks and Wildlife Service and State Forests;
- planting guides are to be prepared for all rehabilitation areas, including species lists and recommended planting densities;

- topsoil in cleared areas will be managed to preserve soil seed banks in areas containing native vegetation for progressive rehabilitation;
- light use will be minimised near remnant habitat areas to prevent light spill;
- monitor dust deposition in areas containing Ingram's Zieria, which are to be retained, with appropriate actions taken if it is found to be affecting plant health; and
- the controlled release of clean water may be used to maintain water levels in persistent pools along Laheys and Sandy creeks if these are reduced by groundwater drawdown.

ii Mitigation measures – construction

Mitigation measures to minimise biodiversity impacts during construction will include the following:

- fauna fencing or mitigation structures (eg underpasses), as required, are to be installed during construction; and
- coffer dams are to be used for any in-stream works and these areas revegetated in accordance with the rehabilitation strategy.

The requirements for progressive clearing works during operational stages will also be incorporated into the construction stages where clearing is required.

6 Impacts of controlled action

6.1 Overview of impacts to matters of NES

The significance of potential impacts to matters of NES was assessed according to the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance.* Assessments were only completed for those species recorded within the study area or with a high likelihood of occurrence given the habitat present (see Appendix B). The assessments are provided in full in Appendix B with the potential impacts and significance summarised in Table 6.1. Where significant impacts are likely for matters of NES, the potential impacts will be compensated by the implementation of the Project offset strategy (see Section 7.1).

Table 6.1 Summary of potential impacts to matters of NES

Matter of NES	EPBC Act status	Recorded?	Impact description	Likely significance of impact (Appendix B)
Threatened ecological communities				
Box Gum Woodland	CEEC	Yes	Removal of 12 ha of the TEC	Significant
Grey Box Woodland	EEC	Yes	Removal of 54 ha of the TEC	Significant
Threatened flora species				
Homoranthus darwinioides	V	Yes	Removal of 227 individuals from one sub-population in the study area	Significant
Ingram's Zieria	E	Yes	Removal of 727 individuals from eight sub-populations in the study area	Significant
Philotheca ericifolia	V	No	Removal of potential habitat	Not significant
Rulingia procumbens	V	No	Removal of potential habitat	Not significant
Tylophora linearis	E	Yes	Removal of nine individuals, representing the entire local known population	Significant
Threatened fauna species				
Australasian Bittern	E	Yes	Removal of 9 ha of foraging habitat	Not significant
Koala	V	No	Removal of 142 ha of potential secondary and 27 ha of potential supplementary habitat	Not significant
Large-eared Pied Bat	V	Yes	Removal of 1,400 ha of foraging and 16 km of cliff line (shelter habitat)	Significant
Malleefowl	E, Mi	No (possible historical mounds present)	Removal of 73 ha of potential habitat	Not significant
Regent Honeyeater	E, Mi	No	Removal of potential habitat	Not significant
Southern Long-eared Bat	V	Yes	Removal of 1,400 ha of foraging and potential breeding habitat	Significant
Spotted-tail Quoll	V	No	Removal of potential habitat	Not significant

Table 6.1 Summary of potential impacts to matters of NES

Matter of NES	EPBC Act status	Recorded?	Impact description	Likely significance of impact (Appendix B)
Superb Parrot	V	Yes	Removal of 1,102 ha of foraging (overwintering) habitat	Not significant
Swift Parrot	E	No	Removal of potential habitat	Not significant
Migratory species				
Cattle Egret	Mi	Yes	Removal of 9 ha of foraging habitat. None of the habitat to be removed has been identified as 'important habitat'.	Not significant
Great Egret	Mi	Yes	Removal of 9 ha of foraging habitat. None of the habitat to be removed has been identified as 'important habitat'.	Not significant
Rainbow Bee-eater	Mi	Yes	Removal of 9 ha of foraging habitat. None of the habitat to be removed has been identified as 'important habitat'.	Not significant
Threatened fish species				
Murray Cod	V	No	Potential for alterations to natural flow regime, removal of large woody debris, creation of barriers to fish passage and increased sedimentation.	Not significant
Trout Cod	E	No	Slight increase in water flow.	Not significant

Notes. 1. CE – critically endangered, E – endangered, V- vulnerable, Mi- migratory, CEEC – critically endangered ecological community, EEC – endangered ecological community.

2. EPBC Act – Environment Protection and Biodiversity Conservation Act 1999.

Significant impacts were considered likely for the two recorded TECs, two threatened flora species (Ingram's Zieria and *Tylophora linearis)* and two threatened bats (Large-eared Pied Bat and Southern Long-eared Bat).

6.1.1 Threatened ecological communities

The Project is expected to result in significant impacts to Box Gum Woodland and Grey Box Woodland because it:

- removes up to 54 ha of Grey Box Woodland and 12 ha of Box Gum Woodland from the study area;
- impacts identified critical habitat (within the recovery plan but not listed) for Box Gum Woodland;
- temporarily fragments and isolates known TECs; and
- is not consistent with the recovery plan for these communities.

Box Gum Woodland to be removed represents approximately 1% of the community within the PAA. The Grey Box Woodland represents approximately 8% of the community in the study area. While these are relatively small in comparison with the total area of vegetation to be removed, these are still considered significant due to the status of these communities in the region. These impacts will be compensated for by revegetation activities within the Project footprint and by Project offsets to ensure that there is an improvement in the quality and quantity of these TECs in the region in the long-term.

6.1.2 Threatened flora species

The Project will result in a reduction of the local known population size and area of occupancy of Ingram's Zieria (*Zieria ingramii*) by approximately 57%, *Tylophora linearis* by 100% and *Homoranthus darwinioides* by 53%. These impacts are considered to be significant for these species within the locality. However, all species are known to occur within the region, with large populations recorded in the nearby Goonoo SCA. The local loss of these species will be compensated through biodiversity offsets. This will include the identification, protection and management of additional populations of these species, where possible within the offset sites, the investigation of translocation and/or propagation of plants to be introduced into offset areas, and funding for conservation management in the region where land-based offsets are not available.

6.1.3 Threatened fauna species

Nine threatened fauna species, of which three were recorded in the PAA, may be directly or indirectly impacted by the Project. Due to the progressive removal of foraging and breeding habitat, significant impacts are anticipated for the Large-eared Pied Bat (*Chalinolobus dwyeri*) and Southern Long-eared Bat (*Nyctophilus corbeni*) as the Project:

- removes a large area of known foraging habitat;
- removes significant breeding features (large hollow-bearing trees) for the Southern Long-eared Bat;
- removes 16 km of cliff line that provides potential breeding and roosting habitat for the Large-eared Pied Bat; and
- is not consistent with the recovery actions of these species.

These species are associated with the PAA's woodland areas, depending on habitat resources such as hollow-bearing trees and caves or crevices in cliffs. Progressive rehabilitation during mining will include replanting woodland habitat, the reinstatement of habitat features, such as fallen timber and rock salvaged during clearing, and methods to compensate for the loss of hollow-bearing trees. This will help bird and bat species to maintain territories in the locality, by providing habitat features in the medium to long term.

Habitat resources also occur outside the disturbance footprint, with abundant similar habitat available in the proposed offset areas next to the Project area. In addition, large areas of contiguous vegetation occur for these species in nearby conservation areas in the PAA and the locality, including Goonoo SCA and the Goulburn River NP. Offsets will aim to improve the connectivity of conservation areas and the quality of remnant vegetation within the locality and region. This will potentially increase movement corridors for genetic exchange, foraging habitat and increase breeding resources for threatened fauna species.

While potential habitat for the Trout Cod (*Maccullochella macquariensis*) and Murray Cod (*Maccullochella peelii peelii*) was identified in the study area, potential Project impacts are not considered significant after the implementation of recommended safeguards.

6.1.4 Migratory species

Important habitat for migratory species is defined under the *'Significant Impact Guidelines'* (DEH, 2006) as:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
- habitat that is of critical importance to the species at particular life cycle stages; and/or
- habitat utilised by a migratory species which is at the limit of the species range; and/or
- habitat within an area where the species is declining.

The study area does not constitute an area of important habitat for the Cattle Egret (*Ardea ibis*), Great Egret (*A. modesta*), Rainbow Bee-eater (*Merops ornatus*), Malleefowl or Regent Honeyeater as:

- an ecologically significant proportion does not reside in the study area;
- no breeding occurs in the study area;
- the study area is not at the limit of the species range; and
- the species are not known to be declining in the study area.

Additionally, foraging habitat is sub-optimal for these species in the study area, and the Project does not disrupt their migration or dispersal capability. Therefore, no significant impact is anticipated on migratory species.

6.2 Cumulative impacts

Cumulative impacts to biodiversity may result from the accumulation and interaction of impacts from past, present or future activities. The loss of native vegetation, habitat values and alteration to flow regimes in the PAA from the Project may combine spatially and temporally to result in cumulative impacts locally and within the region.

The Project occurs in an area that has been subject to historical clearing and disturbance as a result of agricultural activities. On a local scale, more than 60% of the PAA has been cleared of all native vegetation, with remaining areas in varying stages of regeneration or subjected to continued grazing and wood collection activities. Most of the higher conservation areas within the PAA and its surrounds have already been conserved under the NSW *Brigalow and Nandewar Community Conservation Area Act* 2005.

The areas disturbed by the Project will be rehabilitated and improved, with rehabilitated woodland areas comparable to existing conditions. The offset strategy will improve the quality of woodland between conservation areas and add to the amount of reserved vegetation in the area. Therefore potential negative local cumulative impacts will be temporary and small in comparison to the cumulative improvements as a result of the Project.

The Project occurs on the edge of a potential growth region for coal mining (Franks *et al*, 2010). Several mineral mines and coal mines occur within the wider region to the east. This includes three large coal mines: Ulan, Moolarben and Wilpinjong. Other smaller mineral mines occur, or are proposed within the region including a zirconium mine south of Dubbo. Therefore impacts from the Project may combine with those from other existing and future mines projects, particularly for TECs, threatened flora and threatened fauna.

At other coal projects to the east, the vegetation communities and fauna habitat varies from that within the Cobbora Project area. However these projects will all impact on areas of Box Gum Woodland TEC, with a net cumulative impact of more than 225 ha, of which the Project contributes 5%.

Cumulative impacts to the Southern Long-eared Bat are shared between Cobbora and Moolarben with the loss of important values such as hollow-bearing trees and contiguous habitats. Cumulative impacts are also likely for cave-roosting microbats as cliff-lines are a limiting factor in the locality. The combined projects will impact on approximately 30 km of cliff-line which provides roosting and potential breeding habitat for the Large-eared Pied Bat. The Cobbora Project represents half of this loss of cliff-line habitat.

However, despite the potential negative cumulative impacts, the Project is also likely to have a beneficial cumulative impact through the investment in biodiversity offsets and rehabilitation efforts. Offsets will add to the conservation network and to habitat corridors within the wider region, protecting important areas of identified threatened species and community habitat. Disturbed offset areas will be rehabilitated with native vegetation representative of the likely original communities, including areas indicative of Box Gum Woodland.

7 Offsets and monitoring

7.1 Biodiversity Offset Strategy

Biodiversity offsets are required for impacts to threatened species, populations and communities and their habitats that cannot be avoided, minimised or mitigated by the Project. The offset strategy provides a framework for identifying and prioritising offset requirements. The resultant offset package, which will be negotiated with Office of Environment and Heritage (OEH) and SEWPaC when finalised, will ensure that the Project results in a net gain for biodiversity values in the region.

7.1.1 Offset principles

The Project offset strategy has been prepared in accordance with the *EPBC Act Environmental Offsets Policy* (consultation draft 2011). Table 7.1 details the consideration of the principles of this policy.

In line with the guiding offset principles, the Project offsets will:

- provide a net improvement in the quantity, quality and conservation of biodiversity values within the region in the medium to long term through:
  - rehabilitation and protection of woodland, particularly the Box Gum Woodland and Inland Grey Box Woodland TECs; and
  - protection of threatened flora and fauna habitat and habitat features (eg hollow-bearing trees).
- provide long-term protection for threatened flora, fauna and TECs;
- improve vegetation and habitat connectivity between existing conservation areas within the locality; and
- protect areas identified as key corridors within the Central West Catchment Action Plan (CW CMA, 2011) and as NPWS conservation priorities.

Table 7.1 Compliance with Commonwealth offset principles

	Principle	Compliance
1	Environmental offsets should be targeted to the matter protected by the EPBC Act that is being impacted	Offsets identified have targeted the TECs and threatened species habitats which will be impacted by the Project.
2	A flexible approach should be taken to the design and use of environmental offsets to achieve long-term and certain conservation outcomes which are cost effective for proponents	Corridor mapping, OEH priority areas and the Central West Catchment Action Plan have been reviewed as part of the identification of potential offsets sites. Offsets aim to improve connectivity of remnant vegetation and protected areas in the long-term within the locality. Where possible, offsets have been identified within land already owned by CHC. Additional offsets have been identified as potential property acquisitions to add to CHC-owned property. Where land-based offsets cannot be identified for the values to be offset, the credit to hectare calculator has been used to identify the likely costs to the proponent for indirect offset requirements.

Table 7.1 Compliance with Commonwealth offset principles

	Principle	Compliance
3	Environmental offsets should deliver a real conservation outcome	Offset areas are not already part of the reserve system and are therefore supplementary areas of protection and enhancement of biodiversity values. These areas will be managed for conservation into the future to deliver outcomes for the biodiversity of the locality and region.
4	Environmental offsets should be developed as a package of actions, which may include both direct and indirect offsets	A minimum of 80% of offsets will be land-based and these will be managed for conservation in perpetuity. Additional offsets where land-based offsets are not feasible may include investment into the management of threatened species within the region.
5	As a minimum, environmental offsets should be commensurate with the magnitude of the impacts of the development and ideally deliver outcomes that are 'like for like'.	The proposed offset areas provide a minimum of 2:1 offset to impact ratio for vegetation types, which is greater than the like for like outcome. For threatened species a minimum of like for like will be achieved via land-based offsets and where this is not feasible, through the funding of management and research within the region for the target species. Minimum requirements have been determined using the Biobanking calculator and the credit to hectare calculator.
6	Environmental offsets should be located within the same general area as the development activity	All proposed offset areas have been identified adjacent to the proposed impact areas.
7	Environmental offsets should be delivered in a timely manner and be long lasting	The majority of offsets will be provided prior to removal of significant vegetation within the Project area. Offset sites will be protected in perpetuity which goes well beyond the proposed mine life.
8	Environmental offsets should be enforceable, monitored and audited.	An appropriate monitoring program will be developed for offset sites in accordance with the management of these areas.

7.1.2 Strategy framework

Offset locations adjacent to, or close to, the impact site are favoured for offsetting (SEWPaC, 2011). The aim of land-based offsets will be to ensure identified areas are compatible with regional conservation priorities close to the PAA.

High priority areas have been identified within and surrounding the PAA, south of Goodiman SCA outside the disturbance areas on CHC-owned land. Significant wildlife corridors will be created in such areas by the permanent dedication of CHC lands. The aim of onsite offsets will be to provide vegetated links to existing conservation areas and large areas of remnant native vegetation that will be retained.

Matters of NES that require offsetting have been determined using the outcomes of the significance assessments. Matters of NES which require offsetting include:

- Box Gum Woodland;
- Grey Box Woodland;
- Large-eared Pied Bat;
- Southern Long-eared Bat;

- *Tylophora linearis*;
- *Homoranthus darwinioides*; and
- Ingram's Zieria.

Where land-based offsets are not able to be found for threatened species, particularly threatened flora, indirect offsets may be considered including investment in the management of the species in the region.

7.1.3 Offset package

A total of 5,667 ha of CHC-owned land has been identified as biodiversity offset areas. These areas will be conserved in perpetuity to protect and enhance the ecological values present.

i Vegetation communities

The offsets consist of both high quality native vegetation and areas of regrowth and native and introduced pasture which require improvement. The lower quality areas will be rehabilitated back to their likely pre-disturbance vegetation types.

Outcomes for matters of NES and other vegetation types, which provide potential habitat for threatened species listed under the EPBC Act, are provided in Table 7.3. A total of 458 ha of vegetation considered to be representative of EPBC Act-listed TECs will be protected within the offset area. An additional 954 ha of vegetation characteristic of Box Gum Woodland and Grey Box Woodland will be rehabilitated within the offset area. This will deliver conservation gains within the region which would not have otherwise occurred with continuation of current land use.

With rehabilitation in offset areas, the Project will result in offset to impact ratios of 40:1 for Box Gum Woodland and 8.4:1 for Grey Box Woodland. All other vegetation will be offset at a ratio of 2.1:1. Rehabilitation areas have been discounted in the calculations by 50% to account for decreases in the diversity and values of rehabilitation areas when compared with remnant communities. These rehabilitated communities are likely to provide habitat for EPBC Act-listed threatened species.

Table 7.2 Vegetation types identified in CHC-owned offset sites

Vegetation type	Area to be impacted (ha)	Area within offsets (ha)[1]	Offset to impact ratio	Area to be rehabilitated in offsets (ha) (discounted value in brackets[2])	Offset to impact ratio including rehabilitation[2]
Box Gum Woodland	12	347	27:1	270 (135)	40:1
Grey Box Woodland	54	111	2:1	684 (342)	8.4:1
Other vegetation	1,801	3,451	2:1	804 (402)	2.1:1
Total	**1,867**	**3,909**	2:1	**1,758 (879)**	**2.6:1**

Note: 1.Does not include areas to be rehabilitated within the offset areas.

2. Rehabilitation areas have been discounted by 50% in the calculations of ratios

ii Threatened species

The offset areas have been identified to provide habitat for a number of NES species. An overview of these is provided in Table 7.3. The Large-eared Pied Bat and Keith's Zieria have been recorded in the offset areas. Habitat for the Large-eared Pied Bat and the Southern Long-eared Bat has also been identified, as well as potential habitat for other NES species which were not considered likely to be significantly impacted, including Australasian Bittern, Superb Parrot , and possibly Regent Honeyeater, Spotted-tail Quoll, Koala, Swift Parrot and migratory birds.

Table 7.3 Matters of NES in the offset areas

Matter of NES	Impact	Habitat present or recorded in offset areas	Likelihood of occurrence in offset areas?	Offset ratio
Keith's Zieria	727 plants	358 plants in two sub-populations	Approximately 1,950 ha of potential habitat occurs within the offset areas	0.5:1 Additional offsets required
Homoranthus darwinioides	227 plants	None identified	Approximately 1,950 ha of potential habitat occurs within the offset areas	Additional offsets required
Tylophora linearis	9 plants	None identified	Approximately 1,950 ha of potential habitat occurs within the offset areas	Additional offsets required
Large-eared Pied Bat	Recorded in impact area 16 km of cliff line 1,400 ha of foraging habitat	Recorded within the offset sites. 20.1 ha of cliff line 3,200 ha of foraging habitat	n/a	1.25:1 cliff line Additional offsets required for loss of potential breeding habitat 2.3:1 foraging habitat
Southern Long-eared Bat	Recorded in impact area 1,400 ha of habitat	3,200 ha of foraging, roosting and potential breeding habitat	n/a	2.3:1 habitat

iii Adequacy of package

With rehabilitation in the offset areas, the offset ratios for TECs are generally comparable and in some cases in excess of regional offset precedents (Continued Operations Project for Ulan Coal Mines and the Duralie Coal Extension Project). While the currently proposed offset package for TECs is considered to be sufficient to result in a net gain outcome, there is some uncertainty about adequacy for all threatened species. For this reason additional properties are being investigated in case extra offset areas are needed (Figure 7.1).

Most of the additional potential offset areas have not been mapped in detail. However, an area of 80 ha of Grey Box Woodland has been identified in one of the sites, which would increase the ratio for this TEC to 3.5:1 without rehabilitation. These additional areas are being negotiated with landholders and may be added to the onsite offsets. These properties are adjacent to the PAA and contain similar biodiversity values to CHC properties and the areas to be impacted by the Project. The location of the potential offset properties is shown on Figure 7.1.

Additional surveys are planned in spring/summer to identify the presence of threatened species. Detailed targeted flora surveys and bat harp trapping will be undertaken at this time. It is likely that the species which have not already been recorded within the offset areas are present, given the similarities and proximity to the proposed impact area. If the affected threatened species are not found in the current and potential offset sites, indirect offsets will be required to ensure a net gain outcome for the Project. With the existing offset areas and the known threatened species populations, it is considered that indirect offsets would be required for the following matters of NES (in the absence of additional surveys):

- Keith's Zieria;
- *Homoranthus darwinioides*;
- *Tylophora linearis;* and
- Large-eared Pied Bat breeding habitat.

7.1.4 Offset management plan

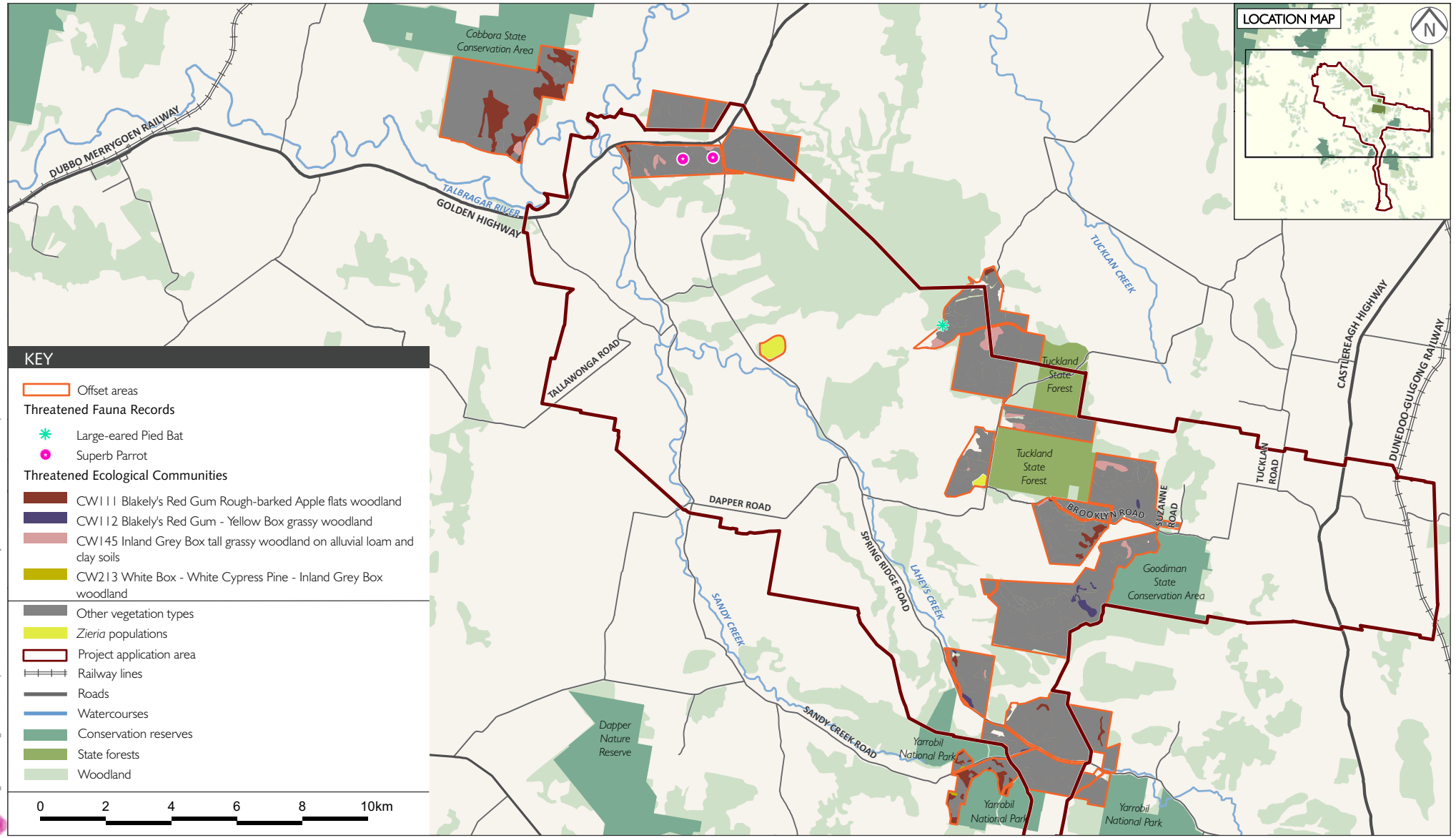
The offset management plan will detail the management requirements for each of the offset properties, the arrangements for conservation in perpetuity and rehabilitation works to be undertaken. The plan will also detail the indirect offset actions for threatened species should these be necessary. Indirect offsets in accordance with recovery plans and priority actions identified for these species may include:

- funding for research into the life history of *Z. ingramii*, *H. darwinioides* and *T. linearis* including seed viability and germination trials, propagation success, translocations and seedling establishment and survival (potentially within offset areas); and
- funding for the identification of roost and maternity sites for the Large-eared Pied Bat and research into the species.

7.2 Monitoring

Monitoring will allow for the adaptive management of biodiversity values during the life of the Project and beyond, focusing on rehabilitation works and threatened species, populations and communities within the PAA. The aim of biodiversity monitoring for the Project will be to determine the effectiveness of the mitigation and offset measures in the PAA and its surrounds and to adapt these if required.

Monitoring will be detailed within the biodiversity management plan and will be based on quantitative measures with key triggers to detect impacts on threatened species, populations and communities as a result of the Project. Contributions and partnerships to facilitate environmental education and research will be integrated into the Project where possible.



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Offset Areas

Cobbora Coal Project - Matters of NES Report

Figure 7.1

8 Conclusion

The Cobbora Coal Project study area has been surveyed and assessed in accordance with the SEWPaC environmental assessment requirements. Matters of NES identified within the PAA include threatened plants, birds, bats, ecological communities and migratory species. The Project may impact local populations of threatened species and communities identified within the PAA. This includes significant impacts to:

- Large-eared Pied Bat;
- Southern Long-eared Bat;
- *Tylophora linearis*;
- *Homoranthus darwinioides*; and
- Ingram's Zieria.

The Project will also require clearing of woodland and regenerating vegetation (1,867 ha), of which less than 4% (67 ha) comprises EPBC Act listed TECs (Grey Box Grassy woodlands and Derived Native Grasslands of South-eastern Australia and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland).

Potential impacts from the Project have and will be avoided, minimised and mitigated through design changes and the implementation of management plans during construction and operation. Any remaining impacts will be compensated through an offset strategy. As a result, the Project will have a net gain in biodiversity values in the medium to long term, from the improvement of biodiversity values within the region as a result of progressive rehabilitation and the offset package.

The offset package will be further developed in the coming months based on current and future ecological survey results and in consultation with OEH and SEWPaC. CHC is committed to conserving and enhancing the ecological values of the identified potential offset sites, though the implementation of a biodiversity offset plan. The plan will provide measures to improve and enhance the biodiversity values of the offset lands.

The connectivity of remnant habitat within the locality will be improved through the Project offsets, linking Cobbora SCA and Goonoo SCA in the north-west, through Tuckland State Forest and Goodiman SCA, to Yarrobil National Park in the south-east of the PAA. A total of 458 ha of EPBC Act listed TECs has been identified within the offset areas. An additional 954 ha of these communities will be rehabilitated in the offsets in disturbed and native pasture areas. Offset ratios for these communities (with rehabilitation areas discounted to 50%) are 40:1 for Box Gum Woodland and 8.4:1 for Grey Box Woodland.

The Large-eared Pied Bat and Keith's Zieria have been recorded within the offset areas. Habitat for the Large-eared Pied Bat and the Southern Long-eared Bat has also been identified. Additional surveys within the offset areas are planned in spring/summer to identify the presence and distribution of threatened species. If these species are not present, indirect offsets will be provided to ensure the Project results in a net gain outcome. This may involve investment in threatened species management in the region according to species recovery plans.

Ongoing ecological management, rehabilitation works and the offset package will improve the connectivity of remnant habitat within the locality. The Project result in a net gain in the quality, quantity and protection of biodiversity values within the region in the medium to long term.

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Appendix A of Matters of national environmental significance

Likelihood of occurrence for EPBC Act listed species

A.1 Likelihood of occurrence for EPBC Act listed species

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	EPBC Act status	Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
Plants				
Austral Toadflax *Thesium australe*	V	Not recorded since 1959 in Goulburn River National Park within the region. This plant is quite rare in the Brigalow Belt South, with only six individuals recorded in surveys of all National Parks and State Forests in the bioregion. Occurs in grassland or grassy woodland, often in damp sites in association with Kangaroo Grass (*Themeda australis*) (DEC, 2005).	Low likelihood given far proximity of records and time since recorded.	No
Euphrasia arguta	CE	This species is known from six sites within 25 km of each other, four in Nundle SF (SE of Tamworth) another within Nundle SF and on adjacent forested private land, the sixth site is on private land nearby. All sites are in the Nandewar IBRA Bioregion of northern NSW, in the south-east section of Namoi NRM region (DSEWPaC, 2011). The populations are in grassy forests or regrowth vegetation following clearing of a firebreak. It flowers mainly from October to January, although one flowering collection was made in June (DSWEPaC, 2011).	Low likelihood as known populations are over 250 km east of the study area.	No
Finger Panic Grass *Digitaria porrecta*	E	In NSW, it occurs from Graman and Croppa Creek (near Inverell), south to the Liverpool Plains near Coonabarabran and Werris Creek (33 sites). Occupies native grassland, woodlands or open forest with a grassy understorey, on richer soils. Often found along roadsides and travelling stock routes where there is light grazing and occasional fire. Associated tree species are *Eucalyptus albens* and *Acacia pendula* (DSEWPaC, 2011).	Low likelihood as the study area is over 200 km from its known distribution.	No
Homoranthus darwinioides	V	Found in Goonoo SCA. Grows in various woodland habitats with shrubby understoreys, usually in gravely sandy soils. Landforms the species has been recorded growing on include flat sunny ridge tops with scrubby woodland, sloping ridges, gentle south-facing slopes, and a slight depression on a roadside with loamy sand. Associated species include *Callitris endlicheri, Eucalyptus crebra, E. dwyeri, E. rossii, Melaleuca uncinata, Calytrix tetragona,* and *Allocasuarina spp.* (DEC, 2005).	Recorded.	Yes
Ingram's Zieria *Zieria ingramii*	E	Found in Goonoo SCA in 2006. Grows in dry sclerophyll forest on light sandy soils. All known populations have been recorded in Eucalyptus-Callitris woodland or open forest with a shrubby to heathy understorey. Mostly from gentle slopes in red-brown and yellow-brown sandy loams, often with a rocky surface. Associated canopy species include *Eucalyptus crebra, Eucalyptus dwyeri*, *Eucalyptus microcarpa* and *Callitris endlicheri* (DEC 2005).	Recorded.	Yes

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	EPBC Act status	Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
Philotheca ericifolia	V	Known from Goonoo SCA. Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies. It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. Associated species include *Melaleuca uncinata, Eucalyptus crebra, E. rossii, E. punctata,* and *Philotheca australis.* Flowering time is in the spring (DEC, 2005).	High likelihood as it occurs close by in Goonoo SF and suitable habitat is present within the study area.	Yes
Rulingia procumbens	V	In 2002, recorded 56 km from Dubbo along Danedo Rd, at the turnoff to Wellington and in Goonoo SCA. It is mainly confined to the Dubbo-Mendooran-Gilgandra region. Grows in sandy sites, often along roadsides. Recorded in *Eucalyptus dealbata* and *Eucalyptus sideroxylon* communities, *Melaleuca uncinata* scrub, under mallee eucalypts with a *Calytrix tetragona* understorey, and in a recently burnt Ironbark and Callitris area (DEC, 2005). Fruiting occurs in summer and autumn (Harden, 2000).	Moderate likelihood of occurrence in Ironbark and Callitris communities.	Yes
Tylophora linearis	E	Recorded in the study area. Also recorded from Goonoo SCAs, Coolbaggie NR, Goobang NP and Beni SCA. Grows in dry scrub and open forest on low-altitude sedimentary flats in dry woodlands of *Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla* and *Allocasuarina luehmannii*. Also grows in association with *Melaleuca uncinata,* and *Casuarina* species (DEC, 2005).	Recorded.	Yes
Zieria obcordata	E	Recorded in 2005 near Wellington, where a population with 77 plants occurs. Another population occurs at Crackerjack Rock/Rock Forests area north-west (NW) of Bathurst with 259 plants. Grows in eucalypt woodland or shrubland dominated by species of *Acacia* on rocky hillsides. Also occursin *Eucalyptus* and *Callitris* dominated woodland with an open, low shrub understorey, on moderately steep, west to north-facing slopes in sandy loam amongst granite boulders. Associated vegetation includes *Eucalyptus blakelyi, Brachychiton populneus*, *Eucalyptus dwyeri* and *Callitris glaucophylla*. Flowering time is in spring (September-October). It is extremely sensitive to grazing and browsing disturbances by domestic stock and native herbivores (DEC, 2005).	Low likelihood of occurrence considering its sensitivity to grazing and browsing.	No

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	EPBC Act status	Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
Amphibians				
Boorolong Frog *Litoria booroolongensis*	E	Records occur near Tamworth. It occurs in permanent streams with some fringing vegetation cover such as ferns, sedges or grasses (DSEWPaC, 2012). The species occurs along streams in both forested areas and open pasture (The Victorian Frog Group, 1999).	Low likelihood due to distance from closest record and absence of permanent streams.	No
Birds				
Australasian Bittern *Botaurus poiciloptilus*	E	Recorded from the study area, and previously from Goonoo SCA (NPWS, 2000). Favours permanent freshwater wetlands with tall, dense vegetation (Morcombe, 2000), particularly bullrushes (*Typha* spp.) and spikerushes (*Eleoacharis* spp.). Hides during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails (DEC, 2005).	Recorded.	Yes
Cattle Egret *Ardea ibis*	Mi	Recorded in study area. The Cattle Egret occurs in temperate grasslands, wooded lands and terrestrial wetlands. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora. They have sometimes been observed in swamps with tall emergent vegetation (DSEWPaC, 2012).	Recorded.	Yes
Great Egret *Ardea alba*	Mi	Recorded in the study area. The Eastern Great Egret has been reported in swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels. The species usually frequents shallow waters (DSEWPaC, 2012).	Recorded.	Yes
Malleefowl *Leipoa ocellata*	V, Mi	Recorded in 2010 in Goonoo SCA and in 2000 in Yarrobil SCA. Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300 - 450 mm mean annual rainfall) areas. Less frequently found in other eucalypt woodlands, such as Inland Grey Box or Ironbark with thick understorey, or in other woodlands dominated by native Cypress Pine species. Prefers areas of light sandy to sandy loam soils and habitats with a dense but discontinuous canopy and dense and diverse shrub and herb layers (DEC, 2005).	Moderate likelihood. Old possible mounds recorded along Spring Ridge Rd (more likely to be historical piling and burning of tree stumps).	Yes

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	EPBC Act status	Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
Painted Snipe (Australian subsp) *Rostratula benghalensis australis*	V	Recorded as a rare visitor to the wetlands and fringes of dams in the Dubbo region (Hosking *et al*, 2009). Prefers fringes of swamps, dams and nearby marshy areas where there is cover. Forages nocturnally on mud-flats and in shallow water (DEC, 2005).	Low likelihood due to the lack of suitable dense rushes and permanent wetlands.	No
Rainbow Bee-eater *Merops ornatus*	Mi	Recorded in study area. The Rainbow Bee-eater occurs in open woodlands and shrublands, including mallee, and in open forests that are usually dominated by eucalypts. It also occurs in grasslands and, especially in arid or semi-arid areas, in riparian, floodplain or wetland vegetation assemblages (Birdlife Australia, 2012).	Recorded.	Yes
Regent Honeyeater *Anthochaera phrygia*	E, Mi	Previously recorded east of Cobbora SCA, and east of Cope SF. Recorded as a rare visitor to the Dubbo area, with breeding records from the local forestry office (Hosking *et al*, 2009). This species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum and White Box (DEC, 2005).	High likelihood of occurrence due to presence of key eucalypt species.	Yes
Superb Parrot *Polytelis swainsonii*	V	Recorded in 2006 between Goolma and Wellington. Recorded as an uncommon winter migrant to woodlands and urban gardens of the Dubbo area (Hosking *et al*, 2009). Inhabit Box-Gum, Box-Cypress-pine and River Red Gum Forest. Nest in the hollows of large trees (dead or alive) in Blakely's Red Gum and Yellow Box and forages up to 10 km from nesting sites, primarily in grassy box woodland (DEC, 2005).	Recorded in Ironbark Woodland.	Yes
Swift Parrot *Lathamus discolor*	E	Recorded 10 km north of Cope in 2005. Recorded as a rare visitor to the Dubbo region, in woodlands when flowering is occurring (Hosking *et al*, 2009). Found in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Mugga Ironbark, and White Box. Commonly used lerp infested trees include Inland Grey Box (DEC, 2005).	Moderate likelihood in Inland Grey Box Woodland of the study area, when in flower.	Yes

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	EPBC Act status	Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
Mammals				
Brush-tail Rock-wallaby *Petrogale penicillata*	V	Recorded from Goulburn River NP. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Highly territorial and have strong site fidelity with an average home range size of about 15 ha (DEC, 2005).	Unlikely as rocky outcrops and cliffs are not large enough or isolated from predators.	No
Grey-headed Flying-fox *Pteropus poliocepahlus*	V	One outlying record from Dubbo in 2004. Distributed along the east coast of roosting in dense vegetation greater than 3 m in height. In summer, camps may number in the thousands, depending upon local eucalypt blossom, rainforest fruit or fruit crop availability. In winter, adults migrate north to feed on Swamp Mahogany *(Eucalyptus robusta),* a winter-flowering eucalypt (DEC, 2005).	Unlikely to occur given far proximity from coast.	No
Koala *Phascolarctos cinereus*	V	Recorded in 2006 in Ironbark forest at Goonoo SCA. This species has also been recorded within the study area at Goodiman SCA and Yarrobil NP. Key feed trees within the area include *Eucalyptus camaldulensis* and *Eucalyptus albens* (SEPP 44).	Moderate likelihood due to presence of food tree species.	Yes
Large-eared Pied Bat *Chalinolobus dwyeri*	V	Recorded in 2009 along Spring Ridge Road, and previously in Yarrobil NP. This species roosts in caves and crevices in cliffs and mines, preferring the twilight areas not far from the entrance. Males can roost alone or in small groups in winter during torpor. Females form maternity colonies from November to February in the roof domes of sandstone caves (Churchill, 2008). Most frequently associated with Box Gum Woodlands or creek flats (DECC, 2007).	Recorded.	Yes
New Holland Mouse *Pseudomys novaehollandiae*	V	Last recorded in 1998 from Goobang NP. This species shows a preference for soft sandy substrates in which to make their burrow, a layer of heath to 1 m in height and sparse groundcover. This species begins to colonise burnt areas one year after fire and mined areas after four to five years (Strahan, 1995).	Unlikely - no proximal records to study area and unsuitable habitat present.	No

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	EPBC Act status	Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
Southern Long-eared Bat *Nyctophilus corbeni*	V	Recorded in Scribbly Gum Woodland along Spring Ridge Rd. Also known from Goonoo SCA (NPWS, 2000). Roosts in hollows of live trees which are also used as maternity sites. Forages up to 3 km away from the roost (Churchill, 2008). This species is most abundant where the vegetation has a canopy and a dense cluttered understorey layer. Most common in box, ironbark and cypress open forests of inland northern NSW. Highly manoueverable and forages in forest gaps (Churchill, 2008).	Recorded.	Yes
Spotted-tail Quoll *Dasyurus maculatus*	E	Recorded in 2006 along Spring Ridge Road. Utilises a range of habitats including open forest and open woodland. Commonly associated with gullies, rocky escarpments and outcrops (Belcher, 2000; Belcher *et al*, 2001). The spotted-tailed quoll shelters during the day in dens located in caves, among rocks, hollow logs; low tree hollows and burrows (Edgar and Belcher 1995; Belcher and Darrant, 2006). Spotted-tailed quolls are solitary, with females defending exclusive home range territories (600–1,000 ha), whereas males have larger and undefended home ranges, which overlap a number of female home ranges (2,000–4,500 has) (Belcher, 2000; Belcher and Darrant, 2004).	Moderate likelihood - suitable habitat is present along creeklines, gullies, rocky escarpments and gullies.	Yes
Fish				
Murray Cod *Maccullochella peelii peelii*	V	Previously recorded in the Cudgegong River and Macquarie River. Murray Cod migrate long distances upstream to spawn.	This species may use waterways in the study area during peak flow events over spring and early summer.	Yes
Trout Cod *Maccullochella macquariensis*	E	Previously recorded in the Macquarie River. This species has a small home range and does not undertake large-scale spawning migrations.	The unregulated Talbragar River contains potential habitat.	Yes

Notes *1. CE – critically endangered, E-endangered, V-vulnerable, Mi-migratory*

2, SPRAT – Species Profiles and Threats Database, NPWS Atlas- threatened species and communities records for the Cobbora 1:100,000 mapsheet , NPWS Online- NSW Atlas of Wildlife

Appendix B of Matters of national environmental significance

Significant Impact Assessment

B.1 Significant impact criteria in accordance with the EPBC Act

The following sections provide the criteria that must be considered in the assessment of all threatened species listed under the EPBC Act. There are separate criteria for each listing category under the EPBC Act, in accordance with *'EPBC Act Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance'* (DEH 2006).

B.1.1 Significant impact criteria for critically endangered and endangered ecological communities

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- Reduce the extent of an ecological community;
- Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;
- Adversely affect habitat critical to the survival of an ecological community;
- Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;
- Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;
- Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
    - assisting invasive species, that are harmful to the listed ecological community, to become established; or
    - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or
- Interfere with the recovery of an ecological community.

B.1.2 Significant impact criteria for critically endangered and endangered species

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- Lead to a long-term decrease in the size of a population;
- Reduce the area of occupancy of the species;
- Fragment an existing population into two or more populations;
- Adversely affect habitat critical to the survival of a species;

- Disrupt the breeding cycle of a population;
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
- Introduce disease that may cause the species to decline; or
- Interfere with the recovery of the species.

B.1.3 Significant impact criteria for vulnerable species

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- Lead to a long-term decrease in the size of an important population of a species;
- Reduce the area of occupancy of an important population;
- Fragment an existing important population into two or more populations;
- Adversely affect habitat critical to the survival of a species;
- Disrupt the breeding cycle of an important population;
- Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat;
- Introduce disease that may cause the species to decline; or
- Interfere substantially with the recovery of the species.

B.1.4 Significant impact criteria for listed migratory species

An action will require approval if the action has, will have, or is likely to have a significant impact on a listed migratory species. Note that some migratory species are also listed as threatened species. The criteria below are relevant to migratory species that are not threatened. An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

B.1.5 Assessments of impact criteria

Assessments of impact criteria have been prepared for species listed under the EPBC Act, in accordance with the criteria presented above. The results of assessments have been tabulated for ease of reading, and are presented in the following sections.

i Critically endangered and endangered ecological communities: Box Gum Woodland and Grey Box Woodland

Box Gum Woodland is restricted to floodplains of the study area. Grey Box Woodland is also present, and occurs on plains and footslopes in the study area. Seventy four hectares of a total of 804 ha of mapped TEC, comprising 14.1 ha Box Gum Woodland critically endangered ecological community (CEEC) and 47.7 ha of Grey Box Woodland EEC, will be removed from the study area. However, other areas of these communities occur outside the disturbance footprint.

An assessment of impact criteria has been completed to assess potential impacts to these threatened ecological communities (Table B.1).

Table B.1 Assessment of impact criteria for TECs

Criteria	Discussion
1: reduce extent of EEC	These TECs have been heavily cleared within the Central West CMA (between 75% and 95% cleared since 1750 (DECC, 2006)). Within the study area, Box Gum Woodland is mainly restricted to linear remnants within riparian zones and along roadsides. Grey Box Woodland was recorded predominantly on the footslopes of Ironbark communities. The Project will result in the removal of up to 48 ha of Grey Box Woodland and 14 ha of Box Gum Woodland from the study area.
2: fragment an EEC	Small-scale, temporary fragmentation will occur in two patches of Box Gum Woodland over the life of the mine. Grey Box Woodland will not be fragmented, although clearing will reduce the size of individual patches.
3: adversely affect critical habitat for an EEC	Habitat critical to the survival of Box Gum Woodland has been identified by DECCW (2010b) as wherever it occurs. The Project will result in the removal of 14 ha of habitat critical to the survival of the community.
4: modify or destroy abiotic factors	Abiotic factors including soil will be removed for the Project. A topsoil storage and re-spreading strategy will be included in the biodiversity management plan to minimise impacts to this abiotic factor that the community relies on. Soil will not be impacted in areas of retained woodland.
5: substantial change in composition of an EEC	Potential changes to composition of the TECs could occur through weed invasion or dust deposition (where species assemblages change to favour dust tolerant species). In order to reduce the potential for these impacts, management and mitigation measures will be implemented as part of the Project Environmental Management Plan.
6: substantial reduction in quality or integrity of EEC	Potential reduction in integrity or quality of the TECs could occur, primarily through weed invasion. Management of weeds will be implemented as part of the Project Environmental Management Plan.
7: interfere with recovery	Recovery objectives for Box Gum Woodland focus on the achievement of 'no net loss', increasing connectivity and restoring sites (DECCW, 2010b). The biodiversity management plan to be developed for the Project will incorporate these objectives, with species characteristic of these communities to be planted within rehabilitated mine areas. However, as the Project removes these vegetation types, it is not considered to be consistent with recovery of these community types.

Table B.1 Assessment of impact criteria for TECs

Criteria	Discussion
Conclusion	The Project is expected to result in significant impacts to Box Gum and Grey Box Woodland because it: • removes up to 62 ha of TECs from the study area; • impacts critical habitat for Box Gum Woodland; • temporarily fragments and isolates known TECs; and • is not consistent with the recovery plan for these communities.

ii Endangered flora: Ingram's Zieria

Ingram's Zieria has been recorded as 1,255 individual plants across 15 separate areas within the study area. The individuals within the study area are discussed and referred to here as the 'local population', while the plants within the 15 separate areas are referred to as 'subpopulations'. Each subpopulation is separated from others within the local population by a distance of 1 km or greater.

Historically, the species has been recorded in three separate localities: Goonoo SCA Cobbora SCA and Goobang NP (referred to here as the 'known population'). Recent records are only in Goonoo and Cobbora SCA, are within of approximately 20 km of each other. Should the species be confirmed at Goobang, this would extend the known range by 125 km to the south (DEC, 2007).

In the study area, Ingram's Zieria has been recorded on gentle slopes, and relatively flat topography (Figure 4.2). The species does not appear to prefer a certain aspect, being recorded on slopes of all aspects. It was most commonly recorded in Blue-leaved Ironbark Woodland or Blue-leaved Ironbark/Red Stringybark Woodland. A population was also recorded within Dwyer's Red Gum Woodland. In Blue-leaved Ironbark Woodland, it sometimes occurred at disturbed track edges in close vicinity to fallen timber, which appeared to be affording individual plants a certain degree of protection from herbivores. This may be an artefact of previous grazing regimes.

This species generally flowers in spring and fruits in summer. It appears to possess functional pollen but other aspects of pollination and reproductive biology are unknown. Not much is known about the life cycle of Ingram's Zieria. However, it is thought that the main pollinators are flies (DEC, 2007). There are no known or observed species-specific pollinators for Ingram's Zieria, as is the case with some flora species such as orchids. Given this, it is most likely that Ingram's Zieria pollinators are opportunistic in their pollination, and would travel the smallest distance possible to meet their foraging requirements. Consequently, it is considered that each subpopulation within the study area does not cross pollinate with others, or if crosspollination does occur, then it occurs at a low rate. Given the lack of knowledge regarding pollination mechanism, it is assumed that the viability of each subpopulation is reliant on insect pollinators and dispersers in the immediate area.

Germination mechanisms of Ingram's Zieria are not known. DEC (2007) suggests that fire could play a role in germination. However, the authors of this study note that a high density of seedlings was recorded within parts of the study area that had not recently experienced fire. From observations of the species in the field, there is no evidence that fire is needed for germination (author observation) and high frequency fire is listed as a threat to this species (DEC, 2007).

Species of the Rutaceae family in the Sydney region were observed to have limited seed dispersal ability, having a short range initial ballistic dispersal of seeds from fruits followed by secondary seed dispersal primarily by ants. In this latter group, seeds are generally dispersed less than a few metres. There was also a high level of seed dormancy at release (Auld, 2001). Seeds were observed on many plants within the local population when the area was surveyed in January 2012.

Seven hundred and twenty seven plants will be removed from eight subpopulations of the local population within the study area. An area of 1,354 hectares of Blue-leaved Ironbark Woodland and 73 ha of Dwyer's Red Gum Woodland (including known and potential habitat for this species) will be removed for the Project.

An assessment of impact criteria has been completed to assess potential impacts on this endangered species (Table B.2).

Table B.2 Assessment of impact criteria for Ingram's Zieria

Criteria	Discussion
1: long-term decrease in population size	The Project will result in a reduction of the local population by approximately 58 %. This could constitute a long-term decrease in population size, if the population does not recover numbers in the long term.
2: reduce area of occupancy	The known area of occupancy of Ingram's Zieria will be reduced by the Project. Additional populations of this species occur outside the locality.
3: fragment a population	The local population (defined as the population that occurs within the study area) will be fragmented by changed land uses and development of active mine areas and associated infrastructure.
4: adversely affect critical habitat	As the population in the study area is only one of three known populations, habitat in the study area may be critical to the survival of this species.
5: disrupt the breeding cycle of a population	Breeding cycles of a population of flora species can be affected in the following main ways: • impacts to pollination (internal mechanisms or impacts to pollinators) – Ingram's Zieria is thought to be pollinated by flies (or possibly other insects) (DEC, 2007). The Project is not expected to impact flies or their ability to pollinate flowers; • ability of the plant to produce flowers – the Project is not expected to affect the ability of individual plants to produce flowers, this is more likely to be affected by other environmental effects such as rainfall; • ability of the plant to produce and set seed – the Project is not expected to affect the plants ability to be pollinated and then to produce seed, this is more likely to be impacted by environmental effects and grazing; • ability to germinate – many seedlings were observed during surveys conducted in January 2012 in areas that had not recently been subject to fire. The Project is not expected to impact germination; and • ability of seedlings to grow – the Project could produce high levels of dust and edge effects, which could affect growth of plants, particularly in subpopulations 3, 9, and 2, which are located directly adjacent to proposed mine and infrastructure areas. The removal of 58% of the local population means that the remaining local populations are at greater risk of extinction through stochastic impacts (eg bushfire). The need for genetic material from other subpopulations to increase or sustain genetic diversity has not been determined.
6: modify, destroy, remove, isolate or decrease availability or quality of habitat	The Project will remove known habitat and 1,427 ha of potential habitat for the species. Retained habitat could be susceptible to indirect impacts such as increased dust levels, edge effects and weed invasion. There is potential that indirect impacts could result in species decline in retained areas.
7: result in invasive species	Weeds and feral animals will be managed as detailed in the proposed biodiversity management plan. Therefore the Project is unlikely to result in invasive species becoming established in the retained habitat of the species within the study area.
8: introduce disease	Wash-down procedures for weeds and soil will be included in the management of the Project, to reduce the risk of introducing *Phytophthora cinnamomi* or other disease that could affect the species. The Project is unlikely to introduce disease which could threaten the species.
9: interfere with recovery	The Project is not consistent with the recovery of the species as it removes 58% of the known population from the study area.

Table B.2 Assessment of impact criteria for Ingram's Zieria

Criteria	Discussion
Conclusion	The Project is expected to result in significant impacts to Ingram's Zieria because: • it removes 727 individuals and eight subpopulations from the local area; • it removes 1,427 ha potential habitat for the species from the study area; • it could affect the growth phase of individual plants; • removal of individuals from the locality increases the susceptibility of the local population to extinction from stochastic events; and • it is not consistent with the recovery plan for the species.

iii Endangered flora: *Tylophora linearis*

Nine individuals of ***Tylophora linearis*** were recorded from the central portion of the study area in Dwyer's Red Gum Woodland and Blue-leaved Ironbark Woodland. All plants recorded were growing amongst *Lepidosperma* sp., where they appeared to be afforded protection from grazing. This species flowers in spring, with flowers recorded in November or May. Flowering cues are unknown but are suspected to be partly related to rainfall. As with most Asclepiads, *T. linearis* is assumed to be insect-pollinated (NSWSC, 2008).

T. linearis has the ability to survive fires as it has been observed resprouting from the lower stems within 12 months of a moderately intense wildfire (TSSC, 2008a). Variation in flowering is suspected to be partly related to rainfall. The total population of *T. linearis* in New South Wales is estimated to include at least 250 - 500 mature individuals. However, no data are available to estimate the size of several of the known populations. Although the total population of *T. linearis* may be larger than current estimates suggest, there are unlikely to be more than 1,000 mature individuals. At present, there appears to be no evidence that *T. linearis* is undergoing a continuing decline, although it is at risk from stochastic events as a result of its small population size. Most populations of the species occur in protected areas or areas within state forests which are unsuitable for logging (TSSC, 2008a).

The Project will remove all recorded individuals from the study area. An assessment of impact criteria has been completed to assess potential impacts to *T. linearis* (Table B.3).

Table B.3 Assessment of impact criteria for *Tylophora linearis*

Criteria	Discussion
1: long-term decrease in population size	The Project will result in the removal of a local population (defined as the population that occurs within the study area) of *T. linearis.* The total population in NSW is estimated to be around 1,000 individuals and therefore the Project will require removal of only a small percentage of the known population over its occurrence.
2: reduce area of occupancy	The area of occupancy of *T. linearis* will be removed as a result of the Project. No other areas were considered to provide potentially suitable habitat for the species within the study area. Other populations of this species occur outside the locality.
3: fragment a population	The local population will be removed as a result of the Project.
4: adversely affect critical habitat	Habitat in the study area is not considered critical to the survival of the species. The Project will remove the local population of the species. This is not expected to affect the populations that could occur outside of the study area.
5: disrupt the breeding cycle of a population	The Project will remove the local population of the species, this is not expected to affect the breeding cycles of any populations that could occur outside of the study area.
6: modify, destroy, remove, isolate or decrease availability or quality of habitat	The Project will remove known habitat for the species. Retained areas of potential habitat (low likelihood of occurrence) could be susceptible to indirect impacts such as increased dust levels, edge effects and weed invasion.
7: result in invasive species	Weeds and feral animals will be managed as part of the Project. However as no other suitable habitat for this species occurs outside the proposed mine areas, the Project is not likely to increase the threat of invasive species impacting *T. linearis*.

Table B.3 Assessment of impact criteria for *Tylophora linearis*

Criteria	Discussion
8: introduce disease	Control of soil-borne disease will be included in the proposed biodiversity management plan for the Project. However as no other suitable habitat for this species occurs outside the proposed mine areas; the Project is not likely to increase the threat of disease impacting *T. linearis*.
9: interfere with recovery	The Project is not consistent with the recovery of the species as it removes the known population from the study area.
Conclusion	The Project is expected to result in significant impacts to *T. linearis* because: • it removes all known individuals from the study area and the locality; • it removes individuals representing the south-eastern distribution of the species; and • it is not consistent with the recovery of the species.

iv Endangered woodland birds: Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Xanthomyza phrygia*)

The **Swift Parrot** was not recorded within the study area and has not been recorded within the Talbragar CMA subregion, but is predicted to occur there (DEC, 2005). Potential foraging habitat for this species is available throughout the study area. Favoured feed trees occur within the study area and include winter flowering species such as Mugga Ironbark, White Box and Inland Grey Box. The Swift Parrot breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland (DEC, 2005).

The **Regent Honeyeater** was not recorded in the study area. It has been previously recorded east of Cobbora SCA, and east of Cope SF in proximity to the study area. It is recorded as a rare visitor to the Dubbo area, with breeding records in close proximity to the Dubbo forestry office (Hosking *et al*, 2009). Potential foraging (non-breeding) habitat is present for this species in Box Gum Woodland and Ironbark/Stringybark Woodlands that contain large numbers of mature trees, high canopy cover and abundance of mistletoes. Key eucalypt feed species are present including Mugga Ironbark, Yellow Box, Blakely's Red Gum and White Box. Inland Grey Box, Narrow-leaf Ironbark, Red Stringybark, Rough-barked Apple and Mistletoes are also present as a foraging resource for this species (DEC, 2005).

An assessment of impact criteria has been completed to assess potential impacts of the Project to the endangered Swift Parrot and Regent Honeyeater (Table B.4).

Table B.4 Assessment of impact criteria for endangered woodland birds

Criteria	Discussion
1: long-term decrease in population size	Regent Honeyeaters and Swift Parrots breed outside the study area. Therefore the Project will not impact on breeding habitat or breeding success for these species. The Project will result in the loss of potential winter foraging habitat from the local area. However, similar vegetation will be retained within the study area and it also occurs within the local area. .Therefore it is considered that the removal of potential winter foraging habitat is unlikely to lead to a long-term decrease In population size for either species.
2: reduce area of occupancy	Swift Parrots and Regent Honeyeaters show very high site fidelity, returning to sites that have previously been used on a cyclic basis. However, as site use depends on the availability of foraging resources, the species are unlikely to be recorded at the same site every year (DSEWPaC, 2012). Neither species has been recorded within the study area. Additionally, foraging resources will remain within the study area. Therefore the Project is unlikely to reduce the area of occupancy of these species.
3: fragment a population	The removal of an area of potential foraging habitat will not fragment populations of these highly mobile species.
4: adversely affect critical habitat	Box-Ironbark Woodland is critical wintering habitat for these species. In NSW, 70% of this habitat has been cleared. However, habitat within the study area has not been identified as critical habitat for these species.
5: disrupt the breeding cycle of a population	The breeding cycle of these species will not be disrupted as it occurs outside of the study area.
6: decrease availability or quality of habitat	1,102 ha of potential winter foraging habitat for these species will be removed by the Project. However 1,900 ha of woodland containing potential habitat for these species as it matures will be rehabilitated within disturbed areas.
7: result in invasive species	Following clearing for the Project, these species may be subject to competition from the native (however territorial) Noisy Miner which is present across much of the study area.

Table B.4 Assessment of impact criteria for endangered woodland birds

Criteria	Discussion
8: introduce disease	These species are subject to *Psittacine Circoviral* (Beak and Feather) Disease. The Project is unlikely to increase the incidence of this disease.
9: interfere with recovery	Recovery actions for these two species (Menkhorst *et al*, 1999; Swift Parrot Recovery Team, 2001) centre upon the maintenance and enhancement of habitat at key sites. The BMP will minimise impacts on habitat for these species and rehabilitation efforts will replace potential habitat. However, there will be a lag time in these areas associated with the development of suitable habitat features (ie large flowering eucalypts) from the progressive rehabilitation.
Conclusion	The Project is not expected to result in significant impacts to the Regent Honeyeater or Swift Parrot as: • the species have a low likelihood of occurrence in the study area due to non-detection during targeted surveys; • the species breed outside the study area; and • potential wintering habitat will be retained.

v Endangered waterbird: Australasian Bittern (*Botaurus poiciloptilus*)

The Australasian Bittern was recorded in the north of study area, along Dannabar Rd. It was observed in a cleared habitat near a small dam where numerous frogs were calling during the survey. Potential habitat elsewhere in study area include a small freshwater wetland with tall, dense vegetation (Morcombe, 2000), including bullrushes (*Typha* spp.). Breeding occurs in summer from October to January. Nests are built in secluded places in densely-vegetated wetlands on a platform of reeds. There are usually six olive-brown eggs to a clutch (DEC, 2005).

An assessment of impact criteria has been completed to assess potential impacts of the Project on the Australasian Bittern (Table B.5).

Table B.5 Assessment of impact criteria for the Australasian Bittern

Criteria	Discussion
1: long-term decrease in population size	Habitat in the study area for the Australasian Bittern is limited to farm dams and grasslands adjacent to waterbodies. It is likely that the Australasian Bittern utilises habitats of the study area only to forage while they are dispersing to more suitable habitats for breeding. The habitat present is considered to be of lower importance for this species, and as such its removal is not considered likely to cause a long-term decrease in population size.
2: reduce area of occupancy	The estimated area of occupancy for the Australasian Bittern is 1200 km² (DSEWPaC, 2012). Australasian Bittern habitat in the study area is limited to farm dams and grasslands adjacent to waterbodies. It is likely that the Australasian Bittern utilises habitats of the study area only to forage while they are dispersing to more suitable habitats for breeding. The habitat present is considered to be of lower importance for this species, and as such its removal is not considered likely to reduce the area of occupancy for this species.
3: fragment a population	Fragmentation is unlikely due to the presence of habitat opportunities along the length of Laheys and Sandy Creeks (mainly outside the impact area) and the high dispersal ability of these species.
4: adversely affect critical habitat	The study area is not considered to represent critical habitat for the Australasian Bittern as it breeds outside the area and foraging habitat is limited.
5: disrupt the breeding cycle of a population	The Project will remove potential breeding habitat (two large dams) for the Australasian Bittern. A new large rain water storage dam will be constructed prior to removal of these resources, which should compensate for the loss of any existing potential breeding habitat. The new storage dam will provide refuge in times of drought when pools in local creeks and farm dams dry out. There are many farm dams within the local area and therefore these types of water resources are not limited to the impact area. It is therefore considered that the breeding cycle of the Australasian Bittern will not be disrupted by the Project.
6: decrease availability or quality of habitat	Two large dams (covering approximately 9 ha) and providing potential habitat for the Australasian Bittern within the local area will be removed as a result of the Project. A new large storage dam will be built to compensate for this loss. Habitat in the study area for the Australasian Bittern is limited to farm dams and grasslands adjacent to waterbodies. It is likely that the Australasian Bittern utilises habitats of the study area only to forage while they are dispersing to more suitable habitats for breeding. As such, the habitat present is considered to be of lower importance for this species.
7: result in invasive species	European Red Foxes are known to prey upon of eggs and juveniles of the Australasian Bittern (Smith, Pressey and Smith, 1995), but the impact of this upon Australian populations of the Bittern is unknown. European Red Fox numbers may increase in remnant habitat areas as a result of the Project. Measures to restrict the spread of feral animals through the study area will be enacted to minimise this potential impact.

Table B.5 Assessment of impact criteria for the Australasian Bittern

Criteria	Discussion
8: introduce disease	The Australasian Bittern is not known to be susceptible to disease.
9: interfere with recovery	This species does not have a recovery plan, threat abatement plans or priority action statements. Recovery actions for the Australasian Bittern include protection of wetlands and water-courses from pollution, clearing or disturbance. The BMP will address these strategies.
Conclusion	The Project is not expected to result in significant impacts to the Australasian Bittern as: • only minor reductions in groundwater levels and surface water flows will occur in foraging habitat; and • potential breeding and foraging habitat will be retained in the form of large dams that will provide refuge in times of low surface water flow.

vi Endangered mammals: Spotted-tail Quoll (*Dasyurus maculatus maculatus*)

Potential habitat is present for the Spotted-tail Quoll in open woodlands that contain gullies, rocky escarpments and outcrops (Belcher 2000). It was recorded in 2006 along Spring Ridge Road. It utilises a range of habitats including open forest and open woodland. Shelters habitat available in caves, among rocks, hollow logs; low tree hollows (Edgar and Belcher 1995). Potential latrine and den sites are present in rocky outcrops and overhangs.

An assessment of impact criteria has been completed to assess potential impacts of the Project on this endangered mammal (Table B.6).

Table B.6 Assessment of impact criteria for endangered mammals

Criteria	Discussion
1: long-term decrease in population size	Maintenance of territories of female Spotted-tail Quolls (particularly their prey items, breeding dens and connectivity between these dens) are of critical importance to the conservation of the species, as the distribution of males appears to be largely influenced by the presence of breeding adult females (Belcher and Darrant, 2004). The local population should one occur, is likely to be temporarily impacted during the life of the mine within the study area. However, as this species has a large home-range size and is likely to be using it in association with other areas of woodland. If it is using the study area, the Project is unlikely to impact the long-term survival of the species within the region.
2: reduce area of occupancy	The Project may reduce the potential area of occupancy of this species by 1,027 ha during the life of the mine.
3: fragment a population	It is unlikely that the study area supports a local population of the species, given the availability of better quality habitat within nearby conservation areas. As such, individuals likely to use the study area as a movement corridor or supplementary habitat are unlikely to be directly impacted by the Project. This species uses landscape features such as vegetated creeklines for dispersal throughout its territory. Indirect impacts may fragment the corridors used by this species within the study area, should it occur. However, the design of the Project will minimise the fragmentation of riparian corridors.
4: adversely affect critical habitat	Habitat in the study area is not considered critical to the survival of the Spotted-tail Quoll as expected that they occur as vagrants or temporary visitors, moving between patches of habitat.
5: disrupt the breeding cycle of a population	The breeding cycle of this species may be disrupted through the removal of sparsely distributed potential breeding habitat within the study area. The breeding cycle may also be subject to disturbances adjacent to habitat including light, dust and noise, particularly for dispersing individuals looking for mates.
6: decrease availability or quality of habitat	Spotted-tail Quolls have large home ranges (620 – 2,560 ha for males and 90 - 650 ha for females (Claridge *et al*, 2005), making it difficult for individuals to disperse to alternative breeding sites outside the study area and causing intraspecific competition, should the study area represent an area of habitat for this species.
7: result in invasive species	The European Red Fox is known to prey upon the Spotted-tail Quoll (Murray and Poore, 2004). European Red Fox numbers may increase in remnant habitat areas as a result of the Project. Measures to restrict the spread of feral animals through the study area will be enacted to minimise this potential impact.
8: introduce disease	The Spotted-tail Quoll is not known to be susceptible to any diseases.

Table B.6 Assessment of impact criteria for endangered mammals

Criteria	Discussion
9: interfere with recovery	Maintenance of territories of female Spotted-tail Quolls (particularly their prey items, breeding dens and connectivity between these dens) are of critical importance to the conservation of the subspecies, as the distribution of males appears to be largely influenced by the presence of breeding adult females (Belcher and Darrant, 2004). Revegetation will aim to rehabilitate corridors within the study area during the mine life and after the mine.
Conclusion	The Project is not expected to result in significant impacts to the Spotted-tail Quoll as: • they have a low likelihood of occurrence in the study area due to non-detection during targeted surveys; and • the study area is not considered to constitute important habitat. It is expected that they occur as vagrants or temporary visitors, moving between patches of habitat.

vii Endangered fish: Trout Cod (*Maccullochella macquariensis*)

The natural range of the Trout Cod was historically throughout much of the upper reaches of the Murray-Darling drainage although now it is restricted to a few sites in south-eastern Australia (Morris *et al*, 2001). In NSW stocked populations exist in the Macquarie River at Dubbo but it is yet to be determined if these fish have established reproducing populations. Trout Cod have been recorded in the Macquarie River on as recently as 2007 (Primary Industries, 2012).

Trout Cod are often found in streams with a high abundance of submerged woody debris, in water that is deep and relatively close to riverbanks. The species feeds on aquatic insects, crustaceans, tadpoles and other fish. (McDowall, 1996).

Trout Cod have small home ranges and do not undertake large-scale spawning migrations, although they can disperse larger distances during flood events. Following day length and water temperature cues during spring and early summer mature trout cod form pairs and spawn (NSW DPI, 2002a, Koehn and Harrington, 2006).

An assessment of impact criteria has been completed to assess potential impacts of the Project on the Trout Cod (Table 8.7).

Table B.7 Assessment of impact criteria for the Trout Cod

Criteria	Discussion
1: long-term decrease in population size	Trout Cod are endemic to the southern Murray-Darling river system, including the Murrumbidgee and Murray Rivers, and upper Macquarie River. This species has undergone a dramatic decline in its distributional range and abundance over the past century, with the only known natural population being restricted to the Murray River from below Yarrawonga Weir to Strathmerton. The species is not known from the Cudgegong River. There are two historic reports of this species occurring naturally in the Macquarie River, up- and downstream of the confluence with the Talbragar, but no recent records. Hatchery-bred Trout Cod were released multiple in the upper Macquarie River in 2009, with further stocking in 2011. Trout Cod and are known to have been released into the Turon River, a tributary of the Macquarie River, in 1991 and 1993. There are no known stockings in the Talbragar River; however stocked Trout Cod could, in theory, use habitats in the river. The Project is unlikely to cause a long term decrease in the size of local and regional populations, as local populations are unlikely to occur and regional populations are already small in size.
2: reduce area of occupancy	Trout Cod have been recorded in several aquatic habitats. The existing self-sustaining populations are found in deep, flowing rivers with sand, silt or clay substrata and numerous snags and in relatively narrow streams with rock, gravel and sand substrata, and shallow pools interspersed with rapids and cascades. The Talbragar River contains suitable habitat, but that in Sandy and Laheys creeks is less suitable due to the ephemeral nature of the aquatic habitats. The Project would result overall in little change to water flow in the Talbragar, and hence would not cause a reduced area of occupancy for Trout Cod.
3: fragment a population	There is no evidence of an existing population within the Talbragar River, Sandy Creek, Laheys Creek or the Cudgegong River, and hence the Project is unlikely to cause the fragmentation of an existing population.
4: adversely affect critical habitat	Suitable habitat is present in the Talbragar, but not in Sandy and Laheys creek to any appreciable extent. Given that the Project will have very little overall impact on habitats in the Talbragar River, it is unlikely that the effects of the Project on habitat would be critical to the survival of this species.

Table B.7 Assessment of impact criteria for the Trout Cod

Criteria	Discussion
5: disrupt the breeding cycle of a population	It is not known whether any of the Trout Cod that have been released into the upper Macquarie River have survived to sexual maturity. Trout Cod are believed to pair up prior to spawning which takes place in late October to early November, when water temperatures reach about 16°C. Trout Cod are believed to deposit adhesive eggs on hard surfaces on or near the stream bottom. Larvae are thought to disperse downstream in the drift for a short distance, with peak dispersal occurring in November (Koehn and Harrington 2006). The environmental conditions favouring successful recruitment are not known. Given that the Project would have little overall impact on aquatic habitat in the Talbragar River, it is unlikely that it would disrupt the breeding cycle of a regional population.
6: decrease availability or quality of habitat	Potential temporary impacts on the quality of habitat resulting from increased sediment loading during construction would be minimised by application of appropriate erosion and sediment control measures. The Project would not substantially alter flows or cause excessive sedimentation in the Talbragar River, and it is consequently highly unlikely that the Project would change habitat availability and/or quality to such an extent that the species (if present) would decline.
7: result in invasive species	Populations of seven invasive fish species, Brown Trout (*Salmo trutta*), Brook Char (*Salvelinus fontinalis*), Eastern Gambusia (*Gambusia holbrooki*), European Carp (*Cyprinus carpio*), Goldfish (*Carassius auratus*), Rainbow Trout (*Oncorhynchus mykiss*) and Redfin Perch (*Perca fluviatilis*) are known to occur in the Talbragar and Cudgegong rivers. The abstraction of water from the Cudgegong River has very limited potential to entrain adults, larvae and eggs of invasive species, but their translocation to the Talbragar River is highly unlikely and irrelevant given existing populations of the same species in the Talbragar River. It is therefore highly unlikely that additional invasive species will become established as a result of the construction and operation of the proposed pipeline or water management regime of the Project.
8: introduce disease	The construction and operation of the Project does not include any mechanisms that would introduce disease.
9: interfere with recovery	The overall objective of the National Recovery Plan for Trout Cod is to minimise the probability of extinction in the wild, and increase the likelihood of important populations becoming self-sustaining in the long term. Potential for the Project to interfere with the recovery of the species depends on whether stocking of Trout Cod in the upper Macquarie River has led to the establishment of self-sustaining populations that would utilise aquatic habitats in the Talbragar River. The overall objective of the NSW Recovery Plan for Trout Cod is to ensure the recovery and natural viability of this species throughout its former range. The specific objectives of this plan that are pertinent to the Project are: • establishing and protecting stocked populations at selected locations throughout the species former range; • identifying management actions to minimise threats to populations. The recovery actions specified in the NSW Plan that is relevant to the Project is: • minimising habitat degradation and improving protection and rehabilitation of key habitat. The Project would have little impact on aquatic habitats and water quality within the Talbragar River, while providing a slight increase in flows during some operational phases. While the latter would not be a significant increase over the life of the Project, and increase in water flow would improve the access of Trout Cod to aquatic habitats within the Talbragar River, enhancing the recovery of the species by providing additional aquatic habitat.

Table B.7 Assessment of impact criteria for the Trout Cod

Criteria	Discussion
Conclusion	It is unlikely that the Project will impact on a local or regional population of Trout Cod. There is a possibility that the Project will slightly increase water flow in the Talbragar River, marginally improving access to habitats there that could be used by a stocked population of Trout Cod population, if one exists.

viii Vulnerable plants: *Homoranthus darwinioides*

A population of ***Homoranthus darwinioides***, comprising two sub-populations, was recorded within the study area. Sub-population one consisted of 227 individuals. Sub-population two was estimated at greater than 200 individuals (using counts from this study and Irvin and Bartus (2007)). Sub-population one is located near the CHPP and will be removed.

Sub-population two is located in Blue-leaved Ironbark Woodland where the dominant shrub species was Common Fringe-myrtle. Other species present included Silver-leaved Ironbark (*E. melanophloia*), Black Cypress Pine, *Allocasuarina gymanthera, Acacia triptera, Philotheca ciliata, Lomandra filiformis filiformis* and *Platysace linearifolia*. Bare ground in the area was approximately 15%, with canopy cover estimated at 20%, and there was extensive lichen cover on the ground.

H. darwinioides grows in various woodland habitats with shrubby understoreys, usually in gravely sandy soils. Sites where the species has been recorded include flat sunny ridge tops with scrubby woodland, sloping ridges, gentle south-facing slopes, and a slight depression on a roadside with loamy sand. It flowers in spring or from March to December. It has a localised distribution and may be the dominant under shrub at some sites. Its abundance ranges from rare (only one plant at site) to very locally abundant (DEC, 2005).

Two hundred and twenty seven plants will be removed as a result of the Project. An assessment of impact criteria has been completed to assess potential impacts of the Project to *H. darwinioides* (Table B.8).

Table B.8 Assessment of impact criteria for *Homoranthus darwinioides*

Criteria	Discussion
1: long-term decrease in population size	There is one record of *H. darwinioides* from Canberra. Not including this record, the *H. darwinioides* recorded within the study area is close to the southern distribution of the species, and is considered an important population. The Project will result in the removal of 227 individuals from the study area. Greater than 200 individuals will remain in the second subpopulation. The removal of 53 % of the local population may lead to a decrease in the size of an important population.
2: reduce area of occupancy	The known area of occupancy of *H. darwinioides* will be reduced by the Project. Additional populations of this species occur outside the locality.
3: fragment a population	The Project will not result in fragmentation of known or potential habitat for the species, as the two recorded sub-populations are already separated by more than 5 km.
4: adversely affect critical habitat	As the population in the study area is only one of three known populations, habitat in the study area may be critical to the survival of this species.

Table B.8 Assessment of impact criteria for *Homoranthus darwinioides*

Criteria	Discussion
5: disrupt the breeding cycle of a population	The Project will result in the removal of 53 % of known individuals of the species from the study area. The reproductive biology of this species is poorly understood. However, given the similarity between *Homoranthus* and the genus *Darwinia*, the species may self pollinate. Germination mechanisms of the species are not known and therefore it is unknown whether the Project will impact on germination, but it is considered unlikely. Increased dust levels could impact the growth phase of the species given the populations proximity to the southern mining operations. However, air quality modelling shows that this impact is likely to be minor. Given the lack of knowledge regarding pollination mechanism, it is unknown whether the Project will impact indirectly on the pollinators or dispersers of this species, or on ability of the species to germinate and grow. The removal of 53% of the local population means that the remaining local populations are at greater risk of extinction through stochastic impacts (eg bushfire). The need for genetic material from other subpopulations to increase or sustain genetic diversity has not been determined.
6: decrease availability or quality of habitat	The Project will remove 27 ha of known habitat for this species in the locality. Retained habitats may be susceptible to some indirect impacts including increased dust levels and edge effects in remnant habitat adjacent to active mining areas.
7: result in invasive species	The removal of native vegetation for the Project has the potential to increase weed invasion in the *H. darwinioide*s habitat at the study area. Detailed measures to control and suppress weeds will be included as part of the BMP.
8: introduce disease	Control of soil-borne disease will be included in the BMP. Wash-down procedures for vehicles entering the site will be included, to reduce the risk of introducing *Phytophthora cinnamomi* or other disease that could affect potential habitat of the species.
9: interfere with recovery	The Project is not consistent with the recovery of the species as it removes 53% of the known population from the study area.
Conclusion	The Project is expected to result in significant impacts to *H. darwinioides* because: • it removes 53% of known individuals from the local area; • removal of individuals from the locality increases the susceptibility of the local population to extinction from stochastic events; and • it is not consistent with recovery actions for the species. •

ix Vulnerable plants: *Rulingia procumbens*

Rulingia procumbens has been recorded near Dubbo and in Goonoo SCA. It was not recorded within the study area.

This species is mainly confined to the Dubbo-Mendooran-Gilgandra region and grows in sandy sites, often along roadsides. It has been recorded in Tumbledown Gum and Mugga Ironbark communities, Broombush scrub, under mallee eucalypts with a Fringe-myrtle understorey, and has been recorded in a recently burnt Ironbark and Callitris area (DEC, 2005). Fruiting occurs in summer and autumn (Harden, 2000).

The main identified threats to *R. procumbens* are clearing of native vegetation on roadsides; competition from woody shrubs, particularly wattle; and inappropriate fire regimes. This species should not be burnt more frequently than once every seven years (TSSC, 2008c).

The Project will not result in the removal of any known individuals from the study area. However, potential habitat exists within Tumbledown Gum, Mugga Ironbark and Dwyer's Red Gum Woodlands on sandy soils of the study area. The Project will remove approximately 74 ha of potential habitat for this species.

An assessment of impact criteria has been completed to assess potential impacts on *R. procumbens* (Table B.9).

Table B.9 Assessment of impact criteria for Rulingia procumbens

Criteria	Discussion
1: long-term decrease of an important population*	If *R. procumbens* were to occur within the study area it would be considered an important population, as the species would be close to its south-eastern distribution. The Project will result in removal of 74 ha of potential habitat for the species. No individuals were recorded within the study area and the Project is therefore considered unlikely to affect the life cycle of *R. Procumbens.*
2: reduce area of occupancy of an important population	The Project will result in removal of 74 ha of potential habitat for the species. No known individuals or habitat will be removed.
3: fragment an important population	The Project will result in fragmentation of potential habitat through changed land uses and development of mine pits. However, no known populations or habitat will be fragmented.
4: adversely affect critical habitat	As no individuals were detected in the study area, it is not expected to provide critical habitat for this species.
5: disrupt the breeding cycle of an important population	Life cycle of flora species can be affected in the following main ways: • impacts to pollination (internal mechanisms or impacts to pollinators) – pollinators are unknown for this species, however if the pollinators of the species are flies then it is considered unlikely that the Project would impact pollination mechanisms of *R. procumbens;* • ability of the plant to produce flowers – the Project is not expected to affect the ability of individual plants to produce flowers, this is more likely to be affected by other environmental effects such as rainfall; • ability of the plant to produce and set seed – the Project is not expected to impact the ability of the species to produce and set seed. • ability to germinate – the germination requirements of this species are not known; and

Table B.9 Assessment of impact criteria for Rulingia procumbens

Criteria	Discussion
	• ability of seedlings to grow – the Project could produce high levels of dust which could affect photosynthesis capabilities and growth of seedlings and adult plants. The Project will not remove known habitat or individuals of this species and is unlikely to impact pollinators. Potential habitat for the species occurs in sandy open woodlands, of which approximately 74 ha will be impacted. However, no individuals of the species were recorded in these areas. The Project is therefore considered unlikely to affect the breeding cycle of *R. procumbens*, if it were to occur and be retained within the study area.
6: modify, destroy, remove or isolate or decrease availability or quality of habitat	The Project will remove approximately 74 ha of potential habitat for the species. No known habitat for this species will be removed. Retained habitats will be susceptible to indirect impacts including increased dust levels and edge effects in areas adjacent to the proposed mine areas.
7: result in invasive species	The removal of native vegetation for the Project has the potential to increase weed invasion in potential habitats for *R. procumbens*. Detailed measures to control and suppress weeds will be included within the BMP.
8: introduce disease	Control of soil-borne disease will be included as part of the BMP. Wash-down procedures for weeds and soil will be included, to reduce the risk of introducing *Phytophthora cinnamomi* or other disease that could affect potential habitat of the species.
9: interfere with recovery	There are no known occurrences of this species within the study area. The Project is therefore considered unlikely to interfere substantially with the recovery of the species.
Conclusion	The Project is not expected to result in significant impacts to *R. procumbens* because: • it does not remove any known individuals from the local area; and • indirect impacts to potential habitats retained within the study area will be managed according to the BMP.

x Vulnerable flora: *Philotheca ericifolia*

Philotheca ericifolia is listed as vulnerable under the EPBC Act and it is known from Goonoo SCA. It has not been recorded within the study area. It grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies. Potential habitat for the species occurs in the open woodland where moisture collects such as along drainage depressions. It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. Associated species include *Melaleuca uncinata,* Narrow-leaf Ironbark, Scribbly Gum, Grey Gum and *Philotheca australis* (DEC, 2005).

Flowering time is in the spring. A range of insect pollinators have been observed on the members of the Rutaceae family in the Sydney region and most genera have a range of insect pollinators with a particular group of insects being the main pollinators eg *Philotheca* spp. (mostly butterflies, occasionally beetles, flies, bees or moths) (Auld, 2001).

An assessment of impact criteria has been completed to assess potential impacts on *P. ericifolia* (Table B.10).

Table B.10 Assessment of impact criteria for *Philotheca ericifolia*

Criteria	Discussion
1: long-term decrease of an important population*	If *P. ericifolia* occurred at the study area, it would not be considered and important population as the species is not near or at the extent of its known distribution, it has not been identified as an important population in the literature and it would be unlikely to be an important population genetically.
2: reduce area of occupancy of an important population	*P. ericifolia* is not known from the study area and would not be considered to be an important population if it did occur there.
3: fragment an important population	*P. ericifolia* is not known from the study area and would not be considered to be an important population if it did occur there.
4: adversely affect critical habitat	As no individuals were detected in the study area, it is not expected to provide critical habitat for this species.
5: disrupt the breeding cycle of an important population	*P. ericifolia* is not known from the study area and would not be considered to be an important population if it did occur there.
6: modify, destroy, remove or isolate or decrease availability or quality of habitat	The Project will not result in the removal of any known individuals from the study area. However, potential habitat exists for this species in parts of the dry woodlands of the study area where moisture collects. Retained habitats will be susceptible to indirect impacts including increased dust levels and edge effects.
7: result in invasive species	The removal of native vegetation for the Project has the potential to increase weed invasion in potential habitats for *P. ericifolia*. Detailed measures to control and suppress weeds will be included within the BMP.
8: introduce disease	Control of soil-borne disease will be included as part of the BMP. Wash-down procedures for weeds and soil will be included, to reduce the risk of introducing *Phytophthora cinnamomi* or other disease that could affect potential habitat of the species.
9: interfere with recovery	There are no known occurrences of this species within the study area. The Project is therefore considered unlikely to interfere with the recovery of the species.

Table B.10 Assessment of impact criteria for *Philotheca ericifolia*

Criteria	Discussion
Conclusion	The Project is not expected to result in significant impacts to *P. ericifolia* because: • it does not remove any known individuals from the local area; and • indirect impacts to potential habitats retained within the study area will be managed according to the BMP.

xi Vulnerable woodland birds: Superb Parrot

The Superb Parrot was recorded throughout the study area following a mass flowering event in the locality. Foraging habitat for this species within the study area was recorded in Box Woodlands and Ironbark/Stringybark Woodland. Nesting habitat is available in hollows of large trees (dead and alive) in open Box Gum Woodland and in isolated paddock trees. Potential nest tree species are present within the study area and include Blakely's Red Gum and Yellow Box, although core breeding habitat is at least 200 km to the south of the study area (DEC, 2005). However no individuals were recorded to be breeding within the study area, despite the species being recorded in the study area during the breeding season. This species nests in small colonies, often with more than one nest in a single tree. Breeding occurs between September and January (DEC, 2005).

An assessment of impact criteria has been completed to assess potential impacts of the Project on this vulnerable woodland bird (Table B.11).

Table B.11 Assessment of impact criteria for Superb Parrot

Criteria	Discussion
1: long-term decrease of an important population	The Superb Parrot exists as a single population throughout its range (DSEWPaC, 2012). The Superb Parrot occurs in the study area as individuals possibly dispersing from breeding areas further south (Webster, 1988; Webster and Ahern, 1992). The Superb Parrot is threatened by clearing of wooded corridors that the species relies on when moving between breeding and non-breeding habitats (DSEWPaC, 2012). 1,800 ha of potential foraging habitat (non-breeding) will be removed for the Project. However given the large size of this population, this loss will not impact its long-term survival.
2 : reduce area of occupancy of an important population	The study area is not considered to constitute an important population as it does not occur near the known range for this species or in an important breeding area.
3: fragment an important population	This species is migratory and has a high dispersal capability. It occurs in the study area only after the breeding season to forage. Therefore, the Project will not fragment the population.
4: adversely affect critical habitat	As this species completes its lifecycle outside the study area and forages over a wide area, habitat in the study area is not considered critical to its survival.
5: disrupt the breeding cycle of an important population	The key breeding areas are in the Riverina and South-west Slopes Regions of NSW, and spill over from there into northern Victoria. The Superb Parrot occurs in the Central-west as individuals possibly emanating from breeding areas further south, and coincides with part of the population vacating these southern areas (Webster, 1988; Webster and Ahern, 1992). Therefore, the breeding cycle of the Superb Parrot will not be disturbed by the Project as it breeds outside the study area.
6: decrease availability or quality of habitat	The Project requires the clearing of 1,800 ha of foraging habitat for this species during its non-breeding season.
7: result in invasive species	This species is subject to competition from feral honeybees. However, the Project is unlikely to result in the increase of honeybees in the study area and its surrounds.
8: introduce disease	This species is subject to *Psittacine Circoviral* (Beak and Feather) Disease. The Project is not considered to increase the incidence of this disease.

Table B.11 Assessment of impact criteria for Superb Parrot

Criteria	Discussion
9: interfere with recovery	A relevant action from the National Recovery Plan for the Superb Parrot (Baker-Gabb, 2011) is to protect Box Gum Woodland from clearing and degradation within the range of the Superb Parrot, with special emphasis on woodlands within 10 km of colonies. The BMP will minimise the potential impact of foraging habitat loss and the disturbed areas will be rehabilitated progressively over the life of the mine.
Conclusion	The Project is not expected to result in significant impacts to the Superb Parrot as: • they are unlikely to breed in the study area; and • they are a highly mobile and nomadic species that utilise different habitat areas at different times of year.

xii Vulnerable mallee birds: Malleefowl

The Malleefowl was not recorded within the study area. However, several old incubation mounds (probably over 200 years old (M. Irvin, OEH *pers comm*, 2012)) that were likely to have been constructed by this species were observed in the study area to the south of the infrastructure area. This species is known to occur in Goonoo SCA and was recorded in 2000 in Yarrobil NP.

Potential habitat for the species is present in Dwyer's Red Gum Woodland in the north of the study area, which has a Mallee-type vegetation structure. Habitat is also available in Grey Box and Ironbark woodland with thick understorey and Cypress Pine woodland, where it is less commonly found (Benshemesh, 2007). Nesting habitat is available in areas of sandy soils and dense but discontinuous shrub layer. Malleefowl construct mounds in autumn to spring. Egg-laying usually begins in September and an egg is laid every 5-7 days until mid to late summer. The incubation period is about 60 days and chicks begin hatching in November. Although hatching may continue until March in some seasons, most chicks usually emerge from mounds before January (Benshemesh, 2007). An assessment of impact criteria has been completed to assess potential impacts of the Project on this vulnerable mallee bird (Table B.12).

Table B.12 Assessment of impact criteria for Malleefowl

Criteria	Discussion
1: long-term decrease of an important population	Not enough is known about Malleefowl populations to identify the importance of one population over another (Benshemesh, 2007). Historic breeding areas have been identified within the study area for this species, however no evidence of their use was observed within the breeding period.
2: reduce area of occupancy of an important population	If a Malleefowl population is still present, the Project would reduce its area of occupancy by 73 ha.
3: fragment an important population	The local Malleefowl population (if it is still present) would be isolated from populations in Goonoo SCA to the north-east of the study area. If present, the Project may increase fragmentation between the conservation reserves and the study area population. However, given the lack of sightings of this species and the lack of evidence of use of existing mounds during the breeding season suggests that a local population no longer exists within the study area.
4: adversely affect critical habitat	The habitat requirements of Malleefowl are poorly understood. A sandy substrate and abundance of leaf litter are clear requirements for the construction of Malleefowl incubator nests, and they are generally greatest in areas of higher rainfall where shrub diversity is greatest (Benshemesh, 2007). Such habitat occurs within the study area but is not considered to constitute critical habitat for this species as it was not detected during targeted surveys.
5: disrupt the breeding cycle of an important population	Historic breeding habitat for the Malleefowl will be removed as a result of the Project. Breeding Malleefowl tend to be sedentary, nesting in the same area year after year (Benshemesh, 2007). As no active nests were observed during the breeding season for this species, it is considered unlikely that this species is breeding within the study area and therefore the Project is unlikely to impact on the lifecycle of this species.
6: decrease availability or quality of habitat	73 ha of low potential habitat will be removed for the Project. If a population of this species exists in the study area, it is likely that the removal of this habitat would cause the species to decline in the locality.
7: result in invasive species	The Malleefowl is known to be subject to predation by the European Red Fox. To minimise this potential impact, the BMP will detail measures to limit the occurrence of this introduced predator in the study area.
8: introduce disease	There is no information on disease in wild Malleefowl populations (Benshemesh, 2007).

Table B.12 Assessment of impact criteria for Malleefowl

Criteria	Discussion
9: interfere with recovery	A relevant objective in the National Recovery Plan (Benshemesh, 2007) is to reduce habitat loss. The Project is not consistent with this objective, as potential breeding habitat is being removed.
Conclusion	The Project is not expected to result in significant impacts to the Malleefowl as their likelihood of occurrence in the study area is low due to non-detection during targeted surveys.

xiii Vulnerable bats: Large-eared Pied Bat (*Chalinolobus dwyeri*) and Southern Long-eared Bat (*Nyctophilus corbeni*)

The **Large-eared Pied Bat** was recorded along Spring Ridge Road and in Yarrobil National Park (OEH, 2010). Roosting habitat for this species is available in crevices and overhangs in sandstone cliffs (Dwyer, 1966). Potential foraging habitat is present in Box Gum Woodlands and creek flats (DECC, 2007). Males can roost alone or in small groups during torpor in winter. Females form maternity colonies from November to February in the roof domes of sandstone caves. Females show high fidelity to maternity caves (Churchill, 2008).

The **Southern Long-eared Bat** was recorded in Box Woodlands adjacent to an area of Scribbly Gum Woodland in the study area. Habitat opportunities are present for this species in box, ironbark and Cypress open forests. Roosting habitat within the study area is available in the hollows of live trees, which could also be used as maternity sites.

An assessment of impact criteria has been completed to assess potential impacts on these bats (Table B.13).

Table B.13 Assessment of impact criteria for vulnerable flying-mammals

Criteria	Discussion
1: long-term decrease of an important population	No important populations of the Large-eared Pied Bat are known to occur in the study area. Important populations have not been identified for the Southern Long-eared Bat. However this species has a higher detection rate in the Brigalow Belt South Bioregion, in which the study area is located and is likely to represent preferred habitat and therefore potentially important populations. The clearing of woodland habitats is known to be the main reason behind the decline of the Southern Long-eared Bat. Therefore, the temporary removal of woodland habitat may lead to a long-term decrease in the population in the locality, particularly as this species utilises old-growth forest features (hollows) for roosting and breeding.
2: reduce area of occupancy of an important population	Neither local population of bat have been identified as an important population. However, the Project will temporarily reduce the area of habitat and habitat features important for these species within the locality.
3: fragment an important population	Southern Long-eared Bats and Large-eared Pied Bats in the study area are already isolated from other populations in Goonoo SCA and Goulburn River NP. Removal of woodland habitat would temporarily increase fragmentation between surrounding conservation reserves, potentially fragmenting known populations.
4: adversely affect critical habitat	The Project will remove foraging, roosting and potential breeding habitat for these species. As such, it may adversely affect habitat critical to their survival in the locality.
5: disrupt the breeding cycle of an important population	Potential breeding habitat for the Large-eared Pied Bat may be impacted by the Project. This may affect breeding success, limit recruitment and decrease the local population size in the long-term for the Large-eared Pied Bat which was recorded within the study area. Breeding habitat in the study area is sub-optimal for the Large-eared Pied Bat as large and well developed sandstone outcrops are absent. However, it is possible that small colonies of this species exist and breed within the area (Glenn Hoye *pers comm*, 2012; Michael Pennay *pers comm*, 2012). Hollow-bearing trees are considered a limited resource within the study area and the removal of this resource within the impact area may be significant for these species given the likely competition for such resources in the landscape. Potential breeding habitat will be removed for the Southern Long-eared Bat, which may affect breeding success, limit recruitment and decrease the local population size in the long-term.

Table B.13 Assessment of impact criteria for vulnerable flying-mammals

Criteria	Discussion
6: decrease availability or quality of habitat	Foraging habitat is widely distributed within the study area, with sheltering habitat and potential breeding habitat occurring in more restricted areas, only on ridgelines in woodland. Up to 1,800 ha of woodland representing foraging habitat for these species and approximately 16 km of ridgeline will be removed for the Project. If present, breeding habitat for the Large-eared Pied bat would be considered important. This has not been confirmed within the study area and is considered to be unlikely given the sub-optimal conditions.
7: result in invasive species	The BMP will detail measures to limit the introduction and spread of invasive species in the study area.
8: introduce disease	Bat species are prone to Australian Bat Lyssavirus. However, this virus has not been isolated from either of these species.
9: interfere with recovery	Recovery actions for the Southern Long-eared Bat focus on gaining a better understanding of the species ecology (Schulz and Lumsden, 2010). The Project does not directly interfere with this objective. A relevant objective to the Project for the Large-eared Pied Bat is the protection of all known roost sites (Environment Australia, 1999). It is likely that sub-optimal overwintering roost sites are present in the sandstone escarpments of the study area. Therefore, the removal of these potential roosts may interfere with the recovery of the species. The use of artificial cave roosts will be investigated in the BMP.
Conclusion	The Project is expected to result in significant impacts to the Southern Long-eared Bat and Large-eared Pied Bat as: • it removes a large area of known foraging habitat; • it removes significant breeding features (large hollow-bearing trees) for the Southern Long-eared Bat; • it removes 16 km of potential breeding and roosting habitat for the Large-eared Pied Bat; and • it is not consistent with the recovery of the species.

xiv Vulnerable arboreal mammals: Koala (*Phascolarctos cinereus*)

The Koala was not recorded within the study area. It was recorded in 2006 in Ironbark forest at Goonoo SCA. Potential habitat is available for the Koala in ironbark woodlands and riparian woodlands. This species breeds between September and December (DECCW, 2008). As this species is known to be rare within the locality the lack of records in the study area is not considered to represent the absence of this species and therefore it is assumed it occurs. However, it is likely that the study area does not constitute an important population of the species and this species may be utilising habitat present as part of a larger movement corridor and its extended home range.

An assessment of impact criteria has been completed to assess potential impacts on the Koala (Table B14).

Table B.14 Assessment of impact criteria for the Koala

Criteria	Discussion
1: long-term decrease of an important population	An important population of the Koala does not occur in the study area.
2: reduce area of occupancy of an important population	An important population of the Koala does not occur in the study area.
3: fragment an important population	An important population of the Koala does not occur in the study area.
4: adversely affect critical habitat	As no individuals were detected during targeted surveys, habitat in the study area is not considered critical to the survival of the Koala.
5: disrupt the breeding cycle of an important population	An important population of the Koala does not occur in the study area.
6: decrease availability or quality of habitat	The Project will remove 169 ha of potential Koala habitat but will also rehabilitate 1,900 ha of woodland which would provide sheltering and foraging habitat for this species into the future.
7: result in invasive species	The Koala is known to be subject to predation by domestic dogs. The Project is not considered to increase the threat of this species to the Koala as it is located away from built up areas.
8: introduce disease	The Koala is known to be susceptible to Chlamidia There is circumstantial evidence that chlamydiosis might increase in response to environmental stresses such as overcrowding and poor nutrition (Melzer, Carrick, Menkhorst, Lunney and John, 2000). As Koalas are considered to be a vagrant species in the study area, the Project is unlikely to cause environmental stress such that a disease outbreak would occur.
9: interfere with recovery	A recovery plan for the Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) will be developed and is to commence following the expiration of the National Koala Conservation and Management Strategy in 2014. A recovery action relevant to the Project from the Koala Recovery Plan (DECCW, 2008) is to revegetate and rehabilitate koala habitats. The Project will remove 169 ha of potential Koala habitat but will also rehabilitate 1,900 ha of woodland which would provide sheltering and foraging habitat for this species into the future.

Table B.14 Assessment of impact criteria for the Koala

Criteria	Discussion
Conclusion	The Project is not expected to result in significant impacts to the Koala as: • this species has a low likelihood of occurrence in the study area due to non-detection during targeted surveys; and • the study area is not considered to constitute important habitat for this species. It is expected to occur as vagrants or temporary visitors moving between patches of habitat.

xv Vulnerable fish: Murray Cod (*Maccullochella peelii peelii*)

Murray Cod are found in a range of habitats, from small, clear, rocky streams in the upper-western slopes of NSW to turbid, slow-flowing lowland rivers of the western plains (Morris et al. 2001). The species prefers deeper holes near cover such as fallen trees, rocks and overhanging vegetation. Larvae and juvenile Murray Cod feed on zooplankton and aquatic insects whereas adults feed on other fishes, crustaceans and molluscs Koehn and O'.Connor 1990).

The species is relatively sedentary during late summer, autumn and winter but during spring and early summer when waters reach temperatures between 16 – 21^{o}C the Murray Cod migrates large distances (up to 120 km) upstream to spawn. Seasonal floods are important in stimulating these spawning migrations (McDowall 1996, Koehn and Harrington 2006).

An assessment of impact criteria has been completed to assess potential impacts to the Murray Cod (Table B.15).

Table B.15 Assessment of impact criteria for the Murray Cod

Criteria	Discussion
1: long-term decrease of an important population	Murray Cod were naturally widespread throughout the entire Murray-Darling Basin and abundant, particularly in the lower and mid-altitude reaches (Lintermans 2007). Overfishing, river regulation, sedimentation and barriers to passage have caused a dramatic decline in their abundance and the species now has a patchy distribution across its historical range. Murray Cod are generally associated with deep 'holes' and submerged woody debris or undercuts, and are sedentary sit and wait predators. However, during late winter/ early spring they migrate for distances of up to 80 – 120 km to spawn following seasonal floods or high flows (Morris et al. 2001, Lintermans 2007). In spring/summer they spawn in relatively small anabranch streams, laying their adhesive eggs on snags, rocks or clay banks (Lintermans 2007).
2: reduce area of occupancy of an important population	There are a number of recent records of Murray Cod from the Macquarie River downstream of the Talbragar River. The species has been stocked in this reach and it can be difficult to ascertain if an observed individual was wild or hatchery-reared (Morris et al. 2001). There are no formal records of Murray Cod from the Study Area but the author has heard anecdotal accounts of historical observations of Murray Cod by residents along the Talbragar River. Given the proximity of Murray Cod to the unregulated Talbragar River and the size of their spawning migrations the Talbragar River (and potentially Sandy Creek) would constitute possible spawning habitat during an appropriately timed flow event. However, given that these rivers now have no flow approximately 35 – 40% of the time (partly due to extraction within the catchment), it is possible that isolated individuals could persist in some of the Study Area's deeper and more cryptic pools, but unlikely that a reproducing, viable population had become established.
3: fragment an important population	There is no evidence of an existing population within the Talbragar River, Sandy Creek, Laheys Creek or the Cudgegong River, and hence the Project is unlikely to cause the fragmentation of an existing population.
4: adversely affect critical habitat	The potential threats to Murray Cod represented by the Project include: alterations to the natural flow regime, removal of large woody debris, construction of instream barriers to passage, degradation of habitat from sedimentation and loss of habitat. The installation of appropriate drainage structures at road, rail and pipeline crossings should ensure there is no detrimental effect on Murray Cod passage. Whilst the existing structures in the Talbragar River do represent a barrier to passage the majority of habitat upstream of these is ephemeral and it is unlikely Murray Cod would attempt or benefit from access. Recommendations relating to woody debris and sediment control should mitigate any potential impacts from these threats.

Table B.15 Assessment of impact criteria for the Murray Cod

Criteria	Discussion
5: disrupt the breeding cycle of an important population	Alterations to flow usually reduce Murray Cod recruitment. Changes to the size, frequency, duration and seasonality of floods can mask spawning cues, reduce the availability of productive flooded areas for nursery habitat and impede upstream fish passage to spawning sites. The Project would alter the natural flow regime of the Study Area. However, the predicted reduction in flow would have the greatest effect during periods of low to zero flow, when the Murray Cod are least likely to initiate upstream spawning migrations, and hence the reduction in frequency of low flows is not likely to impact on Murray Cod. The loss of some groundwater fed pools could result in mortality to some adult Murray Cod if they had become trapped in them as water levels fell, however most adults spawning in the area would probably return to home sites downstream. It is also possible that sediment dams might capture or alter the hydrology of smaller storm events (i.e. sediment dams can contain the 95th percentile five day event), which could hypothetically conceal a flood signal, but this would probably have little effect on peak flows in the Talbragar River if the rest of the catchment was in flood.
6: decrease availability or quality of habitat	Potential temporary impacts on the quality of habitat resulting from increased sediment loading during construction would be minimised by application of appropriate erosion and sediment control measures. The Project would not substantially alter flows or cause excessive sedimentation in the Talbragar River, and it is consequently highly unlikely that the Project would change habitat availability and/or quality to such an extent that the species (if present) would decline.
7: result in invasive species	Populations of seven invasive fish species, Brown Trout, Brook char, Eastern Gambusia, European Carp, Goldfish, Rainbow Trout and Redfin Perch are known to occur in the Talbragar and Cudgegong rivers. The abstraction of water from the Cudgegong River has very limited potential to entrain adults, larvae and eggs of invasive species, but their translocation to the Talbragar River is highly unlikely and irrelevant given existing populations of the same species in the Talbragar River. It is therefore highly unlikely that additional invasive species will become established as a result of the construction and operation of the proposed pipeline or water management regime of the Project.
8: introduce disease	The construction and operation of the Project does not include any mechanisms that would introduce disease.
9: interfere with recovery	The overall objective of the National Recovery Plan for Murray Cod is to rehabilitate Murray Cod populations in the Murray Darling Basin to 60% (or better) of their estimated pre-European settlement levels after 50 years of implementation. Remnant pools within Talbragar River, and, to a lesser extent those in Sandy and Laheys creeks represent potential aquatic refugia for Murray Cod. Hence the Project has potential to interfere with the recovery of the species if it reduces the quantity and quality of pool refugia that Murray Cod may use as refugia in periods of low flow. The recovery actions specified in the Recovery Plan that is relevant to the Project is to identify, protect and repair key aquatic and riparian habitats for Murray Cod in each Spatial Management Unit. The Project would have little impact on aquatic habitats and water quality within the Talbragar River, while providing a slight increase in flows during some operational phases. While the latter would not be a significant increase over the life of the Project, and increase in water flow would improve the access of Murray Cod to aquatic habitats within the Talbragar River, enhancing the recovery of the species by providing additional aquatic refugia.
Conclusion	The key threats that the Project poses to Murray Cod relate to; alterations to natural flow regime, removal of large woody debris, creation of barriers to passage and increased sedimentation. These potential impacts can be minimised or eliminated by implementing the suggested recommendations. As such, the assessment of significance found that the proposal would be unlikely to significantly affect Murray Cod.

xvi Migratory birds: Rainbow Bee-eater (*Merops ornatus*), Cattle Egret (*Ardea ibis*) and Great Egret (*A. modesta*)

Habitat is present for the **Rainbow Bee-eater** within woodlands and grasslands of the study area. It breeds outside the study area on Rottnest Island (Western Australia) and islands in the south west Torres Strait (DSEWPaC, 2012).

The **Cattle Egret** was recorded in the study area. Habitat exists in the study area for this speices in dry grassland or ploughed paddocks and farm dams. Breeding occurs outside the study area from the central east coast to Bundaberg, and in inland wetlands including the Macquarie Marshes (DSEWPaC, 2012).

The **Great Egret** was recorded in the study area. Habitat exists in the study area for this species in dry grassland or ploughed paddocks and farm dams. Breeding occurs outside the study area, in the Northern Territory (DSEWPaC, 2012).

An assessment of impact criteria has been completed to assess potential impacts on these migratory birds (Table B.16).

Table B.16 Assessment of impact criteria for migratory birds

Criteria	Discussion
1: substantially modify important habitat	The study area does not constitute an area of important habitat for these species, as an ecologically significant proportion (as defined under the guidelines (DEH, 2006) of their populations do not reside in the study area, no breeding occurs in the area, it is not at the limit of their range and they are not known to be declining in the study area.
2 : result in invasive species	These migratory species are known to be subject to predation by the European Red Fox. To minimise this potential impact, the BMP will detail measures to limit the occurrence of this introduced predator in the study area.
3: disrupt lifecycle of ecologically significant proportion of population	An ecologically significant proportion of these species do not reside in the study area. In addition, they do not breed in the study area, foraging habitat is sub-optimal and the Project is unlikely to disrupt their migration patterns.
Conclusion	The Project is not expected to result in significant impacts to the migratory bird species as: • an ecologically significant proportion of the species is not known to reside in the study area; and • the study area does not contain important habitat for the species.

xvii Migratory birds: Malleefowl (*Leipoa ocellata*) and Regent Honeyeater (*Anthochaera phrygia*)

A description of the Malleefowl and Regent Honeyeater is provided in Section B.1.5 (xii) and (iv), respectively. An assessment of impact criteria has been completed to assess potential impacts on these migratory birds (Table B.17).

Table B.17 Assessment of impact criteria for migratory birds

Criteria	Discussion
1: substantially modify important habitat	The study area does not constitute an area of important habitat for these species, as an ecologically significant proportion (as defined under the guidelines (DEH, 2006) of their populations do not reside in the study area, no breeding occurs in the area, it is not at the limit of their range and they are not known to be declining in the study area.
2 : result in invasive species	Malleefowl is known to be subject to predation by the European Red Fox. The Regent Honeyeater is known to be subject to grazing by rabbits (DSEWPaC, 2012). To minimise these potential impacts, the BMP will detail measures to limit the occurrence of this introduced predator in the study area.
3: disrupt lifecycle of ecologically significant proportion of population	An ecologically significant proportion of these species do not reside in the study area. These species have a low likelihood of occurrence due to non-detection during targeted surveys. Therefore, habitat in the study area is not considered important to the lifecycle of either species.
Conclusion	The Project is not expected to result in significant impacts to these migratory bird species as: • an ecologically significant proportion of the species is not known to reside in the study area; and • the study area does not contain important habitat for the species.

Appendix E

Species recorded

Table E.1 Flora species recorded within the study area

Family	Scientific Name	Common Name
ADIANTACEAE	*Cheilanthes sieberi* subsp. *sieberi*	Mulga Fern
AMARANTHACEAE	*Alternanthera denticulata*	Lesser Joyweed
AMARANTHACEAE	*Dysphania glomulifera* subsp. *glomulifera*	
AMARANTHACEAE	*Maireana microphylla*	Small-leaf Bluebush
ANACARDIACEAE	*Schinus areira**	Pepper Tree
ANTHERICACEAE	*Laxmannia gracilis*	Slender Wire Lily
ANTHERICACEAE	*Tricoryne elatior*	Yellow Rush-lily
APIACEAE	*Daucus glochidiatus*	Native Carrot
APIACEAE	*Hydrocotyle laxiflora*	Stinking Pennywort
APIACEAE	*Hydrocotyle peduncularis* sterile	
APIACEAE	*Platysace ericoides*	
APIACEAE	*Cyclospermum leptophylla**	Slender Carrot
APOCYNACEAE	*Tylophora linearis*[#]	
ASPHODELACEAE	*Bulbine semibarbata*	Native Leek
ASTERACEAE	*Actinotus helianthi*	Flannel Flower
ASTERACEAE	*Brachyscome ciliaris*	
ASTERACEAE	*Brachyscome formosa*	Pillaga Posy
ASTERACEAE	*Calotis cuneifolia*	Purple Burr-daisy
ASTERACEAE	*Calotis lappulacea*	Yellow Burr-daisy
ASTERACEAE	*Cassinia arcuata*	Sifton Bush
ASTERACEAE	*Cassinia laevis*	Cough Bush
ASTERACEAE	*Cassinia laevis* subsp. *rosmarinifolius*	Rosemary Bush
ASTERACEAE	*Chrysocephalum apiculatum*	Common Everlasting
ASTERACEAE	*Chrysocephalum semipapposum*	Yellow Buttons
ASTERACEAE	*Cotula australis*	Common Cotula
ASTERACEAE	*Cymbonotus lawsonianus*	Bears Ear
ASTERACEAE	*Euchiton* sp.	
ASTERACEAE	*Euchiton sphaericus*	
ASTERACEAE	*Olearia microphylla*	
ASTERACEAE	*Ozothamnus diosmifolius*	Rice Flower
ASTERACEAE	*Senecio quadridentatus*	Cotton Fireweed
ASTERACEAE	*Senecio tenuiflorus*	Slender Fireweed
ASTERACEAE	*Solenogyne bellidioides*	
ASTERACEAE	*Stuartina* sp.	Cudweed
ASTERACEAE	*Triptilodiscus pygmaeus*	Common sunray
ASTERACEAE	*Veronica plebeia*	Trailing Speedwell
ASTERACEAE	*Xerochrysum viscosum*	Sticky Everlasting
ASTERACEAE	*Arctotheca calendula**	Capeweed

Table E.1 Flora species recorded within the study area

Family	Scientific Name	Common Name
ASTERACEAE	*Cirsium vulgare**	Spear Thistle
ASTERACEAE	*Conyza albida**	Fleabane
ASTERACEAE	*Conyza bonariensis**	Fleabane
ASTERACEAE	*Conyza sp.**	Fleabane
ASTERACEAE	*Gamochaeta americana**	Cudweed
ASTERACEAE	*Hypericum perforatum**	St John's Wort
ASTERACEAE	*Hypochaeris glabra**	Smooth Catsear
ASTERACEAE	*Hypochaeris radicata**	Catsear
ASTERACEAE	*Soliva sessilis**	Bindyi
ASTERACEAE	*Sonchus asper**	Prickly Sowthistle
BORAGINACEAE	*Cynoglossum suaveolens*	
BORAGINACEAE	*Echium plantagineum**	Paterson's Curse
BRASSICACEAE	*Rorippa laciniata*	
BRASSICACEAE	*Lepidium africanum**	
BRASSICACEAE	*Lepidium bonariense**	
BRASSICACEAE	*Sisymbrium orientale**	Indian Hedge Mustard
CACTACEAE	*Opuntia stricta**	Common Prickly Pear
CAMPANULACEAE	*Isotoma axillaris*	Rock Isotome
CAMPANULACEAE	*Isotoma fluviatilis*	Swamp Isotome
CAMPANULACEAE	*Wahlenbergia communis*	Tufted Bluebell
CAMPANULACEAE	*Wahlenbergia gracilenta*	Annual Bluebell
CAMPANULACEAE	*Wahlenbergia gracilis*	Sprawling Bluebell
CAMPANULACEAE	*Wahlenbergia* sp.	
CAMPANULACEAE	*Wahlenbergia stricta* subsp. *stricta*	Australian Bluebell
CAMPANULACEAE	*Walwhalleya subxerophila*	Gilgai Grass
CARYOPHYLLACEAE	*Moenchia erecta**	Erect Chickweed
CARYOPHYLLACEAE	*Paronychia brasiliana**	Brazilian Whitlow
CARYOPHYLLACEAE	*Paronychia* sp.*	
CARYOPHYLLACEAE	*Polycarpon tetraphyllum**	Four-leaved Allseed,
CARYOPHYLLACEAE	*Stellaria media**	Common Chickweed
CASUARINACEAE	*Allocasuarina diminuta* subsp. *diminuta*	
CASUARINACEAE	*Allocasuarina gymnanthera*	
CASUARINACEAE	*Allocasuarina leuhmannii*	Bulloke
CASUARINACEAE	*Allocasuarina littoralis*	Black She-oak
CHENOPODIACEAE	*Einadia hastata*	Berry Saltbush
CHENOPODIACEAE	*Einadia nutans* subsp. *nutans*	Climbing Saltbush
CONVULVULACEAE	*Dichondra repens*	Kidney Weed
CONVULVULACEAE	*Dichondra* sp. A	Kidney Weed

Table E.1 Flora species recorded within the study area

Family	Scientific Name	Common Name
CUPRESSACEAE	*Callitirs endlicheri*	Black Cypress Pine
CUPRESSACEAE	*Callitris glaucophylla*	White Cypress Pine
CYPERACEAE	*Carex appressa*	Tall Sedge
CYPERACEAE	*Carex inversa*	
CYPERACEAE	*Cyperus eragrostis*	
CYPERACEAE	*Fimbristylis dichotoma*	Common Fringe-sedge
CYPERACEAE	*Gahnia aspera*	Rough Saw-sedge
CYPERACEAE	*Lepidosperma laterale*	Sword Sedge
CYPERACEAE	*Schoenus apogon*	Common Bog-rush
CYPERACEAE	*Scleria mackaviensis*	-
CYPERACEAE	*Cyperus eragrostis**	
DILLENIACEAE	*Hibbertia crinita*	det H.R. Toelken x 2011
DILLENIACEAE	*Hibbertia linearis*	
DILLENIACEAE	*Hibbertia obtusifolia*	Hoary Guinea Flower
DILLENIACEAE	*Hibbertia riparia*	Erect Guinea-flower
ERICACEAE	*Brachyloma daphnoides*	Daphne Heath
ERICACEAE	*Lissanthe strigosa*	Peach Heath
ERICACEAE - STYPHELIOIDEAE	*Melichrus erubescens*	Ruby Urn Heath
ERICACEAE - STYPHELIOIDEAE	*Melichrus urceolatus*	Urn-heath
ERICACEAE - STYPHELIOIDEAE	*Styphelia triflora*	Pink Five-Corners
EUPHORBIACEAE	*Chamaesyce drummondii*	Caustic Weed
FABACEAE	*Lotus angustissimus**	Slender Birds-foot Trefoil
FABACEAE	*Ornithopus compressus**	Yellow Serradella
FABACEAE	*Trifolium dubium**	Yellow Suckling Clover
FABACEAE	*Trifolium glomeratum**	Clustered Clover
FABACEAE	*Trifolium repens**	White Clover
FABACEAE - FABOIDEAE	*Bossiaea obcordata*	
FABACEAE - FABOIDEAE	*Desmodium varians*	Slender Tick-trefoil
FABACEAE - FABOIDEAE	*Dillwynia phylicoides*	
FABACEAE - FABOIDEAE	*Dillwynia sericea*	Showy Parrot-pea
FABACEAE - FABOIDEAE	*Glycine tabacina*	Love creeper
FABACEAE - FABOIDEAE	*Hardenbergia violacea*	Purple Coral Pea
FABACEAE - FABOIDEAE	*Hovea lanceolata*	
FABACEAE - FABOIDEAE	*Hovea linearis*	
FABACEAE - FABOIDEAE	*Hovea rosmarinifolia*	
FABACEAE - FABOIDEAE	*Pultenaea foliolosa*	Small-leaf Bush-pea
FABACEAE - FABOIDEAE	*Pultenaea microphylla*	
FABACEAE - FABOIDEAE	*Pultenaea procumbens*	Heathy Bush-pea

Table E.1 Flora species recorded within the study area

Family	Scientific Name	Common Name
FABACEAE - FABOIDEAE	*Pultenaea spinosa*	Spiny Bush-pea
FABACEAE - MIMOSOIDEAE	*Acacia ausfeldii*[#]	Ausfeld's Wattle[#]
FABACEAE - MIMOSOIDEAE	*Acacia cremiflora*	Gold Dust Wattle
FABACEAE - MIMOSOIDEAE	*Acacia decora*	Western Silver Wattle
FABACEAE - MIMOSOIDEAE	*Acacia difformis*	Drooping Wattle
FABACEAE - MIMOSOIDEAE	*Acacia doratoxylon*	Currawang
FABACEAE - MIMOSOIDEAE	*Acacia flexifolia*	Bent-leaf Wattle
FABACEAE - MIMOSOIDEAE	*Acacia linearifolia*	Narrow-leaved Wattle
FABACEAE - MIMOSOIDEAE	*Acacia myrtifolia*	Red-stemmed Wattle
FABACEAE - MIMOSOIDEAE	*Acacia parramattensis*	Sydney Green Wattle
FABACEAE - MIMOSOIDEAE	*Acacia triptera*	Spurwing Wattle
GOODENIACEAE	*Goodenia glabra*	
GOODENIACEAE	*Goodenia hederacea* subsp. *hederacea*	Forest Goodenia
GOODENIACEAE	*Goodenia ovata*	Hop Goodenia
GOODENIACEAE	*Goodenia pinnatifida*	
GOODENIACEAE	*Dampiera lanceolata*	Grooved Dampiera
HALORAGACEAE	*Gonocarpus tetragynus*	
HALORAGACEAE	*Haloragis heterophylla*	Rough Raspwort
HYPERICACEAE	*Hypericum gramineum*	Small St John's Wort
HYPOXIDACEAE	*Hypoxis hygrometrica*	
IRIDACEAE	*Patersonia sericea*	Silky Purple Leaf
JUNCACEAE	*Juncus aridicola*	
JUNCACEAE	*Juncus filicaulis*	
JUNCACEAE	*Juncus filicaulis* x *J. subsecundus* hybrid	
JUNCACEAE	*Juncus homalocaulis*	
JUNCACEAE	*Juncus remotiflorus*	
JUNCACEAE	*Juncus* sp.	
JUNCACEAE	*Juncus* sp.sterile	
JUNCACEAE	*Juncus subsecundus*	
LAMIACEAE	*Prostanthera howelliae*	Mint Bush
LAMIACEAE	*Marrubium vulgare**	Horehound
LAURACEAE	*Cassytha pubescens*	Devils Twine
LINACEAE	*Linum marginale*	Native Flax
LOMANDRACEAE	*Lomandra bracteata*	
LOMANDRACEAE	*Lomandra filiformis* subsp. *coriaceae*	Wattle Mat-rush
LOMANDRACEAE	*Lomandra filiformis* subsp. *filiformis*	Wattle Mat-rush
LOMANDRACEAE	*Lomandra longifolia*	Mat Rush
LOMANDRACEAE	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush

Table E.1 Flora species recorded within the study area

Family	Scientific Name	Common Name
LOMANDRACEAE	*Lomandra* sp.	
LORANTHACEAE	*Amyema pendula*	Mistletoe
LORANTHACEAE	*Lysiana subfalcata*	
LYTHRACEAE	*Lythrum hyssopifolia*	Hyssop Loosestrife
MALVACEAE	*Sida cunninghamii*	Ridged Sida
MALVACEAE	*Anagallis arvensis**	Scarlet Pimpernel,
MALVACEAE	*Malva parviflora**	Small-flowered Mallow
MALVACEAE	*Modiola caroliniana**	Red-flowered Mallow
MYOPORACEAE	*Eremophila debilis*	Winter Apple
MYRTACEAE	*Angophora floribunda*	Rough-barked Apple
MYRTACEAE	*Baeckea utilis*	Mountain Baeckea
MYRTACEAE	*Calytrix tetragona*	Common Fringe-myrtle
MYRTACEAE	*Eucalyptus blakelyi*	Blakely's Red Gum
MYRTACEAE	*Eucalyptus conica*	Fuzzy Box
MYRTACEAE	*Eucalyptus crebra*	Narrow-leaved Ironbark
MYRTACEAE	*Eucalyptus dawsonii*	Slaty Gum
MYRTACEAE	*Eucalyptus dwyeri*	Red Gum
MYRTACEAE	*Eucalyptus eugenioides*	Thin-leaved Stringybark
MYRTACEAE	*Eucalyptus macrorhyncha* subsp. *macrorhyncha*	Red Stringybark
MYRTACEAE	*Eucalyptus melliodora*	Yellow Box
MYRTACEAE	*Eucalyptus microcarpa*	Inland Grey Box
MYRTACEAE	*Eucalyptus nubila*	Blue-leaved Ironbark
MYRTACEAE	*Eucalyptus rossii*	Scribbly Gum
MYRTACEAE	*Eucalyptus sideroxylon*	Mugga Ironbark
MYRTACEAE	*Eucalyptus* sp.	Ironbark
MYRTACEAE	*Eucalyptus* sp.	Stringybark
MYRTACEAE	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark
MYRTACEAE	*Kunzea parvifolia*	Violet Kunzea
MYRTACEAE	*Melaleuca erubescens*	
MYRTACEAE	*Melaleuca thymifolia*	Thyme Honey-myrtle
MYRTACEAE	*Melaleuca uncinata*	Broombrush
MYRTACEAE	*Sannantha cunninghamii*	
MYRTACEAE	*Homoranthus darwinioides*#	
ORCHIDACEAE	*Caladenia cucullata*	Hooded Caladenia
ORCHIDACEAE	*Caladenia fuscatus*	Dusky Fingers
ORCHIDACEAE	*Calochilus robertsonii*	Bearded Orchid
ORCHIDACEAE	*Thelymitra pauciflora*	Slender Sun Orchid

Table E.1 Flora species recorded within the study area

Family	Scientific Name	Common Name
OXALIDACEAE	*Oxalis exilis*	
PHORMIACEAE	*Dianella caerulea*	Blue Flax-lily
PHORMIACEAE	*Dianella longifolia*	Blue Flax-lily
PHORMIACEAE	*Dianella revoluta* subsp. *revoluta*	Blueberry Lily
PHORMIACEAE	*Stypandra glauca*	Nodding Blue Lily
PHYLLANTHACEAE	*Phyllanthus hirtellus*	Thyme Spurge
PHYLLANTHACEAE	*Poranthera corymbosa*	
PHYLLANTHACEAE	*Poranthera microphylla**	
PITTOSPORACEAE	*Bursaria spinosa* subsp. *spinosa*	Blackthrorn
PLANTAGINACEAE	*Plantago debilis*	
PLANTAGINACEAE	*Plantago turrifera*	
PLANTAGINACEAE	*Plantago varia*	
POACAE	*Bothriochloa macra*	Red Leg Grass
POACEAE	*Aristida ramosa*	Purple Wiregrass
POACEAE	*Aristida* sp.	Threeawn Grass
POACEAE	*Aristida vagans*	Threeawn Speargrass
POACEAE	*Arundinella nepalensis*	Reedgrass
POACEAE	*Austrodanthonia eriantha*	Wallaby Grass
POACEAE	*Austrodanthonia fulva*	Wallaby Grass
POACEAE	*Austrodanthonia monticola*	Wallaby Grass
POACEAE	*Austrodanthonia pilosa*	Smooth-flower Wallaby Grass
POACEAE	*Austrodanthonia* sp. sterile	Wallaby Grass
POACEAE	*Austrostipa bigeniculata*	Speargrass
POACEAE	*Austrostipa densiflora*	Speargrass
POACEAE	*Austrostipa scabra* subsp. *falcata*	Speargrass
POACEAE	*Austrostipa scabra* subsp. *scabra*	Slender Speargrass
POACEAE	*Austrostipa* sp.	Speargrass
POACEAE	*Austrostipa verticillata*	Slender Bamboo Grass
POACEAE	*Cymbopogon refractus*	Barbed Wire Grass
POACEAE	*Dichelachne rara*	Plumegrass
POACEAE	*Dichelachne* sp.	Plumegrass
POACEAE	*Digitaria diffusa*	Open Summer-grass
POACEAE	*Digitaria ramularis*	
POACEAE	*Echinopogon caespitosus*	Hedgehog Grass
POACEAE	*Elymus scaber*	Common Wheatgrass
POACEAE	*Entolasia* sp.	Panic Grass
POACEAE	*Eragrostis elongata*	Clustered Lovegrass
POACEAE	*Eragrostis* sp.	Love grass

Table E.1 Flora species recorded within the study area

Family	Scientific Name	Common Name
POACEAE	*Joycea pallida*	Red-anther Wallaby Grass
POACEAE	*Microlaena stipoides* var. *stipoides*	Weeping Meadow Grass
POACEAE	*Panicum effusum*	Panic Grass
POACEAE	*Phragmites australis*	Bullrush
POACEAE	*Poa sieberiana* var. *hirtella*	Snowgrass
POACEAE	*Poa* sp. sterile	
POACEAE	*Sporobolus creber*	Slender Rats Tail Grass
POACEAE	*Austrodanthonia carphoides*	Short Wallaby Grass
POACEAE	*Austrodanthonia racemosa*	Wallaby Grass
POACEAE	*Entolasia stricta*	Wiry Panic
POACEAE	*Eragrostis brownii*	Brown's Lovegrass
POACEAE	*Lachnagrostis filiformis*	
POACEAE	*Themeda australis*	Kangaroo Grass
POACEAE	*Aira cupaniana**	Hairgrass
POACEAE	*Avena ludoviciana**	Ludo Wild Oats
POACEAE	*Briza minor**	Shivery Grass
POACEAE	*Bromus catharticus**	Brome
POACEAE	*Bromus racemosus**	Smooth Brome
POACEAE	*Eleusine tristachya**	Goose Grass
POACEAE	*Hordeum leporinum**	Barley Grass
POACEAE	*Lolium perenne**	Perennial Rye Grass
POACEAE	*Lolium* sp.*	Ryegrass
POACEAE	*Paspalum dilatatum**	Paspalum
POACEAE	*Vulpia bromoides**	Squirrel Tail Fescue
POLYGONACEAE	*Rumex brownii*	Swamp Dock
POLYGONACEAE	*Acetosella vulgaris**	Sorrel
PROTEACEAE	*Grevillea triternata*	
PROTEACEAE	*Hakea decurrens*	
PROTEACEAE	*Persoonia linearis*	Narrow-leaved Geebung
RANUNCULACEAE	*Ranunculus sessiliflorus* var. *sessiliflorus*	Small-flowered Buttercup
RHAMNACEAE	*Cryptandra amara*	Bitter Cryptandra
RUBIACEAE	*Asperula conferta*	Common Woodruff
RUBIACEAE	*Galium gaudichaudii* subsp. *gaudichaudii*	Rough Bedstraw
RUBIACEAE	*Opercularia diphylla*	
RUBIACEAE	*Pomax umbellata*	
RUTACEAE	*Zieria ingramii*#	Ingram's Zieria#
RUTACEAE	*Phebalium squamulosum* subsp. *gracile*	Scaly Phebalium
SANTALACEAE	*Exocarpos cupressiformis*	Native Cherry

Table E.1 Flora species recorded within the study area

Family	Scientific Name	Common Name
SANTALACEAE	*Exocarpos strictus*	Dwarf Cherry
SAPINDACEAE	*Dodonaea cuneata*	Hop-bush
SAPINDACEAE	*Dodonaea peduncularis*	Hop-bush
SAPINDACEAE	*Dodonaea viscosa* subsp. *angustifolia*	Sticky Hop-bush
SAPINDACEAE	*Dodonaea viscosa* subsp. *spathulata*	Sticky Hop-bush
SOLANACEAE	*Solanum sterile -S. linearifolium* group	
SOLANACEAE	*Lycium ferocissimum**	Boxthorn
SOLANACEAE	*Solanum nigrum**	Deadly Nightshade
STACKHOUSIACEAE	*Stackhousia viminea*	Slender Stackhousia
STERCULIACEAE	*Brachychiton populneus*	Kurrajong
THYMELAEACEAE	*Pimelea linifolia* subsp. *linifolia*	Slender Rice Flower
URTICACEAE	*Urtica incisa*	Stinging Nettle
VERBENACEAE	*Verbena bonariensis**	Purpletop
XANTHORRHOEACEAE	*Xanthorrhoea johnsonii*	Johnson's Grass Tree

Notes: 1. * *exotic species*

2. # *threatened species listed under the TSC Act and/or EPBC Act*

Table E.2 Fauna species recorded within the study area

Family	Scientific name	Common name
Reptiles		
AGAMIDAE	*Amphibolurus muricatus*	Jacky Lizard
AGAMIDAE	*Amphibolurus nobi nobi*	Nobi Dragon
AGAMIDAE	*Pogona barbata*	Eastern Bearded Dragon
AGAMIDAE	*Rankinia diemensis*	Mountain Dragon
CHELUIDAE	*Chelodina longicollis*	Snake-necked Turtle
ELAPIDAE	*Demansia psammophis*	Yellow-faced Whip Snake
ELAPIDAE	*Pseudonaja textilis*	Eastern Brown Snake
ELAPIDAE	*Vermicella annulata*	Bandy-bandy
GEKKONIDAE	*Diplodactylus vittatus*	Eastern Stone Gecko
GEKKONIDAE	*Oedura lesueurii*	Lesueur's Velet Gecko
GEKKONIDAE	*Oedura robusta*	Robust Velet Gecko
GEKKONIDAE	*Underwoodisaurus milii*	Thick-tailed Gecko
SCINCIDAE	*Anomalopus leuckartii*	Two-clawed Worm-skink
SCINCIDAE	*Carlia foliorum*	Rainbow Skink
SCINCIDAE	*Cryptoblepharus carnabyi*	Spiny-palmed Snake-eyed Skink
SCINCIDAE	*Cryptoblepharus virgatus*	Wall Skink
SCINCIDAE	*Ctenotus robustus*	Eastern Striped Skink
SCINCIDAE	*Ctenotus taeniolatus*	Copper-tailed Skink
SCINCIDAE	*Egernia whitei*	White's Skink
SCINCIDAE	*Lampropholis delicata*	Garden Skink
SCINCIDAE	*Menetia greyii*	Common Dwarf Skink
SCINCIDAE	*Saiphos equalis*	Three-toed Skink
SCINCIDAE	*Tiliqua rugosa*	Shingleback
SCINCIDAE	*Tiliqua scincoides*	Eastern Blue-tongue Skink
VARANIDAE	*Varunus varius*	Lace Monitor
Frogs		
HYLIDAE	*Litoria caerulea*	Green Tree Frog
HYLIDAE	*Litoria dentata*	Bleating Tree Frog
HYLIDAE	*Litoria latopalmata*	Broad-palmed Rocket-frog
HYLIDAE	*Litoria nasuta*	Rocket Frog
HYLIDAE	*Litoria peronii*	Peron's Tree Frog
HYLIDAE	*Litoria rubella*	Desert Tree Frog
MYOBATRACHIDAE	*Crinia parinsignifera*	Eastern Sign-bearing Froglet
MYOBATRACHIDAE	*Crinia signifera*	Common Eastern Froglet
MYOBATRACHIDAE	*Limnodynastes dumerilii*	Eastern Pobblebonk
MYOBATRACHIDAE	*Limnodynastes ornatus*	Ornate Burrowing Frog
MYOBATRACHIDAE	*Limnodynastes peronii*	Striped Marsh Frog
MYOBATRACHIDAE	*Limnodynastes tarraereginae*	Northern Banjo Frog
MYOBATRACHIDAE	*Limnodynastes tasmaniensis*	Spotted Marsh Frog

Table E.2 Fauna species recorded within the study area

Family	Scientific name	Common name
MYOBATRACHIDAE	*Paracrinia haswelli*	Beeping Froglet
MYOBATRACHIDAE	*Pseudophryne bibroni*	Bibron's Toadlet
MYOBATRACHIDAE	*Uperoleia laevigata*	Smooth Toadlet
MYOBATRACHIDAE	*Uperoleia rugosa*	Rugose Toadlet
MYOBATRACHIDAE	*Uperoleia tylerii*	Tyler's Toadlet
Mammals		
BOVIDAE	*Bos taurus**	Cow*
BOVIDAE	*Capra hirsus**	Goat*
BOVIDAE	*Sus scrofa**	Pig*
BOVIDAE	*Ovis aries**	Sheep*
CANIDAE	*Canis lupus familiaris**	Dog
CANIDAE	*Vulpes vulpes**	European Red Fox*
DASYURIDAE	*Antechinus flavipes*	Yellow-footed Antechinus
EQUIDAE	*Equus caballus**	Horse*
FELIDAE	*Felis catus**	Feral Cat*
LEPORIDAE	*Lepus capensis**	Brown Hare*
LEPORIDAE	*Oryctolagus cuniculus**	European Rabbit*
MACROPODIDAE	*Macropus giganteus*	Eastern Grey Kangaroo
MACROPODIDAE	*Macropus robustus*	Wallaroo
MACROPODIDAE	*Macropus rufogriseus*	Red-necked Wallaby
MACROPODIDAE	*Wallabia bicolor*	Swamp Wallaby
MURIDAE	*Mus musculus**	House Mouse*
MURIDAE	*Rattus rattus**	Black Rat*
PETARIDAE	*Petaurus breviceps*	Sugar Glider
PHALANGERIDAE	*Pseudocheirus peregrinus*	Common Ringtail Possum
PHALANGERIDAE	*Trichosurus vulpecula*	Common Brushtail Possum
TACHYGLOSSIDAE	*Tachyglossus aculeatus*	Short-beaked Echidna
VOMBATIDAE	*Vombatus ursinus*	Common Wombat
Bats		
EMBALLONURIDAE	*Saccolaimus flaviventris*[#]	Yellow-bellied Sheathtail Bat
MOLOSSIDAE	*Mormopterus planiceps long penis*	Southern Freetail Bat
MOLOSSIDAE	*Mormopterus planiceps small penis*	Inland Freetail Bat
MOLOSSIDAE	*Tadarida australis*	White-striped Mastiff Bat
VESPERTILIONIDAE	*Chalinolobus dwyeri*[#]	Large-eared Pied Bat[#]
VESPERTILIONIDAE	*Chalinolobus gouldii*	Gould's Wattled Bat
VESPERTILIONIDAE	*Chalinolobus morio*	Chocolate Wattled Bat
VESPERTILIONIDAE	*Chalinolobus picatus*[#]	Little Pied Bat[#]
VESPERTILIONIDAE	*Miniopterus schreibersii oceanensis*[#]	Eastern Bent-wing Bat[#]
VESPERTILIONIDAE	*Scoteanax orion*	Eastern Broad-nosed Bat
VESPERTILIONIDAE	*Scotorepens balstoni*	Inland Broad-nosed Bat

Table E.2 Fauna species recorded within the study area

Family	Scientific name	Common name
VESPERTILIONIDAE	*Scotorepens greyii*	Little Broad-nosed Bat
VESPERTILIONIDAE	*Vespadelus vulturnus*	Little Forest Bat
VESPERTILIONIDAE	*Nyctophilus geofroyi*	Lesser Long-eared Bat
VESPERTILIONIDAE	*Nyctophilus gouldi*	Gould's Long-eared Bat
VESPERTILIONIDAE	*Nyctophilus corbeni*[#]	Southern Long-eared Bat[#]
Birds		
ACCIPITRIDAE	*Elanus axillaris*	Black-shouldered Kite
ACCIPITRIDAE	*Accipiter fasciatus*	Brown Goshawk
ACCIPITRIDAE	*Elanus scriptus*	Letter-winged Kite
ACCIPITRIDAE	*Aquila audax*	Wedge-tailed Eagle
AEGOTHELIDAE	*Aegotheles cristatus*	Australian Owlet-nightjar
ANATIDAE	*Chenonetta jubata*	Australian Wood Duck
ANATIDAE	*Cygnus atratus*	Black Swan
ANATIDAE	*Oxyura australis*[#]	Blue-billed Duck[#]
ANATIDAE	*Anas castanea*	Chestnut Teal
ANATIDAE	*Anas gracilis*	Grey Teal
ANATIDAE	*Aythya australis*	Hardhead
ANATIDAE	*Biziura lobata*	Musk Duck
ANATIDAE	*Anas superciliosa*	Pacific Black Duck
ANHINGIDAE	*Anhinga melanogaster*	Darter
ARDEIDAE	*Ardea ibis*[m]	Cattle Egret[m]
ARDEIDAE	*Ardea alba*[m]	Great Egret[m]
ARDEIDAE	*Ardea intermedia*	Intermediate Egret
ARDEIDAE	*Egretta novaehollandiae*	White-faced Heron
ARDEIDAE	*Ardea pacifica*	White-necked Heron
ARDEIDAE	*Botaurus poiciloptilus*[#]	Australasian Bittern[#]
ARTAMIDAE	*Gymnorhina tibicen*	Australian Magpie
ARTAMIDAE	*Artamus cinereus*	Black-faced Woodswallow
ARTAMIDAE	*Artamus cyanopterus*	Dusky Woodswallow
ARTAMIDAE	*Cracticus torquatus*	Grey Butcherbird
ARTAMIDAE	*Artamus minor*	Little Woodswallow
ARTAMIDAE	*Artamus personatus*	Masked Woodswallow
ARTAMIDAE	*Cracticus nigrogularis*	Pied Butcherbird
ARTAMIDAE	*Strepera graculina*	Pied Currawong
ARTAMIDAE	*Artamus leucorynchus*	White-breasted Woodswallow
ARTAMIDAE	*Artamus superciliosus*	White-browed Woodswallow
CACATUIDAE	*Nymphicus hollandicus*	Cockatiel
CACATUIDAE	*Cacatua roseicapilla*	Galah
CACATUIDAE	*Calyptorhynchus lathami*	Glossy Black-Cockatoo
CACATUIDAE	*Cacatua galerita*	Sulphur-crested Cockatoo

Table E.2 Fauna species recorded within the study area

Family	Scientific name	Common name
CAMPEPHAGIDAE	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike
CAMPEPHAGIDAE	*Coracina tenuirostris*	Cicadabird
CAMPEPHAGIDAE	*Coracina maxima*	Ground Cuckoo-shrike
CAMPEPHAGIDAE	*Lalage leucomela*	Varied Triller
CAMPEPHAGIDAE	*Coracina papuensis*	White-bellied Cuckoo-shrike
CAMPEPHAGIDAE	*Lalage sueurii*	White-winged Triller
CAPRIMULGIDAE	*Eurostopodus mystacalis*	White-throated Nightjar
CASUARIIDAE	*Dromaius novaehollandiae*	Emu
CHARADRIIDAE	*Elseyornis melanops*	Black-fronted Dotterel
CHARADRIIDAE	*Vanellus miles*	Masked Lapwing
CHARADRIIDAE	*Erythrogonys cinctus*	Red-kneed Dotterel
CLIMACTERIDAE	*Climacteris picumnus*[#]	Brown Treecreeper[#]
CLIMACTERIDAE	*Cormobates leucophaeus*	White-throated Treecreeper
COLUMBIDAE	*Geopelia humeralis*	Bar-shouldered Dove
COLUMBIDAE	*Phaps elegans*	Brush Bronzewing
COLUMBIDAE	*Phaps chalcoptera*	Common Bronzewing
COLUMBIDAE	*Ocyphaps lophotes*	Crested Pigeon
COLUMBIDAE	*Geopelia striata*	Peaceful Dove
CORACIIDAE	*Eurystomus orientalis*	Dollarbird
CORCORACIDAE	*Struthidea cinerea*	Apostlebird
CORCORACIDAE	*Corcorax melanorhamphos*	White-winged Chough
CORVIDAE	*Corvus coronoides*	Australian Raven
CORVIDAE	*Corvus tasmanicus*	Forest Raven
CORVIDAE	*Corvus mellori*	Little Raven
CUCULIDAE	*Chrysococcyx osculans*	Black-eared Cuckoo
CUCULIDAE	*Cacomantis variolosus*	Brush Cuckoo
CUCULIDAE	*Cacomantis flabelliformis*	Fan-tailed Cuckoo
CUCULIDAE	*Chrysococcyx basalis*	Horsfield's Bronze-Cuckoo
CUCULIDAE	*Cuculus pallidus*	Pallid Cuckoo
CUCULIDAE	*Chrysococcyx lucidus*	Shining Bronze-Cuckoo
DICAEIDAE	*Dicaeum hirundinaceum*	Mistletoebird
DICRURIDAE	*Rhipidura fuliginosa*	Grey Fantail
DICRURIDAE	*Myiagra rubecula*	Leaden Flycatcher
DICRURIDAE	*Grallina cyanoleuca*	Magpie-lark
DICRURIDAE	*Myiagra inquieta*	Restless Flycatcher
DICRURIDAE	*Rhipidura leucophrys*	Willie Wagtail
FALCONIDAE	*Falco longipennis*	Australian Hobby
FALCONIDAE	*Falco berigora*	Brown Falcon
FALCONIDAE	*Falco cenchroides*	Nankeen Kestrel
FALCONIDAE	*Falco peregrinus*	Peregrine Falcon

Table E.2 Fauna species recorded within the study area

Family	Scientific name	Common name
FRINGILLIDAE	*Carduelis carduelis**	European Goldfinch*
HALCYONIDAE	*Todiramphus macleayii*	Forest Kingfisher
HALCYONIDAE	*Dacelo novaeguineae*	Laughing Kookaburra
HALCYONIDAE	*Todiramphus sanctus*	Sacred Kingfisher
HIRUNDINIDAE	*Hirundo ariel*	Fairy Martin
HIRUNDINIDAE	*Hirundo nigricans*	Tree Martin
HIRUNDINIDAE	*Hirundo neoxena*	Welcome Swallow
HIRUNDINIDAE	*Cheramoeca leucosternus*	White-backed Swallow
LARIDAE	*Chlidonias hybridus*	Whiskered Tern
MALURIDAE	*Malurus cyaneus*	Superb Fairy-wren
MALURIDAE	*Malurus lamberti*	Variegated Fairy-wren
MEGAPODIIDAE	*Leipoa ocellata*[#]	Malleefowl (abandoned nests)[#]
MELIPHAGIDAE	*Entomyzon cyanotis*	Blue-faced Honeyeater
MELIPHAGIDAE	*Epthianura albifrons*[#]	White-fronted Chat[#]
MELIPHAGIDAE	*Melithreptus brevirostris*	Brown-headed Honeyeater
MELIPHAGIDAE	*Lichenostomus fuscus*	Fuscous Honeyeater
MELIPHAGIDAE	*Meliphaga lewinii*	Lewin's Honeyeater
MELIPHAGIDAE	*Philemon citreogularis*	Little Friarbird
MELIPHAGIDAE	*Philemon corniculatus*	Noisy Friarbird
MELIPHAGIDAE	*Manorina melanocephala*	Noisy Miner
MELIPHAGIDAE	*Anthochaera carnunculata*	Red Wattlebird
MELIPHAGIDAE	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater
MELIPHAGIDAE	*Plectorhyncha lanceolata*	Striped Honeyeater
MELIPHAGIDAE	*Lichenostomus leucotis*	White-eared Honeyeater
MELIPHAGIDAE	*Lichenostomus penicillatus*	White-plumed Honeyeater
MELIPHAGIDAE	*Lichenostomus chrysops*	Yellow-faced Honeyeater
MEROPIDAE	*Merops ornatus*[#]	Rainbow Bee-eater[#]
MOTACILLIDAE	*Anthus novaeseelandiae*	Richard's Pipit
MUSCICAPIDAE	*Acrocephalus stentoreus*	Australian Reed-Warbler
MUSCICAPIDAE	*Cincloramphus cruralis*	Brown Songlark
MUSCICAPIDAE	*Megalurua gramineus*	Little Grassbird
MUSCICAPIDAE	*Cincloramphus mathewsi*	Rufous Songlark
NEOSITTIDAE	*Daphoenositta chrysoptera*[#]	Varied Sittella[#]
PACHYCEPHALIDAE	*Falcunculus frontatus*	Crested Shrike-tit
PACHYCEPHALIDAE	*Pachycephala pectoralis*	Golden Whistler
PACHYCEPHALIDAE	*Colluricincla harmonica*	Grey Shrike-thrush
PACHYCEPHALIDAE	*Pachycephala rufiventris*	Rufous Whistler
PARDALOTIDAE	*Gerygone mouki*	Brown Gerygone
PARDALOTIDAE	*Acanthiza pusilla*	Brown Thornbill
PARDALOTIDAE	*Acanthiza reguloides*	Buff-rumped Thornbill

Table E.2 Fauna species recorded within the study area

Family	Scientific name	Common name
PARDALOTIDAE	*Acanthiza uropygialis*	Chestnut-rumped Thornbill
PARDALOTIDAE	*Aphelocephala leucopsis*	Southern Whiteface
PARDALOTIDAE	*Chthonicola sagittata*[#]	Speckled Warbler[#]
PARDALOTIDAE	*Pardalotus punctatus*	Spotted Pardalote
PARDALOTIDAE	*Pardalotus striatus*	Striated Pardalote
PARDALOTIDAE	*Smicrornis brevirostris*	Weebill
PARDALOTIDAE	*Gerygone fusca*	Western Gerygone
PARDALOTIDAE	*Gerygone olivacea*	White-throated Gerygone
PARDALOTIDAE	*Acanthiza nana*	Yellow Thornbill
PARDALOTIDAE	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill
PASSERIDAE	*Stagonopleura guttata*[#]	Diamond Firetail
PASSERIDAE	*Taeniopygia bichenovii*	Double-barred Finch
PASSERIDAE	*Passer domesticus**	House Sparrow*
PASSERIDAE	*Neochmia modesta*	Plum-headed Finch
PASSERIDAE	*Neochmia temporalis*	Red-browed Finch
PETROICIDAE	*Eopsaltria australis*	Eastern Yellow Robin
PETROICIDAE	*Melanodryas cucullata*[#]	Hooded Robin[#]
PETROICIDAE	*Microeca fascinans*	Jacky Winter
PETROICIDAE	*Petroica goodenovii*	Red-capped Robin
PHALACROCORACIDAE	*Phalacrocorax carbo*	Great Cormorant
PHALACROCORACIDAE	*Phalacrocorax sulcirostris*	Little Black Cormorant
PHALACROCORACIDAE	*Phalacrocorax melanoleucos*	Little Pied Cormorant
PHALACROCORACIDAE	*Phalacrocorax varius*	Pied Cormorant
PHASIANIDAE	*Coturnix ypsilophora*	Brown Quail
PHASIANIDAE	*Pavo cristatus**	Indian Peafowl*
PHASIANIDAE	*Coturnix pectoralis*	Stubble Quail
PODARGIDAE	*Podargus strigoides*	Tawny Frogmouth
PODICIPEDIDAE	*Tachybaptus novaehollandiae*	Australasian Grebe
PODICIPEDIDAE	*Poliocephalus poliocephalus*	Hoary-headed Grebe
POMATOSTOMIDAE	*Pomatostomus temporalis*[#]	Grey-crowned Babbler[#]
POMATOSTOMIDAE	*Pomatostomus superciliosus*	White-browed Babbler
PSITTACIDAE	*Alisterus scapularis*	Australian King-parrot
PSITTACIDAE	*Barnardius zonarius*	Australian Ringneck
PSITTACIDAE	*Platycercus eximius*	Eastern Rosella
PSITTACIDAE	*Glossopsitta pusilla*[#]	Little Lorikeet[#]
PSITTACIDAE	*Glossopsitta concinna*	Musk Lorikeet
PSITTACIDAE	*Trichoglossus haematodus*	Rainbow Lorikeet
PSITTACIDAE	*Psephotus haematonotus*	Red-rumped Parrot
PSITTACIDAE	*Aprosmictus erythropterus*	Red-winged Parrot
PSITTACIDAE	*Polytelis swainsonii*[#]	Superb Parrot[#]

Table E.2 Fauna species recorded within the study area

Family	Scientific name	Common name
RALLIDAE	*Gallinula ventralis*	Black-tailed Native-hen
RALLIDAE	*Gallinula tenebrosa*	Dusky Moorhen
RALLIDAE	*Fulica atra*	Eurasian Coot
RECURVIROSTRIDAE	*Himantopus himantopus*	Black-winged Stilt
STRIGIDAE	*Ninox connivens*[#]	Barking Owl[#]
STRIGIDAE	*Ninox strenua*[#]	Powerful Owl[#]
STRIGIDAE	*Ninox novaeseelandiae*	Southern Boobook
STURNIDAE	*Sturnus vulgaris**	Common Starling
THRESKIORNITHIDAE	*Threskiornis molucca*	Australian White Ibis
THRESKIORNITHIDAE	*Threskiornis spinicollis*	Straw-necked Ibis
THRESKIORNITHIDAE	*Platalea flavipes*	Yellow-billed Spoonbill
TYTONIDAE	*Tyto alba*	Barn Owl
TYTONIDAE	*Tyto novaehollandiae*	Masked Owl
ZOSTEROPIDAE	*Zosterops lateralis*	Silvereye

Notes: 1. ** exotic species*

2. *# threatened species listed under the TSC Act and/or EPBC Act*

3. [m] *listed as migratory under the EPBC Act*

Appendix F

Qualifications and experience of the authors

Table F.1 Overview of the contributors

Name	Company	Qualifications	Experience	Role for project
Cassandra Thompson	EMGA Mitchell McLennan	BSc; MAppSc (EnvSc)	Cassandra is a senior ecologist with eight years of experience in flora and fauna survey within south-eastern Australia. She has led and conducted ecological surveys and assessments for a range of projects, concentrating on fauna ecology.	Ecology Project Manager (fauna)
Renae Baker	EMGA Mitchell McLennan	BSc(Hons)	Renae is the senior technical advisor for EMM's ecology team. Renae has over a decade of experience in project management and provision of corporate advice, flora and fauna survey, statistical analysis and survey sampling design.	Senior Ecologist (flora)
Katie Whiting	EMGA Mitchell McLennan	BSc, MWldMgt (Habitat)	Katie is a senior ecologist whose ecological expertise lies in the survey of microchiropteran bats. She has undertaken a range of assessments for varying projects throughout NSW.	Senior Ecologist (fauna)
Alison Hunt	Alison Hunt and Associates	BSc (Hons), PhD	Alison is an experienced ecologist who has worked extensively throughout NSW for a range of ecological and environmental projects. She is also a Councillor for the Ecological Consultants Association of NSW.	Independent technical review
Isobel Crawford	Australian Botanical Surveys	BA, Dip. Lib., B. Appl. Sci.	Isobel is a botanist with extensive experience in the survey of vegetation communities and threatened species.	Flora advice and survey
Glenn Hoye	Fly By Night Bat Surveys	BEng (Mining), BSc(Hons)	Glenn has extensive experience in the survey and research of bats, particularly within the Hunter Valley and eastern NSW where his research has been undertaken from 1980.	Microbat advice and survey
Brendan Ryan	OMVI Ecological	BSc (Zoology), MSc (Env)	Brendan has over 17 years experience in terrestrial ecology conducting surveys for a range of ecosystems, but concentrating in eastern Australia.	Fauna advice and survey