APPENDIX 6

# Biodiversity Assessment Report

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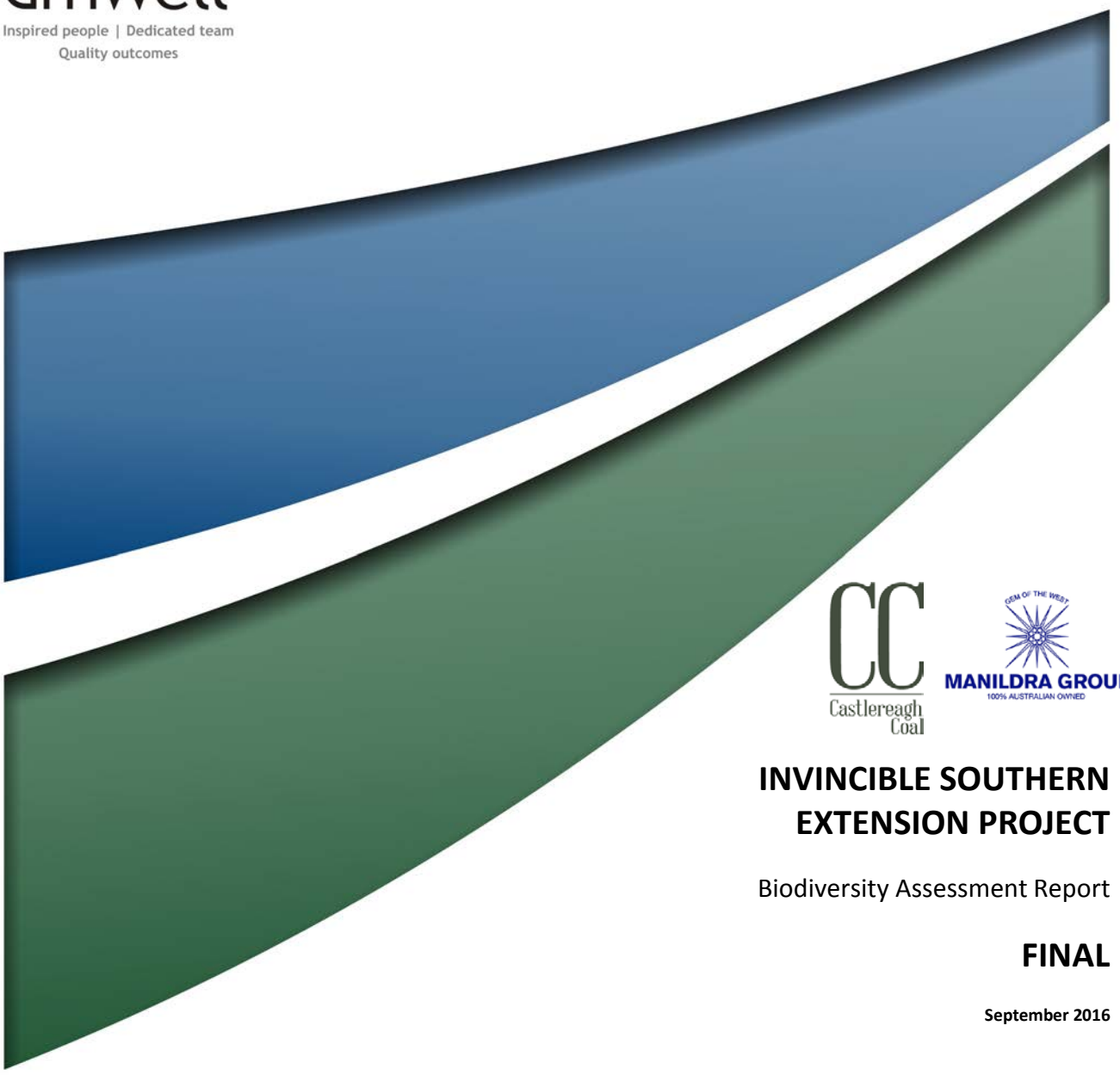

Castlereagh Coal

MANILDRA GROUP
100% AUSTRALIAN OWNED

# INVINCIBLE SOUTHERN EXTENSION PROJECT

Biodiversity Assessment Report

**FINAL**

**September 2016**

# INVINCIBLE SOUTHERN EXTENSION PROJECT

Biodiversity Assessment Report

## FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Castlereagh Coal

| | |
|---|---|
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| Report No. | 3622/R04/FINAL |
| Date: | September 2016 |


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This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

# Executive Summary

Castlereagh Coal operates the Invincible Colliery (Invincible), an open cut coal mine located approximately 25 kilometres north-west of Lithgow in NSW. Castlereagh Coal is the trading name for Shoalhaven Coal Pty Ltd which is part of the Manildra Group, an integrated and diverse agribusiness.

Castlereagh Coal is seeking to modify the Invincible Project Approval to extend the life of mining operations at the Invincible Colliery and obtain approval to extend the open cut mining operations to an area immediately south of the existing operations (Southern Extension Area). The primary purpose of the operation will be to provide nut coal to Manildra's Shoalhaven Starches Plant located at Bomaderry on the NSW South Coast. Project features (including location and setback from potential habitat features) and impact mitigation measures have been incorporated into the detailed design of the Southern Extension Project to minimise biodiversity impacts.

Umwelt (Australia) Pty Limited (Umwelt) has prepared this Biodiversity Assessment Report on behalf of Castlereagh Coal to assess the potential ecological impacts of the proposed Southern Extension Project using the *Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major Projects (FBA)*.

The BioBanking Credit Calculator (Major Project Assessment Type) was applied following extensive literature reviews, the identification of relevant landscape features and detailed flora and fauna field surveys undertaken in August and November 2015 and January and April 2016 of the Southern Extension Area, in accordance with the BioBanking Assessment Methodology (OEH 2014a).

Following the application of appropriate avoidance and mitigation measures, the BioBanking Assessment identified the following biodiversity features and subsequent credits required for offsetting as a result of the Southern Extension Project:

- 542 ecosystem credits for Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion (CW117)
- 2893 ecosystem credits for Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (CW263)
- 388 species credits for the broad-headed snake (*Hoplocephalus bungaroides*)
- 312 species credits for the Capertee stringybark (*Eucalyptus cannoni*)
- 1047 species credits for squirrel glider (*Petaurus norfolcensis*).

An offset strategy is being developed for the Southern Extension Project in accordance with the FBA. Based on assessment completed to date the credits required for the Southern Extension Project are available for the ecosystem credits and species credits for vegetation in the surrounding area. Castlereagh Coal commit to the securing of required credits and appropriate offsets measures prior to the commencement of the Southern Extension Project.

# Glossary

| | |
|---|---|
| BAR | Biodiversity Assessment Report |
| BBAM | BioBanking Assessment Methodology |
| BBCC | BioBanking Credit Calculator |
| BVT | Biometric Vegetation Type |
| CEEC | Critically Endangered Ecological Community |
| CMA Subregion | Catchment Management Authority Subregion |
| DA | Development Application |
| DECC | NSW Department of Environment and Climate Change (now OEH) |
| DoE | Commonwealth Department of the Environment |
| DSEWPC | Department of Sustainability, Environment, Water, Population and Communities (now DoE) |
| EEC | Endangered Ecological Community |
| EP | Endangered Population |
| EP&A Act | *Environmental Planning and Assessment Act 1979* (NSW) |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) |
| ESCP | Erosion and Sediment Control Plan |
| FBA | Framework for Biodiversity Assessment |
| FM Act | Fisheries Management Act |
| GIS | Geographical Information System |
| IBRA | Interim Biogeographic Regionalisation for Australia (Version 7) |
| LGA | Local Government Area |
| LPI | Land and Property Information |
| MGA | Map Grid of Australia |
| MNES | Matters of national environmental significance |
| Project | The subject of this Biodiversity Assessment Report, the proposed Southern Extraction Project. |
| Mtpa | Million tonnes per annum |
| NSW | New South Wales |
| OEH | Office of Environment and Heritage (NSW) |
| PCT | Plant Community Type |
| PMST | Protected Matters Search Tool |

| | |
|---|---|
| Southern Extension Area | The area in which the Modification Project is proposed. The Southern Extension Area will be completely cleared as a result of the Modification Project and all infrastructure related to the project will be contained within the Southern Extension Area. |
| SAT | Spot Assessment Technique |
| SIX | Spatial Information eXchange |
| TEC | Threatened Ecological Community |
| TSC Act | *Threatened Species Conservation Act 1995* (NSW) |
| VIS | Vegetation Information System |

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| Appendix E | Biodiversity Credit Report |
| Appendix F | EPBC Act Listed Threatened and Migratory Species, Endangered Populations and Threatened Ecological Communities Assessment of Significance |

# 1.0 Introduction

Castlereagh Coal Pty Limited (Castlereagh Coal) operates the Invincible Colliery (Invincible), an open cut coal mine located approximately 25 kilometres north-west of Lithgow in NSW (refer to **Figure 1.1**). Castlereagh Coal is the trading name for Shoalhaven Coal Pty Ltd which is part of the Manildra Group, an integrated and diverse agribusiness.

Coal mining at Invincible began in 1901 as an underground operation. Due to the relatively shallow depth of cover in the western part of the mining lease area, open cut mining has also been carried out at Invincible over various times in the long history of the operation. The open cut operations were placed in care and maintenance in 2013. The existing operations are shown in **Figure 1.2**.

Shoalhaven Coal purchased Invincible in 2015 to secure a continued supply of specialty nut coal for Manildra's Shoalhaven Starches Plant at Bomaderry on the NSW South Coast. The available coal within the approved mining area has largely been exhausted and the existing Project Approval 07/0127 (Invincible Project Approval) currently limits mining to eight years from the date of grant of the approval (i.e. to 4 December 2016). The Invincible Project Approval authorises ongoing rehabilitation activities after the date of approved mining.

Castlereagh Coal is proposing to modify the Invincible Project Approval to extend the life of mining operations at Invincible and obtain approval to extend the open cut mining operations to an area immediately south of the existing operations (Southern Extension Area) (refer to **Figure 1.2**). The primary purpose of the operation will be to provide specialty nut coal to Manildra's Shoalhaven Starches Plant. The target seam is the Lithgow Seam which is the lowest of the three coal seams present in the Southern Extension Area. This seam has previously been mined using bord and pillar mining methods as part of the Ivanhoe Colliery workings. The project would extract the remnant coal remaining in the pillars.

Approval for the proposed modification is being sought under section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Umwelt (Australia) Pty Ltd (Umwelt) has prepared this Biodiversity Assessment Report on behalf of Castlereagh Coal to accompany the Environmental Assessment (EA) prepared to support the application to modify the Invincible Project Approval.

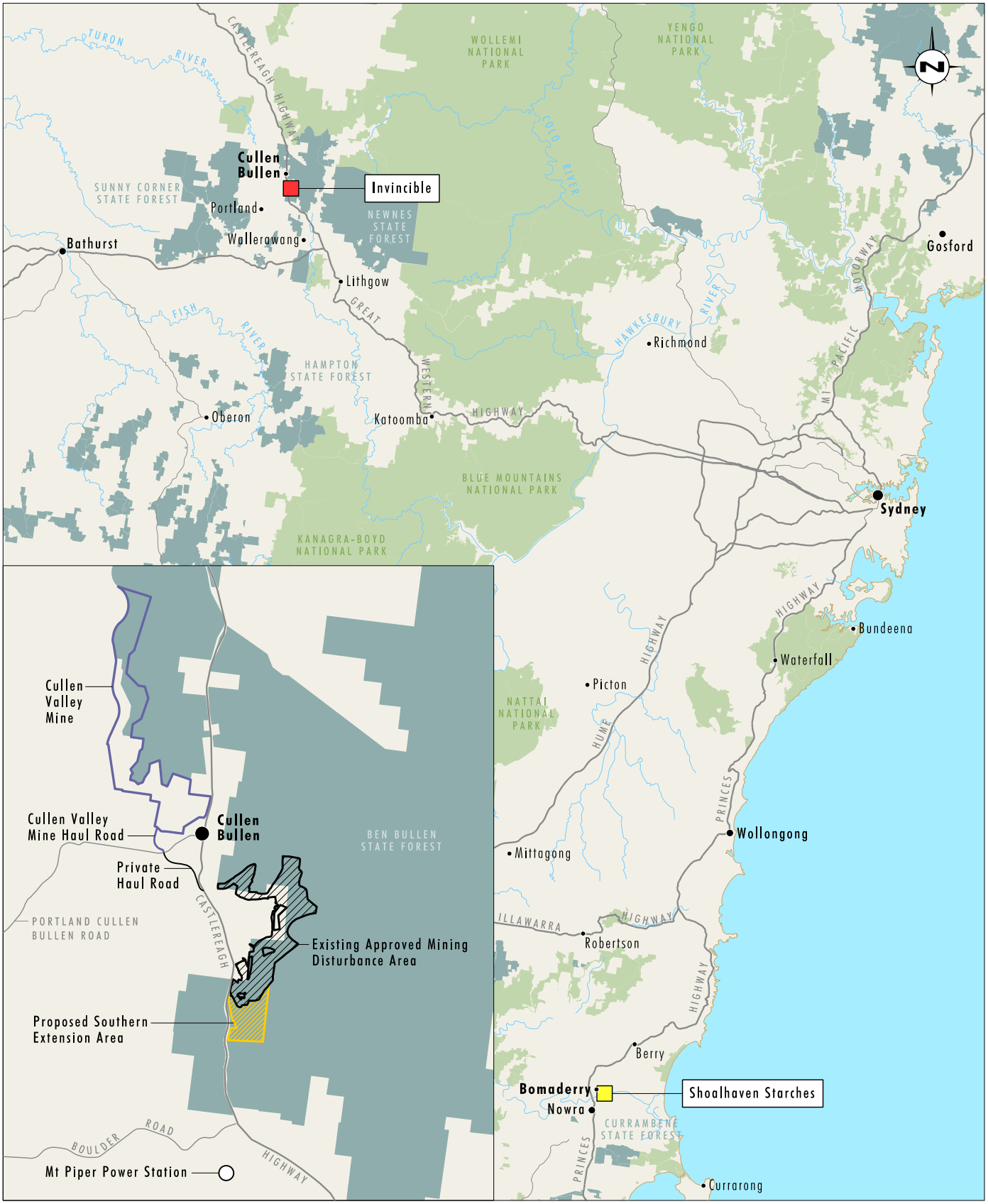


FIGURE 1.1

Locality Plan

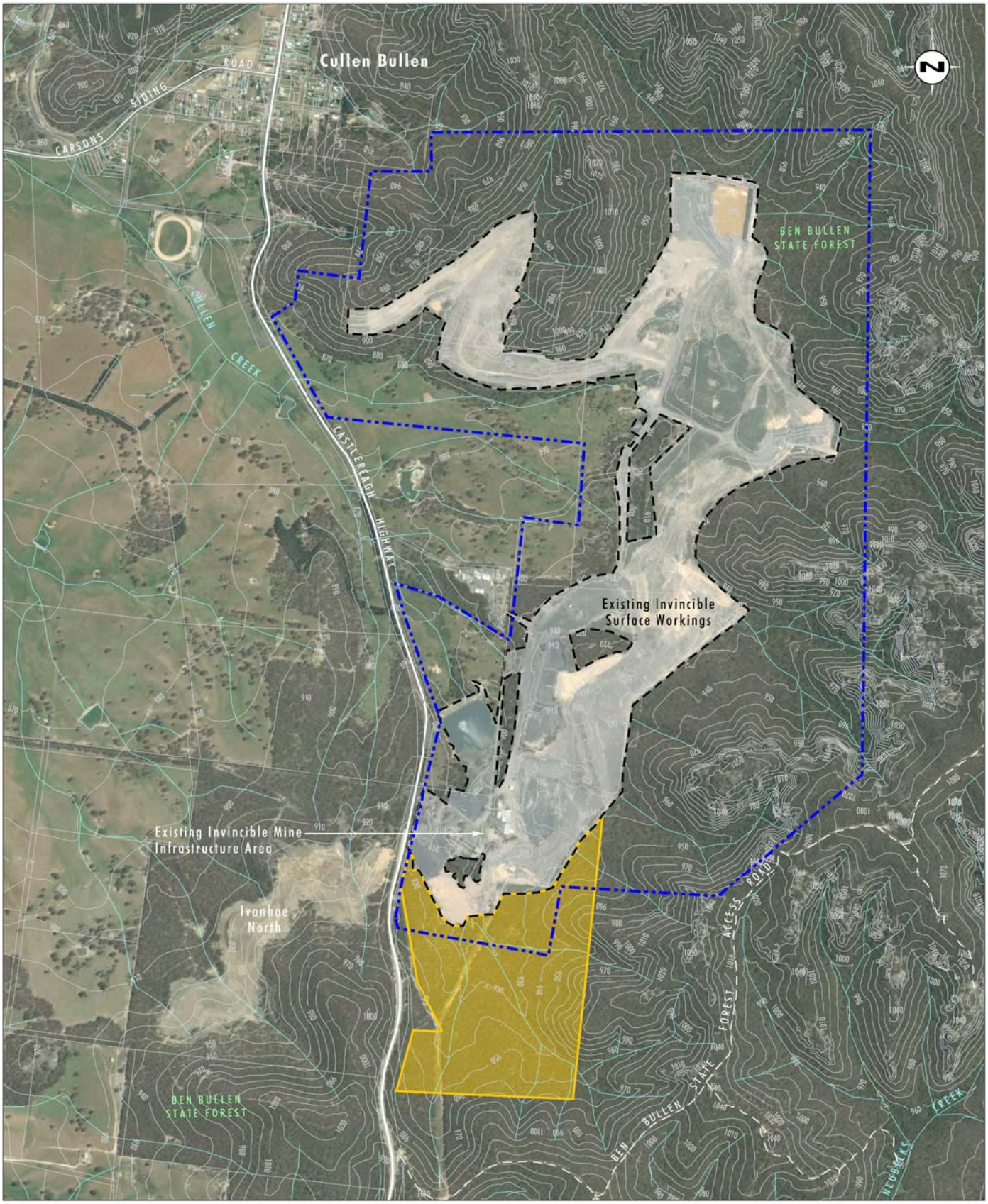


Image Source: Google Earth - CNES/Astrium (Nov 2014)
Data Source: LPI (2016), Forest Corporation of NSW (2015)
Note: Contour Interval 10m

0 0.25 0.5 1.0km

**Legend**

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Invincible Project Approval Boundary (PA07/0127)

FIGURE 1.2

**Invincible Southern Extension Project**

## 1.1 Proposed modification

The Invincible Southern Extension Project (the Southern Extension Project) is an extension of open cut mining operations to the south of the existing approved mining area at Invincible.

The Project includes:

- Extending the period in which mining can continue for a period of 8 years from approval of the modification application.
- Extending the open cut mining area immediately south of the existing mining disturbance area (refer to **Figure 1.2**). Extraction of coal from all seams down to, and including the Lithgow seam. No highwall mining or open cut mining in any other areas of Invincible is proposed as part of the Project.
- Continued use of existing Invincible infrastructure (including operation of, and maintenance work on, the existing Coal Preparation Plant).
- Use of existing open cut voids and former underground workings for water storage.
- No change to currently approved mining production rates.
- No change to currently approved product coal transport arrangements with coal to be transported from the site by road truck to either the Shoalhaven Starches Plant or Mt Piper Power Station.
- Rehabilitation of the proposed Southern Extension Area and all existing disturbance areas at Invincible by reshaping mining areas to remove voids and revegetating the reshaped landform with locally endemic woodland and forest communities.

A comparison of the existing approved operations at Invincible and the proposed Southern Extension Project is provided in **Table 1.1** below.

**Table 1.1 Comparison of existing approved operations at Invincible and the Southern Extension Project**

| | Existing Approved Operations | Southern Extension Project |
|---|---|---|
| **Resource Tonnes** | Defined by existing footprint. Approved reserves have been mined. | Approximately 2.7Mt ROM coal |
| **Mining Methods** | Highwall and Open Cut | Open Cut only |
| **Target Seams** | All seams down to Lithgow Seam (Irondale, Lidsdale and Lithgow) | All seams down to Lithgow Seam (Irondale, Lidsdale and Lithgow) |
| **Mining Rate** | Up to 1.2 Mtpa ROM Coal | Up to 1.2 Mtpa ROM Coal |
| **Production Rate** | Up to 1.2 Mtpa Product Coal | Up to 1.2 Mtpa Product Coal |
| **Mining Life** | To December 2016 (8 years from date of approval) | Up to 8 years from date of approval |
| **Disturbance Area** | 165 ha | Approximately 50 ha of additional disturbance |
| **Operational Workforce** | 35 full time personnel. | Approximately 35 full time personnel. |

| | Existing Approved Operations | Southern Extension Project |
|---|---|---|
| **Hours of operations** | 7.00 am – 10.00 pm Monday to Saturday (excl. public holidays). Mining in south pits not permitted between 6.00 pm and 10.00 pm. | 7:00 am-10.00 pm Monday to Saturday (excl. public holidays). Mining and coal washery operations will not occur between 6.00 pm and 10.00 pm (operations limited to truck loading and maintenance activities only during this period). |
| **Blasting** | Blasting between 9:00 am and 5:00 pm Monday to Saturday, inclusive.<br>No more than:<br>• 2 blasts per day; or<br>• 5 blasts per week averaged over a 12 month period. | Blasting between 9:00 am and 5:00 pm Monday to Saturday, inclusive.<br>No more than:<br>• 2 blasts per day; or<br>• 5 blasts per week averaged over a 12 month period.<br>Blasts sizes limited to manage potential risks to private residences, pagoda and cliffline formations, historical sites and other infrastructure. |
| **Transport** | Road Transport 7.00 am – 9:30 pm Monday to Saturday, excluding Sundays and public holidays.<br>No more than 146 laden coal truck movements from the site per day (averaged over a week).<br>No more than 16 laden coal truck movements per hour. | Road Transport 7.00 am – 9:30 pm Monday to Saturday, excluding Sundays and public holidays.<br>No more than 146 laden coal truck movements from the site per day (averaged over a week).<br>No more than 16 laden coal truck movements per hour. |
| **Tailings Management** | Coarse tailings are co-disposed with overburden. Fine tailings are dried in drying ponds; dry tailings are then either mixed with product coal or co-disposed with overburden. | Coarse tailings are co-disposed with overburden. Fine tailings are dried in drying ponds; dry tailings are then either mixed with product coal or co-disposed with overburden. |

## 1.2 Southern Extension Area information

For the purposes of this Biodiversity Assessment Report (BAR), the Southern Extension Area for the Southern Extension Project is the total area of impact (refer to **Figure 1.3**), which comprises approximately 50 hectares. This is referred to as the Southern Extension Area throughout the report.

### 1.2.1 Location

Invincible is located approximately 25 kilometres north-west of Lithgow in NSW (refer to **Figure 1.1**). The Southern Extension Area is located within the South Eastern Highlands IBRA bioregion and the Capertee IBRA subregion. Refer to **Figure 1.3** and **Figure 1.4** for the location of the Southern Extension Area and other relevant landscape features.

**Table 1.1 Southern Extension Area Location in the Landscape**

| Invincible Southern Extension Area | |
|---|---|
| **IBRA Bioregion** | South Eastern Highlands |
| **IBRA Subregion** | Capertee |
| **Major Catchment Area** | Central West |
| **Mitchell Landscape** | Newnes Plateau |
| **LGA** | Lithgow |
| **Address** | Castlereagh Highway, Cullen Bullen NSW 2790 |

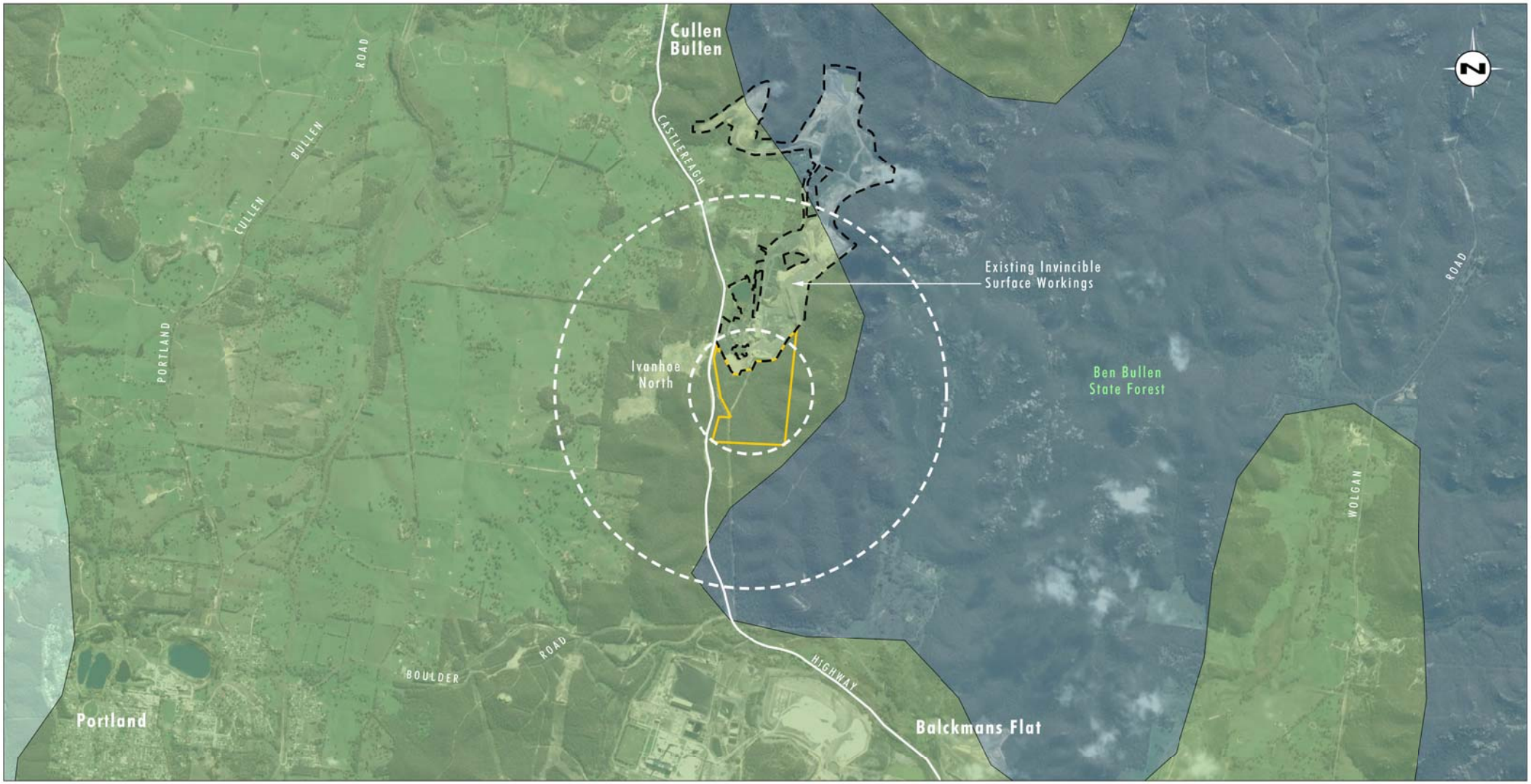


Image Source: Google Earth · CNES/Astrium (May 2014)
Data Source: OEH (2012)

0 0.5 1.0 2.0km

## Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Assessment Circles

IBRA Subregions:

- Capertee Uplands
- Hill End
- Wollemi

FIGURE 1.3

**Location Map**
**IBRA V7 Regions**

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20160916 11.29

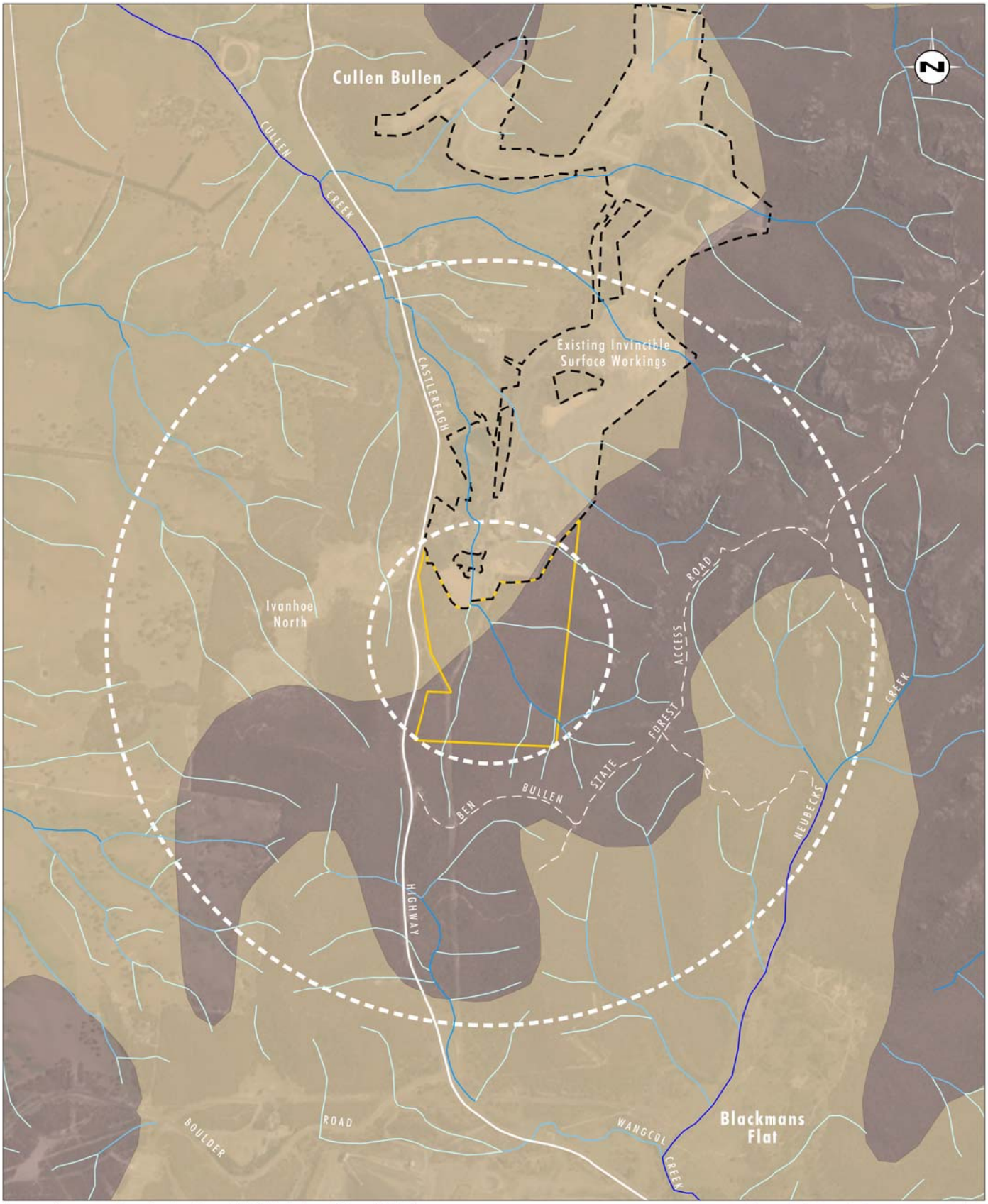



Image Source: Google Earth - CNES/Astrium (Nov 2014)
Data Source: OEH (2012)

## Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Assessment Circles

Mitchell Landscapes:
- Capertee Plateau
- Newnes Plateau

Stream Order:
- Stream Order 1
- Stream Order 2
- Stream Order 3
- Stream Order 4

FIGURE 1.4

**Location Map**
**Landscape Features**

### 1.2.2 Size

The approved Invincible disturbance footprint is approximately 165 hectares in size. The Southern Extension Area, (referred to in this report as the Southern Extension Area) covers an additional approximately 50 hectares. Both the approved Invincible Disturbance area and the Southern Extension Area are shown on **Figure 1.2**.

### 1.2.3 Topography and natural features

The topography surrounding the Southern Extension Area is generally characterised by steep forested slopes and escarpments within the Ben Bullen State Forest to the north, east and south and the Castlereagh Highway to the west. Elevations within the Southern Extension Area range from approximately 912 metres AHD in the south to 997 metres AHD in the east.

The Southern Extension Area lies entirely within the upper catchment of Cullen Creek. Cullen Creek is an ephemeral stream that rises in the steep hills of the Ben Bullen Range. It flows in a north-westerly direction before joining Delhuntys Creek approximately 4 kilometres (km) downstream of Invincible Colliery, which in turn joins Williwa Creek before discharging into the Turon River. The confluence with the Turon River is approximately 25 kilometres downstream of the Southern Extension Area.

Invincible and the Southern Extension Area are located on the western slopes of the Great Dividing Range, approximately 25 km north-west of Lithgow, NSW. The village of Cullen Bullen is located approximately 3 km north-west of the Invincible mine infrastructure area. The Southern Extension Area is located within the Ben Bullen State Forest to the east of the Castlereagh Highway. The Southern Extension Project is located in an area of historical mining operations associated with western coalfields of NSW, including the former mining operations at Cullen Valley, Baal Bone Colliery, Pine Dale and Ivanhoe Colliery. The Castlereagh Highway runs in a north-south alignment west of Invincible and the Southern Extension Area (refer to **Figure 1.2**). A number of rural landholdings are located on the western side of the Castlereagh Highway.

## 1.3 Project design changes to avoid ecological impacts

The Southern Extension Project avoids direct impacts on the large sandstone outcrops and pagoda landscape features that occur in this locality and the Southern Extension Area represents an area of relatively homogenous vegetation types and relatively low threatened species diversity and habitats.

Previous applications for mining at Invincible were withdrawn or were refused through the assessment process. One of the key reasons given for refusing approval was the potential impact of mining on the broad-headed snake and the impact on the high biodiversity values associated with pagoda landscapes. It is noted that the previous assessments included substantially larger areas of disturbance in closer proximity to pagodas and associated high value habitat, particularly associated with the narrow steep valley habitats that occur to the north east of the Southern Extension Area.

Many of the impacts of the previous proposals have been avoided by the current Project design, in particular, the avoidance of impacts on high biodiversity value pagoda habitat. Based on research regarding the broad-headed snake's foraging habitats, the PAC for the 2014 Modification Project recommended a minimum setback for mining of 300 metres from all pagodas. To address the key concerns the PAC had regarding potential impacts on the broad-headed snake the limit of disturbance associated mining in the Southern Extension Area was initially set back at least 300 metres from all pagoda formations. The setback to one single nearest pagoda was reduced to approximately 210 metres following further investigations which identified that winter habitat features for the species at the pagoda were generally absent. Notwithstanding, a conservative approach to this assessment has been completed), which has identified tree hollows for the species during spring and summer foraging periods within the Southern Extension Area. It is noted that only one minor pagoda is located at a distance of 210 metres with all other pagodas located at least 300 metres from the Southern Extension Area.

Notwithstanding, incorporating this setback from pagoda structures has resulted in an area of potentially mineable resources, which was previously proposed as part of the 2014 Modification Project, in the north east of the Invincible South area not being mined. Future extraction of the coal in this area is unlikely once the disturbed areas to the west of it are rehabilitated.

The Southern Extension Project does not impact on the steep valleys between pagoda formations and the Southern Extension Area does not hold the same high biodiversity values as areas to the north, which were proposed to be impacted by previous applications, where the terrain features result in a diverse range of vegetation communities and rocky habitat features being in close proximity. Similarly the pagodas located directly to the east of the Southern Extension Project are typically smaller in scale and are associated with much drier vegetation communities than the more significant terrain features associated with the more northerly pagodas. The pagoda landscape occurs primarily within the Hawkesbury Nepean catchment which comprises different landscape and biodiversity features compared to the Permian environment of the Central West catchment in which the Southern Extension Project is located.

The Southern Extension Project does not include any highwall mining or other underground mining and will not have any subsidence impacts that may affect the pagodas. Moreover, detailed project design considers potential indirect impacts on pagoda structures from blasting, which have been addressed through definition of conservative impact criteria for vibration, appropriate design to meet criteria and commitment to ongoing monitoring and management.

It is also noted that at the time the previous applications were assessed the FBA was not in place and therefore the framework for assessing and quantifying the biodiversity impacts of the Projects were less clearly defined. This Project has been assessed in accordance with the FBA which allows for the quantification of impacts and the identification of clear offset requirements and the mechanisms by which these offsets can be achieved. As detailed further in this report, FBA requirements for the broad headed snake requires consideration of habitat within 500m of winter habitat, which may be associated with pagoda structures.

## 1.4 Key resources, policies and documents

The following key resources, policies and documents were used to prepare the BAR for the Southern Extension Project:

- Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major Projects (OEH September 2014)
- BioBanking Assessment Methodology 2014 (OEH September 2014)
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities –Working Draft (DEC 2004)
- BioBanking Credit Calculator (Major Project Assessment Type) accessed in June 2016
- Vegetation Information System (VIS) Classification Database (OEH 2016), accessed in June 2016
- OEH Atlas of NSW Wildlife database and mapping tool (OEH 2016), accessed in June 2016
- OEH Threatened Species Profile Database (TSPD)
- Department of the Environment (DoE) Protected Matters Database (DoE 2016), accessed in June 2016
- Ecological Assessment for the Coalpac Consolidated Project (Cumberland Ecology 2012) and
- Ecological Assessment for the Cullen Valley Modification and Invincible Quarry Modification (Cumberland Ecology 2014).

## 1.5 Report preparation

This BAR was prepared by Shaun Corry (Senior Ecologist) with review and technical direction from Allison Riley (Principal Ecologist). Shaun and Allison are accredited under the NSW *Threatened Species Conservation Act 1995* as BioBanking and BioCertification Assessors from Umwelt.

# 2.0 Methods

## 2.1 Landscape features

### 2.1.1 Identifying landscape features

Landscape features within the Southern Extension Area and the inner and outer assessment circles were determined through reviewing aerial photography and relevant GIS layers. Landscape features and classifications that were relevant to the Southern Extension Area and surrounds included:

- IBRA bioregions and IBRA subregions
- Mitchell landscapes
- Rivers, streams and estuaries (using the Strahler (1952) ordering system)
- Wetlands
- Native vegetation extent
- State and/or Regional Biodiversity Links.

### 2.1.2 Determining landscape value

Determining the 'Landscape Value' of the Southern Extension Area is calculated by assessing the following landscape attributes:

- Percent Native Vegetation Cover
- Connectivity Value
- Patch Size.

#### 2.1.2.1 Percent native vegetation cover

'Percent Native Vegetation Cover' is determined by the current percent native vegetation cover and the future percent native vegetation cover within the inner and outer assessment circles. This was determined using digital aerial photography[1] interpretation using the Manifold GIS software package. Aerial photographs captured during 2013 (LPI 2016) and 2015 (Google 2016) were used to digitise all native vegetation within the assessment circles. Further refinement of these areas was undertaken following field surveys of the Southern Extension Area.

The inner and outer assessment circles must be at a 1:10 ratio and one of the combinations from Table 8 of Appendix 4 of the FBA (OEH 2014b). Due to the size and configuration of the Southern Extension Area, it was determined that a 100 hectare inner assessment circle and 1000 hectare outer assessment circle was the most appropriate combination. These circles were then centred on the Southern Extension Area which represents the area of native vegetation most impacted by the Southern Extension Project.

[1] Aerial photography for the purposes of this report includes photographs and digital imagery derived from aerial and satellite platforms.

#### 2.1.2.2 Connectivity value

To determine the connectivity value, the Southern Extension Area was assessed for the presence of native vegetation connecting links, state, regional or local biodiversity links as required by the FBA (OEH 2014b).

Connecting links are present when an area of native vegetation in a Southern Extension Area is adjoined to other areas of native vegetation and it is:

- in moderate to good condition
- has a patch size of > 1 hectare
- is separated by a distance of < 100 metres (or ≤ 30 metres for non-woody ecosystems)
- is not separated by a large waterbody, dual carriageway, wider highway or similar.

State biodiversity links are defined as links which have been identified as important on a state scale. State biodiversity links are identified in a plan approved by the Chief Executive of OEH or are a riparian buffer either side of a 6$^{th}$ order stream (using the Strahler (1952) ordering system), or greater or either side of an important wetland or estuarine area.

Regional biodiversity links are recognised as important links at a regional scale. Regional biodiversity links are identified in a plan approved by the Chief Executive of OEH or are a riparian buffer either side of a 4$^{th}$ or 5$^{th}$ order stream.

#### 2.1.2.3 Patch size

A 'Patch' is an area of native vegetation that:

- occurs on the Southern Extension Area
- is in moderate to good condition
- includes native vegetation that has a gap of less than 100 metres from the next area of moderate to good condition native vegetation (or ≤ 30 metres for non-woody vegetation).

The patch may extend onto adjoining land that is not part of the Southern Extension Area. An assessment of the patch size class and the patch size score was then determined using Table 15 of the FBA (OEH 2014b).

## 2.2 Native vegetation assessment

### 2.2.1 Literature and database review

A review of previous documents and reports relevant to the Southern Extension Area was undertaken. This included regional and sub-regional vegetation mapping reports, site-specific monitoring surveys, ecological surveys undertaken in the vicinity of the Southern Extension Area and also relevant ecological database searches. The information obtained was used to inform survey design, and was also used to assist in the assessment of potentially occurring threatened and migratory species, EPs and TECs. Relevant documents included:

- Vegetation of the Western Blue Mountains (DEC 2006a)
- Coalpac Consolidation Project Ecological Impact Assessment (Cumberland Ecology 2012)
- Ecological Assessment for the Cullen Valley Modification and Invincible Colliery Modification (Cumberland Ecology 2014)
- VIS Classification Database (OEH 2016), accessed February 2016
- OEH Threatened Species Website for known/predicted Threatened Ecological Communities (TECs) in the Capertee subregion, accessed February 2016
- DoE Protected Matters Search Tool for known/predicted EPBC Act-listed TECs, accessed February 2016.

### 2.2.2 Digital aerial photograph interpretation

Digital imagery (aerial photographs) of the Southern Extension Area was viewed prior to and after vegetation survey to identify spatial patterns in vegetation, land use and landscape features. These informed field survey design and implementation, ecological assessment and vegetation community mapping in the Southern Extension Area.

Manifold System 8.0 Universal Edition geographical information system (GIS) was used to view digital imagery on-screen. Additionally, SIX Maps (LPI 2016) and Google Earth (Google 2016) were used to examine topographic variation across the landscape. Use of GIS and Google Earth allowed for zooming to a relatively large scale. Using this method, mapping was carried out at a scale of approximately 1:4,000; at times observations were made at a larger resolution of approximately 1:1,000. A 1:4,000 zoom was considered appropriate for plant community delineation, with larger zoom used to make fine-scale observations.

In addition to contemporary aerial imagery of the Southern Extension Area, digital imagery from 2006 and 2015 was also viewed in SIX maps (LPI 2016) and Google Earth (Google 2016) to inform the assessment, particularly in relation to the changes in vegetation patterns and land use over this period. The Manifold System 8.0 Universal Edition GIS was used for mapping with the GIS files exported to Bentley Microstation V8i for the purposes of preparing the figures for this report.

### 2.2.3 Systematic plot/transect surveys

A total of 10 systematic plots/transect surveys were conducted across the Southern Extension Area during the surveys undertaken for this assessment (refer to **Figure 2.1**). These surveys were undertaken over five days in one survey period between 11 and 15 January 2016. Additional survey was also undertaken on 18 and 19 April 2016 to further refine the vegetation mapping.

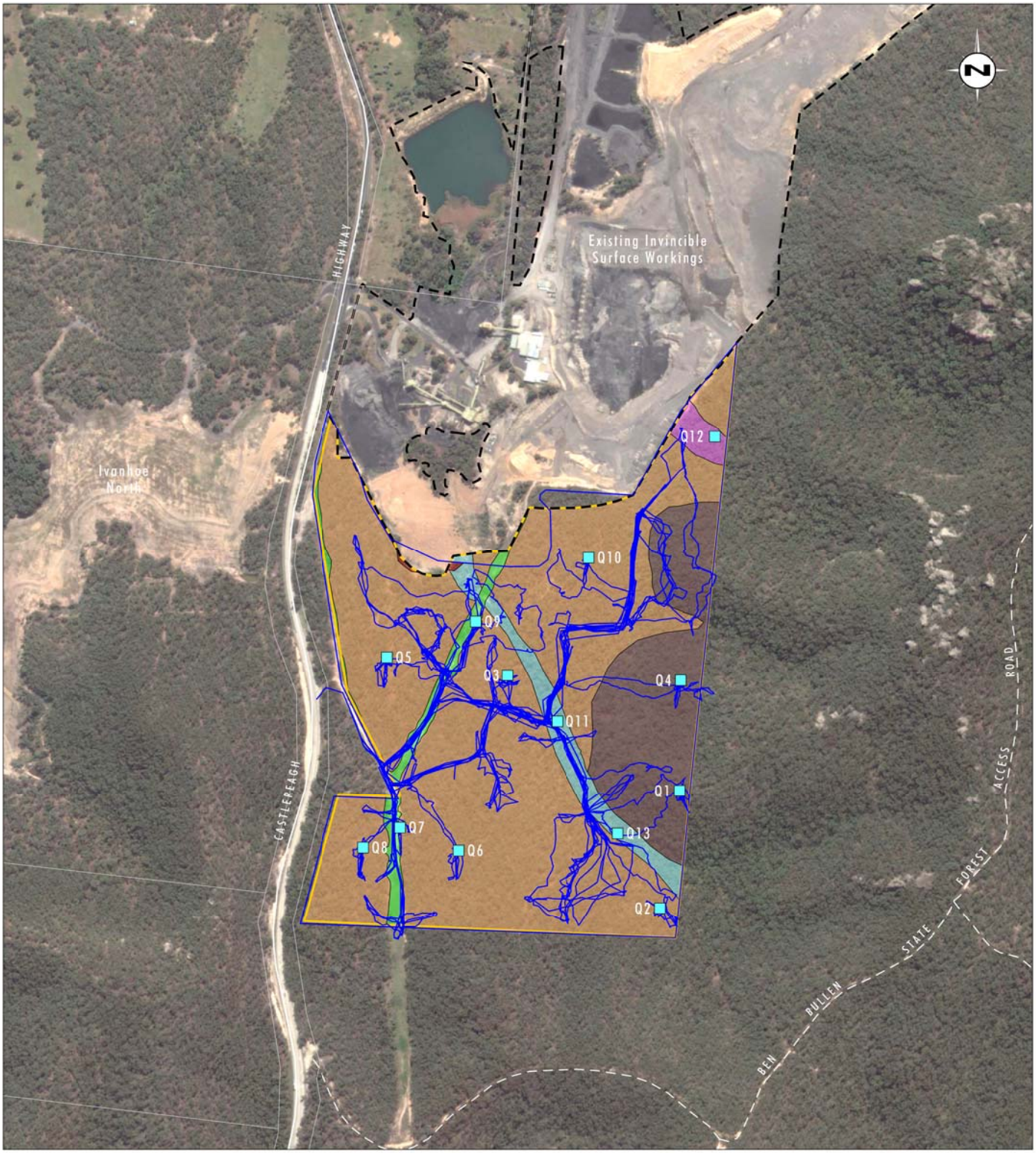



Image Source: Google Earth - CNES/Astrium (March 2015)
Data Source: LPI (2016)

0 100 250 500m

## Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Cleared Area
- Zone 1 - CW117 - Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion (Modertae to Good)
- Zone 2 - CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good)
- Zone 3 - CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good/High)
- Zone 4 - CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good/Moderate)
- Zone 5 - CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good/Other)
- Flora Survey Locations
- Flora Survey Tracks

FIGURE 2.1

**Flora Survey Locations**

#### 2.2.3.1 Plot/transect selection and stratification of the Southern Extension Area

Designing an appropriate survey requires consideration of both survey methods and effort. Reference was made to the VIS Classification Database to identify Plant Community Types (PCTs), as well as reviews of other regional and local vegetation mapping and reporting (refer to **Section 2.2.1**) when designing the field survey. The PCTs were then stratified into Vegetation Zones (condition states) following the initial field survey of the site to determine the appropriate number of transect/plots required in accordance with the BioBanking and FBA Methodology (OEH 2014b) as outlined in **Table 2.1**.

**Table 2.1 Minimum number of plots/transects required per zone area (OEH 2014b)**

| Vegetation Zone Area (ha) | Minimum Number of Plot/Transect |
|---|---|
| 0-4 | 1 transect/plot per 2 ha (or part thereof) or 1 transect/plot if vegetation is in low condition |
| >4-20 | 3 transects/plots or 2 transects/plots if vegetation is in low condition |
| >20-50 | 4 transects/plots or 3 transects/plots if vegetation is in low condition |
| >50-100 | 5 transects/plots or 3 transects/plots if vegetation is in low condition |
| >100-250 | 6 transects/plots or 4 transects/plots if vegetation is in low condition |
| >250-1000 | 7 transects/plots or 5 transects/plots if vegetation is in low condition<br>(More transects/plots may be needed if the condition of the vegetation is variable across the zone) |
| >1000 | 8 transects/plots or 5 transects/plots if vegetation is in low condition or in a homogenous landscape in the Western Division<br>(More transects/plots may be needed if the condition of the vegetation is variable across the zone) |

**Table 2.2** below outlines the adequacy of the plot-based flora survey with respect to the BioBanking Methodology (OEH 2014b) pertinent to the Southern Extension Area.

**Table 2.2 Adequacy of vegetation survey in the Southern Extension Area**

| Vegetation Zone | BVT and Condition Class | Area in the Southern Extension Area (ha) | No. Plots and Transects Sampled (No. Required in parentheses) |
|---|---|---|---|
| 1 | CW117_Moderate/Good | 8.24 | 2(3)* |
| 2 | CW263_Moderate/Good | 36.50 | 6 (4) |
| 3 | CW263_Moderate/Good_High | 0.62 | 1 (1) |
| 4 | CW263_Moderate/Good_Medium | 2.25 | 2 (2) |
| 5 | CW263_Moderate/Good_Other | 1.65 | 2 (1) |
| **Total** | | | **13 (11)** |

*Following the completion of the vegetation community analyses using the VIS classification, an area of CW263 (assumed to be CW263 during surveys and surveyed accordingly) was remapped as CW117. As a result, we have a surplus of plots for the CW263 community and deficit for CW117. For the purposes of the BCC, the plot data for the third plot required for the calculator was derived from the mean value of the other two plots for each of the site values.

#### 2.2.3.2 Plot/transect data collected

At each plot/transect data was recorded according to the BioBanking Assessment Methodology 2014 (BBAM 2014). This involved setting out 20 x 50 metre and 20 x 20 metre plots and a 50 metre transect. The location of each quadrat was recorded using a hand-held GPS with accuracy of ± 5 metres. The Map Grid of Australia (MGA) coordinate system was used. The location of the 13 plots/transects undertaken within the Southern Extension Area is shown on **Figure 2.1**.

At each plot/transect, approximately 45 to 60 minutes was spent searching for all vascular flora species present within the 20 x 20 metre plot. Searches of each 20 x 20 metre plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, which usually supported well over half of the species present, however the composition of the shrub, mid-storey, canopy and emergent layers were also thoroughly examined. Effort was made to search the tree canopy and tree trunks for mistletoes, vines and epiphytes.

The following data was recorded for each plot/transect:

- Native plant species richness
- Stratum and layer in which each species occurs
- Growth form for each species recorded
- Scientific name and common name of each species recorded
- Native foliage cover (including over storey, mid storey, ground)
- Cover and abundance
- Exotic plant cover
- Number of trees with hollows
- Over-storey regeneration
- Total length of fallen logs.

Additional details were also recorded in each quadrat, including soil texture, drainage and depth; site disturbances; physiography (position in the landscape); and vegetation structure (strata percentage covers, heights and dominant species). Photographic records were also taken at each site.

### 2.2.4 Meandering transects

Meandering transects were undertaken through vegetation units across much of the Southern Extension Area, particularly for the delineation and refinement of vegetation mapping and searching for threatened and otherwise significant species, endangered populations and TECs (refer to **Figure 2.1**). Meandering transects enabled floristic sampling across a much larger area than systematic quadrats, allowing the survey to achieve a combination of detailed observation and broader appreciation. Records along transects

supplemented floristic sampling carried out as part of quadrat survey, however, the data collected was in the form of presence records, rather than semi-quantitative cover abundance scores (note that the cover and abundance of additional species was generally low). Where meandering transects revealed significant variation within a vegetation unit, or a potential new vegetation community, additional quadrat survey was undertaken.

Meandering transects provided invaluable information on spatial patterns of vegetation that informed vegetation community mapping of the Southern Extension Area.

### 2.2.5 Plant identification and nomenclature standards

All vascular plants recorded or collected within quadrats and on meandering transects were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Jacobs *et al.* (2008). Where known, changes to nomenclature and classification have been incorporated into the results. Updated taxonomy has been derived from the Australian Plant Census (CHAH 2011), an Australian Government sponsored database which provides a list of currently accepted names for Australian vascular flora.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

### 2.2.6 Vegetation mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Southern Extension Area. Vegetation mapping involved the following key steps:

- review of digital airborne imagery to explore vegetation distribution patterns as dictated by change in canopy texture, tone and colour, as well as topography
- review of the modelled distribution of vegetation communities as part of the Vegetation of the Western Blue Mountains (DEC 2006a)
- review of the modelled distribution of vegetation communities as part of the Reconstructed and Extant Distribution of Native Vegetation in the Central West and Lachlan Catchment (DEC 2006b)
- review of the vegetation community mapping within the Coalpac Ecological Assessment (Cumberland 2012)
- preparation of draft vegetation community map based on interpretation of digital airborne imagery and preliminary delineation of vegetation community floristics
- ground-truthing of vegetation map based on survey effort documented in **Section 2.2**
- preliminary consultation with OEH (Central-West Unit)
- revision of vegetation community floristic delineations based on plot data
- revision of the vegetation map based on ground-truthing.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata. Communities were named in accordance with their site character, with consideration of the naming conventions of those vegetation communities mapped by DEC (2006) and the NSW Biometric vegetation types database (version updated June 2008; OEH 2014b).

### 2.2.7 Threatened ecological community delineation techniques

Vegetation communities identified in the Southern Extension Area were compared to TECs listed under the Commonwealth EPBC Act and NSW TSC Act and an assessment of similarity with the NSW Scientific Committee Final Determinations and the Commonwealth Threatened Species Scientific Committee Listing and Conservation Advice.

The following approach was used:

- full-floristic quadrat assessment, and meandering survey to determine floristic composition and structure of each ecological community
- comparison with published species lists, including lists of 'important species' as identified on the listing advice provided by the NSW Scientific Committee and/or Commonwealth Threatened Species Scientific Committee
- comparison with habitat descriptions and distributions for listed TECs
- assessment using guidelines and recovery plans published by the Commonwealth DoE and the NSW OEH
- comparison with other assessments of TECs in the region.

## 2.3 Threatened species

### 2.3.1 Literature and database review

A review of previous documents and reports relevant to the Southern Extension Area was undertaken. This included reports, previous ecological surveys undertaken in the vicinity of the Southern Extension Area and also relevant ecological database searches. The information obtained was used to inform survey design, and was also used to assist in the assessment of potentially occurring threatened and migratory species and endangered populations. Relevant documents included:

- Ecological Assessment for the Coalpac Development (Cumberland Ecology 2012)
- OEH Threatened Species Website for known/threatened species and Threatened Ecological Communities (TECs) in the Capertee subregion, accessed June 2016
- PlantNET (Royal Botanic Gardens Sydney) database search for Rare or Threatened Australian Plant species within the Lithgow LGA, accessed June 2016
- DoE Protected Matters Search Tool for known/predicted EPBC Act-listed threatened species and TECs, accessed June 2016.

A preliminary assessment using the BioBanking Credit Calculator was undertaken which provided a list of species credit species that might require survey and the suitable survey periods for each species. The results of the database searches, literature review and preliminary assessment using the BioBanking Credit Calculator were used to design the survey requirements for species credit species to ensure that adequate surveys were undertaken.

The Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC 2004) was considered when undertaking the threatened species surveys in the Southern Extension Area.

### 2.3.2 Species-credit flora surveys

Species-credit flora surveys were undertaken over 14 days and five survey periods:

- 25 to 26 August 2015
- 11 to 13 November 2015
- 11 to 15 January 2016
- 7 to 8 April 2016
- 18 to 19 April 2016.

A preliminary list of species-credit flora species with potential to occur in the Southern Extension Area was generated during the literature review, completion of database searches and preliminary assessment using the BioBanking Credit Calculator (BBCC). The preliminary list of potentially occurring species credit species was reviewed to remove species that are not known to occur in the local area or species for which there was a lack of suitable habitat in the Southern Extension Area. **Table 2.3** identifies the species-credit flora species that may occur in the Southern Extension Area and that required targeted and seasonal surveys.

**Table 2.3 Species-credit flora species requiring targeted survey**

| Common Name | Scientific Name | TSC Status | EPBC Status | Required Survey Period^ | Source |
|---|---|---|---|---|---|
| | *Derwentia blakelyi* | V | - | All year | BBCC |
| Black gum | *Eucalyptus aggregata* | V | - | All year | OEH Atlas of NSW Wildlife |
| Capertee stringybark | *Eucalyptus cannonii* | V | | All year | OEH Atlas of NSW Wildlife |
| Evans grevillea | *Grevillea evansiana* | V | - | All year | BBCC |
| Clandulla geebung | *Persoonia marginata* | V | | All year | OEH Atlas of NSW Wildlife |
| | *Pultanaea* sp. *Olinda* | E | - | All year | BBCC |
| Rylestone bell | *Leionema sympetalum* | V | V | All year | BBCC |
| silky Swainson-pea | *Swainsona sericea* | V | - | September - March | BBCC |

^ Months that surveys are required according to the Threatened Species Profile Database for the Central West CMA.

Throughout flora surveys of the Southern Extension Area, targeted searches were carried out for threatened flora species that are known to occur in the vicinity of the Southern Extension Area or were considered likely to occur based on the species' known distribution and the presence of suitable habitat. Searches for these species were undertaken in suitable habitat along numerous walking meandering transects and within the plot and transect surveys. The seasonal requirements of all species-credit flora species with potential to occur within the Southern Extension Area were met by the August, November and January survey periods.

### 2.3.3 Species-credit fauna surveys

Species-credit fauna surveys undertaken over 14 days and five survey periods:

- 25 to 26 August 2015
- 11 to 13 November 2015
- 11 to 15 January 2016
- 7 to 8 April 2016 and
- 18 to 19 April 2016.

A preliminary list of species-credit fauna species with potential to occur in the Southern Extension Area was generated during the literature review, completion of database searches and preliminary assessment using the BioBanking Credit Calculator (BBCC). The preliminary list of potentially occurring species-credit fauna species was reviewed to remove species that are not known to occur in the local area or species for which there was a lack of suitable habitat in the Southern Extension Area. **Table 2.4** identifies the species-credit fauna species that may occur in the Southern Extension Area and that required targeted survey.

**Table 2.4 Species-credit fauna species requiring targeted survey**

| Common Name | Scientific Name | TSC Status | EPBC Status | Required Survey Period^ | Source |
|---|---|---|---|---|---|
| Booroorlong frog | *Litoria booroolongensis* | E | E | November – February | OEH Atlas of NSW Wildlife |
| broad-headed snake | *Hoplocephalus bungaroides* | V | V | March – November | OEH Atlas of NSW Wildlife |
| brush-tailed phascogale | *Phascogale tapoatafa* | V | | All year | BBCC |
| eastern pygmy possum | *Cercartetus nanus* | V | - | September – April | BBCC |
| koala | *Phascolarctos cinereus* | V | V | All year | BBCC |
| large-eared pied bat | *Chalinolobus dwyeri* | V | V | September – April | OEH Atlas of NSW Wildlife |
| regent honeyeater | *Anthochaera phrygia* | CE | CE | All year | OEH Atlas of NSW Wildlife |

| Common Name | Scientific Name | TSC Status | EPBC Status | Required Survey Period^ | Source |
|---|---|---|---|---|---|
| squirrel glider | *Petaurus norfolcensis* | V | - | All year | BBCC |

^ Months that surveys are required according to the Threatened Species Profile Database for the Central West CMA.

Targeted surveys were undertaken for the species listed in **Table 2.4** that included a range of survey techniques including targeted searches, trapping, call playback, spotlighting and remote detection surveys. Throughout surveys of the Southern Extension Area, opportunistic surveys for these species were undertaken in suitable habitat along numerous walking meandering transects. The seasonal requirements of all species-credit fauna species with potential to occur within the Southern Extension Area were met by the August, November and January survey periods. The details of these surveys are discussed in the sections below and specific survey locations are shown on **Figure 2.2.**

#### 2.3.3.1 Broad-headed snake surveys

Targeted searches for broad-headed snake were undertaken in November 2015 within the Southern Extension Area (refer to **Figure 2.2**). The searches targeted the identification of potential rocky habitat and involved traversing rocky areas and looking in cracks, crevices and under rocks in the warmest parts of the day along with targeted nocturnal survey as recommended in the *Survey Guidelines for Australia's Threatened Reptiles* (DSEWPC 2011). The hollow-bearing trees within the Southern Extension Area that may provide potential summer habitat for this species were mapped in an additional visit to the Southern Extension Area in April 2016.

In addition, diurnal herpetological searches were undertaken in 10 locations across the Southern Extension Area, specifically targeting sheltering broad-headed snakes. During the search likely micro-habitats were examined including around waterbodies, beneath rocks and logs, in tree bark and in ground litter. Each survey consisted approximately 1 person hour of survey, totalling 10 hours of diurnal herpetological surveys.

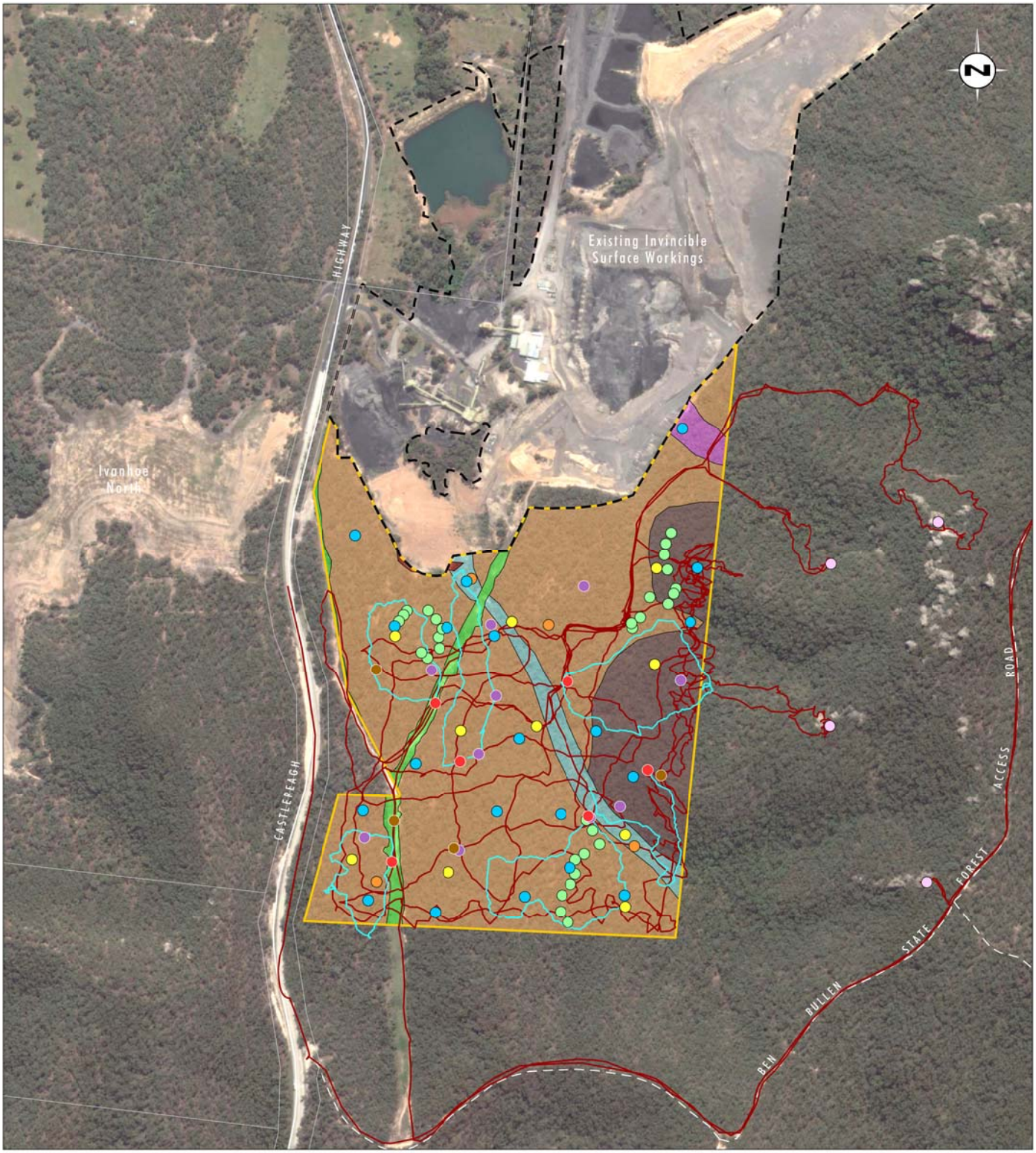



Image Source: Google Earth - CNES/Astrium (March 2015)
Data Source: LPI (2016)

## Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Cleared Area
- Zone 1 - CW117 - Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion (Modertae to Good)
- Zone 2 - CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good)
- Zone 3 - CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good/High)
- Zone 4 - CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good/Moderate)
- Zone 5 - CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good/Other)
- Broad-headed Snake Survey Track
- Spotlighting Transect
- Anabat
- Bird, Reptile and Amphibian Point
- Broad-headed Snake Habitat Assessment Point
- Call Playback
- Habitat Assessment
- Remote Camera
- Trapping Point
- Winter Bird Survey Point

FIGURE 2.2

**Fauna Survey Locations**

**File Name (A4):** R04/3622_069.dgn
20160916 11.49

#### 2.3.3.2 Regent honeyeater and swift parrot surveys

Targeted regent honeyeater and swift parrot surveys were undertaken across two days in August 2015. The bird surveys targeted areas of flowering eucalypts containing other nectarivorous species such as lorikeets and honeyeaters. A total of 10 targeted surveys were undertaken within the Southern Extension Area (refer to **Figure 2.2**). Each survey consisting of a 5 minute period of call playback for both species followed by 15 minutes of searching which consisted of a slow walking transect within a two hectare area.

Bird species were identified from characteristic calls and by observation using binoculars with magnification up to 10 x. Opportunistic observations were recorded during all other aspects of the field survey.

#### 2.3.3.3 Eastern pygmy possum, brush-tailed phascogale and squirrel glider surveys

The brush-tailed phascogale, eastern pygmy possum and squirrel glider were specifically targeted through arboreal Elliot trapping, arboreal hair funnels, spotlighting and remote camera census. Additionally, nocturnal call playback surveys were undertaken for the squirrel glider (refer to **Figure 2.2**).

Arboreal Elliott B traps were set approximately 10 metres apart on tree trunks, and were baited with a mixture of rolled oats, peanut butter and honey. Traps were positioned on platforms attached to the trunks of large trees, 3 to 4 metres above the ground. The trunk of the tree and entrance to the trap were sprayed with a honey and water mixture to attract arboreal mammals. Trap lines were targeted in areas of higher habitat value including along riparian corridors and dense canopied vegetation. A total of 13 arboreal Elliott B traps were set over 4 nights in the Southern Extension Area with a total of 52 arboreal Elliott B trap nights undertaken in February 2016.

Arboreal hair funnels were mounted on trees and were baited with a rolled oats, peanut butter and honey mixture. Arboreal hair funnels were positioned 1.5 to 2.0 metres above the ground on tree trucks or branches. The entrance to the hair funnel and the tree trunk were sprayed with a honey and water emulsion as an attractant. A total of 30 arboreal hair funnels were set over 4 nights in the Southern Extension Area with a total of 120 arboreal hair funnel sampling nights undertaken in February 2016. All collected hair samples were identified by Barbara Triggs of 'Dead Finish'.

Nocturnal spotlighting surveys, each of one person-hour, were undertaken in six locations within the Southern Extension Area over three nights. Spotlighting was conducted on foot within a two hectare area of each survey location using 30 watt Lightforce hand-held spotlights and head torch. Spotlighting was undertaken generally between 8.00 pm and 11:00 pm, commencing one hour after dusk. In addition, opportunistic spotlighting was undertaken from a slow-moving vehicle while travelling between fauna survey locations at night.

Bushnell Trophy Cam HDs (remote cameras) were mounted approximately 1 metre above the ground on a tree trunk and positioned towards a bait station containing tuna. The cameras were set to take three photos in quick succession when movement was detected. The remote cameras were programmed to record movement on an ongoing basis until removed from the site. The cameras were installed for four nights in 20 locations, totalling 80 nights of remote camera survey.

Nocturnal call-playback sessions targeting squirrel glider were undertaken at six locations within the Southern Extension Area. Call-playback sessions commenced with a quiet listening period of approximately five minutes. The squirrel glider call was played on a 15 watt directional loud hailer for a minimum of 4 minutes followed by a listening period of 2 minutes.

#### 2.3.3.4 Koala surveys

Koalas were targeted by conducting nocturnal call playback and walking and driving spotlighting surveys. Three koala SAT surveys were undertaken as part of the three habitat assessments undertaken in the woodlands (refer to **Figure 2.2**). These surveys involved searching a minimum of 10 known koala feed trees for the presence of koalas through direct observation, scats, scratch marks or other signs.

Nocturnal spotlighting surveys, each of one person-hour, were undertaken in six locations within the Southern Extension Area over two nights. Spotlighting was conducted on foot within a two hectare area of each survey location using 30 watt Lightforce hand-held spotlights and head torch. Spotlighting was undertaken generally between 8.00 pm and 11:00 pm, commencing one hour after dusk. In addition, opportunistic spotlighting was undertaken from a slow-moving vehicle while travelling between fauna survey locations at night.

Nocturnal call-playback sessions targeting koala were undertaken at six locations within the Southern Extension Area. Call-playback sessions commenced with a quiet listening period of approximately five minutes. The koala call was played on a 15 watt directional loud hailer for a minimum of 4 minutes followed by a listening period of 2 minutes.

Opportunistic notes on potential koala presence around known koala feed trees, including signs of scats and scratches on trees were taken throughout the surveys conducted in the Southern Extension Area.

#### 2.3.3.5 Reptile and amphibian surveys

The BBCC predicted the occurrence of Booroolong frog (*Litoria booroolongensis*) due to the geographic habitat feature of land within 100 metres of a stream or a creek. Despite these features being mapped within the Southern Extension Area, potential habitat for this species is marginal as the site is highly disturbed and stream or creek habitat that is identified on a topographic map within the site appears to have been substantially altered by the past underground mining (through subsidence and sinks) and is highly unlikely to even temporarily hold water.

Despite this, diurnal herpetological searches were undertaken in 10 locations across the Southern Extension Area (refer to **Figure 2.2**). During the search likely micro-habitats were examined including around waterbodies, beneath rocks and logs, in tree bark and in ground litter. Each survey consisted of approximately one person hour of survey, totalling 10 hours of diurnal herpetological surveys.

Nocturnal spotlighting surveys, each of one person-hour, were undertaken in six locations within the Southern Extension Area over three nights (refer to **Figure 2.2**). Spotlighting was conducted on foot within a two hectare area of each survey location using 30 watt Lightforce hand-held spotlights and head torch. Spotlighting was undertaken generally between 8.00 pm and 11:00 pm, commencing one hour after dusk. In addition, opportunistic spotlighting was undertaken from a slow-moving vehicle while travelling between fauna survey locations at night.

#### 2.3.3.6 Micro-bat habitat surveys

The large-eared pied bat is a species-credit species for roosting habitat containing escarpments, cliffs, saves, deep crevices and mine shafts and foraging habitat occurring in proximity to these features. Habitat searches for these features were conducted throughout the Southern Extension Area.

The presence of threatened micro-bat species was also surveyed using Anabat Express recording devices at four locations within the Southern Extension Area. At each site, the Anabat was positioned towards potential micro-bat flight paths to increase the likelihood of detecting micro-bat species and was left in situ for two entire nights. The Anabat detector was programmed to start recording from one hour before sunset to one hour after sunrise.

Recordings of bat calls were analysed by Dr Anna McConville from Echo Ecology Pty (a recognised expert in the identification of micro-bat calls). The echolocation calls of species were identified to one of three levels of confidence:

- confident
- probable, and
- possible.

## 2.4 Survey effort summary

The ecological surveys undertaken within the Southern Extension Area as documented above are summarised in **Table 2.5** below and shown on **Figures 2.1** and **2.2**.

**Table 2.5 Survey effort summary table**

| Survey Type | Total Survey Effort |
|---|---|
| **Vegetation Mapping/Floristic Sampling** | 13 BioMetric plots/transects<br>General meandering surveys |
| **Targeted Threatened Flora Searches** | general meandering searches for *Derwentia blakelyi,* black gum *(Eucalyptus aggregata),* Capertee stringybark *(Eucalyptus cannonii),* Evans grevillea *(Grevillea evansiana),* Clandulla geebung *(Persoonia marginata), Pultanaea* sp. *Olinda,* Rylestone bell *(Leionema sympetalum) and* silky Swainson-pea *(Swainsona sericea)* |
| **General Fauna Surveys** | 80 remote camera night/days<br>120 terrestrial Elliot A trapping nights<br>52 arboreal Elliot B trapping nights<br>120 arboreal hair funnel sampling nights<br>20 diurnal bird surveys<br>10 diurnal herpetofauna searches<br>6 nocturnal herpetofauna searches<br>6 call payback sessions for nocturnal birds and mammals<br>12 hours of spotlighting<br>8 microbat echolocation recording nights<br>4 habitat assessments<br>tree hollow searches |

| Survey Type | Total Survey Effort |
|---|---|
| **Targeted Threatened Fauna Surveys** | 10 diurnal bird surveys targeting regent honeyeater exclusively<br>6 hours of spotlighting ,12 hours of diurnal searches and four winter habitat assessments for broad-headed snake exclusively<br>6 call playback sessions, 6 spotlighting surveys and 3 spot assessments (SAT) for koala<br>6 call playback sessions, 6 spotlighting surveys and 52 arboreal trapping nights for squirrel glider<br>6 spotlighting surveys, 52 arboreal trapping nights and 80 remote camera nights for brush-tailed phascogale<br>6 spotlighting surveys and 52 arboreal trapping nights and 120 arboreal hair funnel sampling nights for eastern pygmy possum<br>6 nocturnal amphibian searches and 10 diurnal amphibian searches for booroolong frog<br>8 nights of microbat echolocation recording for the large-eared pied bat. |

# 3.0 Results

## 3.1 Landscape value

### 3.1.1 Landscape features

The outer assessment circle contains some prominent landscape features including large sandstone outcrops and pagodas. The outer assessment circle covers two Mitchell landscapes, being Newnes Plateau and Capertee Plateau, and an extensive area of native vegetation in the north and east of the circle. These landscape features are shown in **Figures 1.3** and **1.4**.

Landscape features that were considered in the connectivity value scores for the Southern Extension Area are outlined in **Table 3.1** below.

**Table 3.1 Landscape features in the Southern Extension Area**

| Landscape Features | |
|---|---|
| **IBRA Bioregion** | South Eastern Highlands |
| **IBRA Subregion** | Capertee |
| **Mitchell Landscape** | Newnes Plateau |
| **Rivers, Streams, Estuaries** | 1st, 2nd and 3rd order streams |
| **Wetlands** | None identified |
| **Native Vegetation** | 80 hectares in the inner assessment circle<br>739 hectares in the outer assessment circle |
| **State or Regional Biodiversity Links** | None identified |

### 3.1.2 Landscape value scores

#### 3.1.2.1 Percent native vegetation cover

**Table 3.2** details the percentage native vegetation cover before and after the proposed disturbance in the Southern Extension Area and the native vegetation per cent class entered into the BBCC as per Table 9 of Appendix 4 of the FBA (OEH 2014b).

**Table 3.2 Native vegetation cover in assessment circles**

| Assessment Circle | Before Development | | | After Development | | |
|---|---|---|---|---|---|---|
| | Area of Native Vegetation (ha) | Native Vegetation Cover (%) | Native Vegetation Percent Class | Area of Native Vegetation (ha) | Native Vegetation Cover (%) | Native Vegetation Percent Class |
| Outer (1,000 ha) | 739 | 74 | 71-75 | 692 | 68 | 66-70 |
| Inner (100 ha) | 80 | 80 | 76-80 | 33 | 29 | 30-35 |

### 3.1.2.2 Connectivity value

No state or regional significant biodiversity links were identified within a plan approved by the Chief Executive of OEH in the South Eastern Highlands. Although a number of tributaries run through the Southern Extension Area, including first, second and third order streams, these are not defined as state or regional significant biodiversity links under the FBA (OEH 2014b) (refer to **Figure 3.1**).

The site is completely covered in moderate to good condition native vegetation and joins with much larger areas on moderate to good condition native vegetation to the north, east and south associated with Ben Bullen State Forest and the Newnes Plateau State Forest. Therefore, the narrowest point of the link before and after the impact is >500 metres (refer to **Figure 3.1**).

Woody PCTs within the outer assessment circle were estimated for their current average condition for overstorey foliage cover and midstorey foliage cover. This was estimated based on review of publically available aerial photography from 2014, 2015 and 2016 (LPI 2016). The overstorey and midstorey per cent foliage cover of woody vegetation in the outer assessment circle was estimated to within benchmark. These are likely to remain the same after the Southern Extension Project.

Details of the connectivity value scores entered into the BBCC are shown in **Table 3.3** below.

**Table 3.3 Connectivity value scores**

| Attribute | Before Development | After Development |
|---|---|---|
| Connectivity Width Class | >500 | >500 |
| Connectivity Overstorey Condition | PFC within benchmark | PFC within benchmark |
| Connectivity Midstorey Condition | PFC within benchmark | PFC within benchmark |

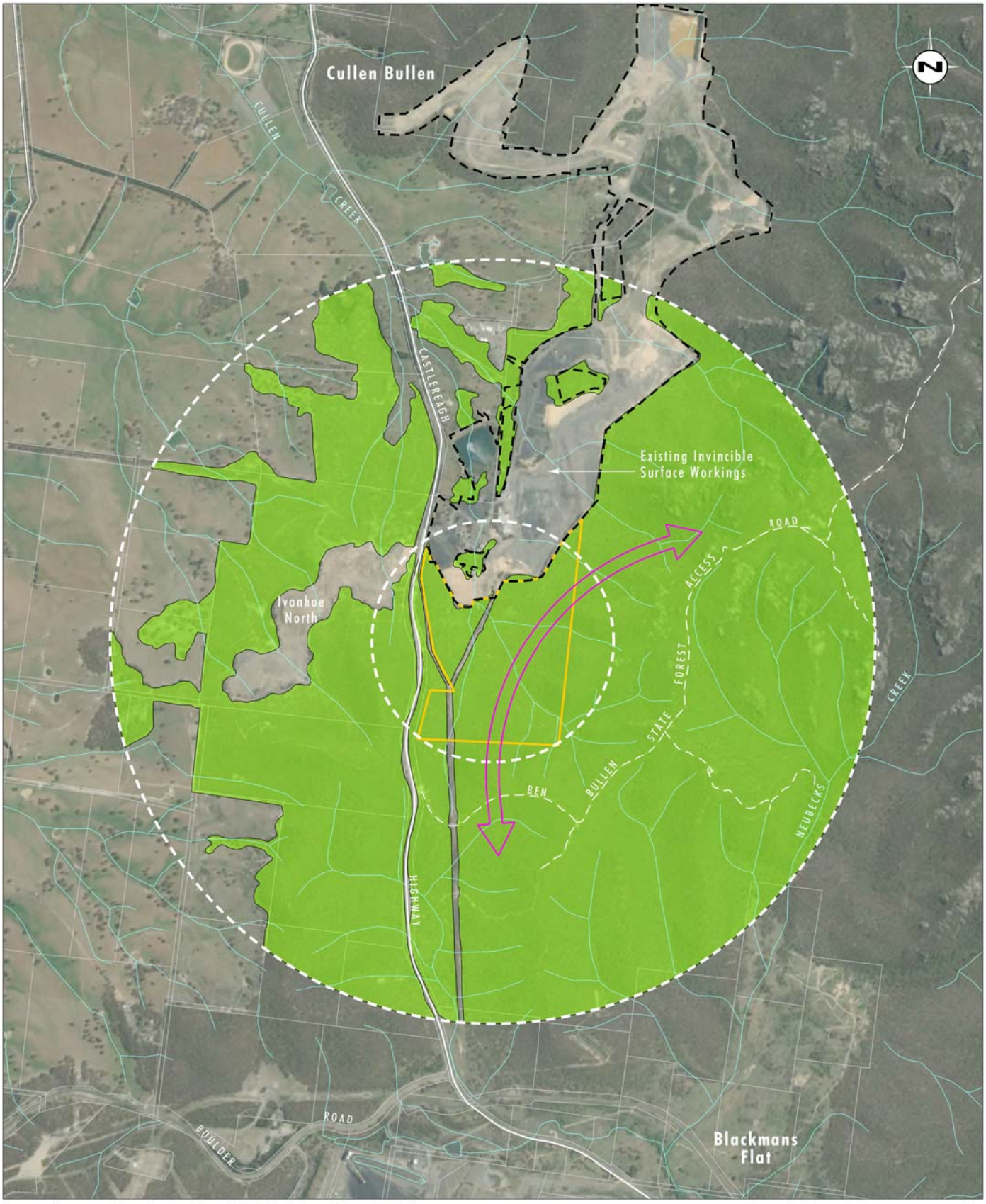



Image Source: Google Earth - CNES/Astrium (Nov 2014)
Data Source: LPI (2016)

0 0.25 0.5 1.0km

## Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Assessment Circles
- Native Vegetation
- Connecting Links

FIGURE 3.1

**Connectivity Value**

#### 3.1.2.3 Patch size

**Table 3.4** below details the parameters that determined the Patch Size score as per Table 15 of Appendix 4 of the FBA (OEH 2014b).

**Table 3.4 Patch size score parameters**

| | |
|---|---|
| **Mitchell Landscape** | Newnes Plateau |
| **Patch Size Class** | > 1000hectares |
| **Patch Size Score** | **12** |

#### 3.1.2.4 Landscape value score

The landscape value score for the Southern Extension Area is 16.2 as calculated by the BBCC.

## 3.2 Native vegetation within the Southern Extension Area

### 3.2.1 Biometric vegetation types and vegetation zones

Surveys of the Southern Extension Area identified two Biometric Vegetation Types (BVTs) (excluding disturbed land) being:

- CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes and
- CW117 - Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion.

These BVTs were aligned with communities described as part of the NSW Biometric vegetation types database (OEH 2014b) and Vegetation of the Western Blue Mountains classification (DEC, 2006). The most appropriate BVT for the CMA sub-region was selected through a process of elimination using the vegetation community key in the VIS Classification 2.1 Database. A number of searches using dominant upper, mid and ground stratum combinations were entered into the vegetation formation key. The BVTs were then categorised into vegetation condition zones based on the condition of the vegetation communities in the Southern Extension Area (refer to **Figure 3.2**). The composition of these vegetation zones are outlined in **Tables 3.5** to **3.10** below.

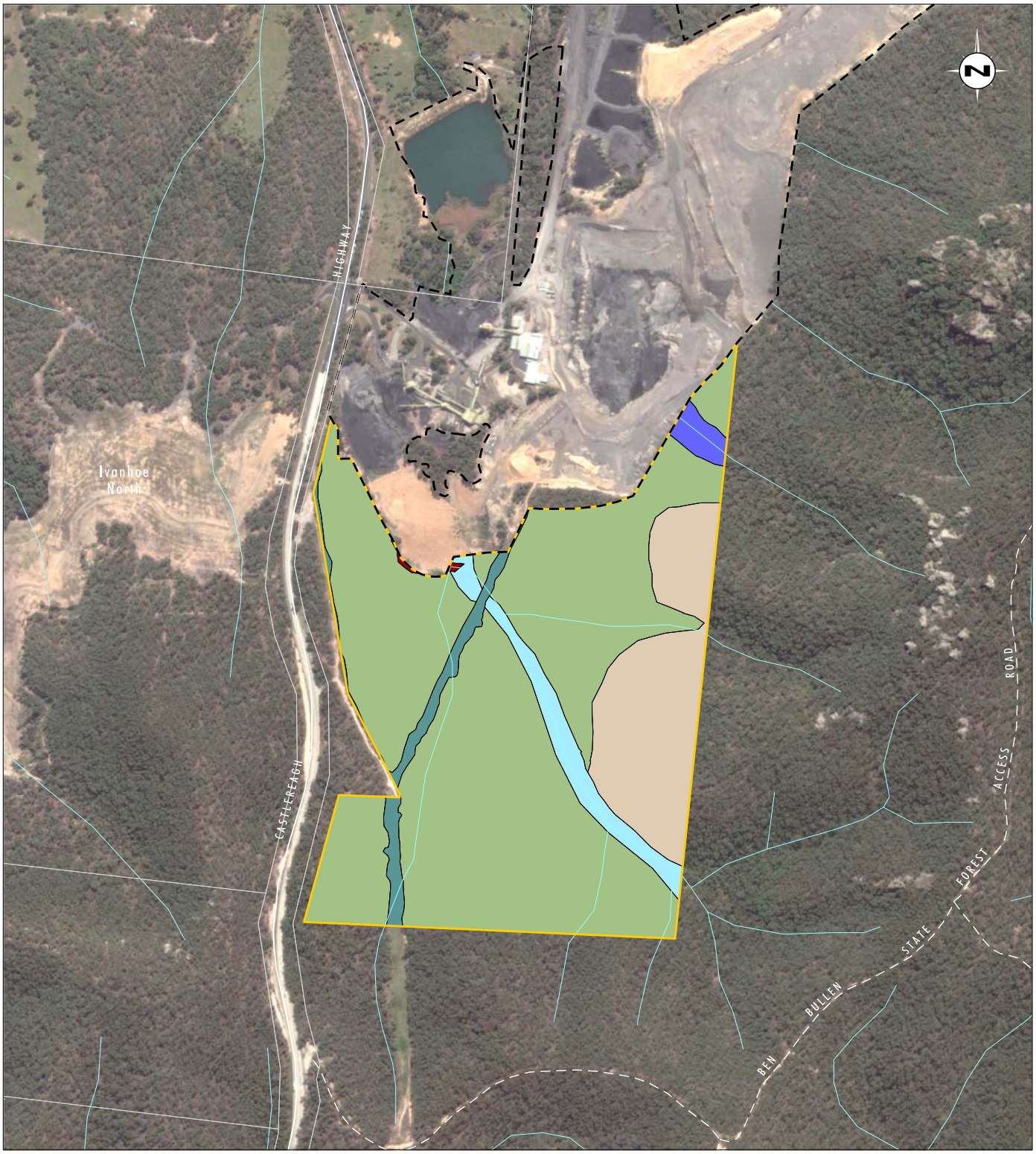



Image Source: Google Earth - CNES/Astrium (March 2015)
Data Source: LPI (2016)

0 100 250 500m

## Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Cleared Area
- Zone 1 - CW117 - Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion (Modertae to Good)
- Zone 2 - CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good)
- Zone 3 - CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good/High)
- Zone 4 - CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good/Moderate)
- Zone 5 - CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good/Other)

FIGURE 3.2

**Biometric Vegetation Type Communities in the Southern Extension Area**

**Table 3.5 Zone 1: CW117 - Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion – Moderate to Good Condition**

| Feature | Description |
|---|---|
| **Name** | Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion |
| **Condition** | Moderate to Good |
| **BVT ID** | CW117 |
| **PCT ID** | 351 |
| **Vegetation Formation** | Dry Sclerophyll Forest (Shrubby sub-formation) |
| **Vegetation Class** | Southern Tableland Dry Sclerophyll Forest |
| **Hectares in Southern Extension Area** | 8.24 |
| **DEC (2006) Equivalent** | MU 34 Tableland Slopes Brittle Gum - Broad-leaved Peppermint Grassy Forest |
| **Plots/Transects Undertaken** | Two (Q1 and Q4) |
| **Floristic Description** | This community occupies the moderate slopes (6-9 degrees) along the eastern boundary of the Southern Extension Area, occurring on shallow (almost skeletal) sandy loams.<br>The community comprises a mature, sparse canopy between 10 and 20 metres in height. The variation in height is likely to be linked with the depth and quality of the soil. Dominant species include narrow-leaved stringybark (*Eucalyptus sparsifolia*), brittle gum (*Eucalyptus mannifera*), Sydney peppermint (*Eucalyptus piperita*) and apple box (*Eucalyptus bridgesiana*). Another species, Blaxland's stringybark (*Eucalyptus blaxlandii*) also occurs scattered through this community.<br>The midstorey of this community comprised two distinct layers, an upper and lower. The very sparse to sparse upper sub-stratum was characterised by recruiting canopy species and ranged from 2 to 6 metres in height. In addition to the canopy species listed above, narrow-leaved geebung (*Persoonia linearis*) also occurred.<br>The lower midstorey included a sparse layer of low shrubs, between 0.5 and 2 metres high. Dominant species included prickly shaggy pea (*Podolobium ilicifolium*), sunshine wattle (*Acacia terminalis*), narrow-leaved geebung (*Persoonia linearis*) and box-leaf wattle (*Acacia buxifolia*).<br>A sparse groundlayer occurred throughout this community, typically less than 0.5 metres in height and comprising a mixture of grasses and forbs. Dominant species include *Poa sieberiana*, mat-rush (*Lomandra confertifolia*), silvertop wallaby grass (*Rytidosperma pallidium*), ivy goodenea (*Goodenia hederacea* subsp. *hederacea*), silky purple-flag (*Patersonia sericea*), *Leucopogon lanceolatus* and hoary guinea flower (*Hibbertia obtusifolia*).<br>Flora species recorded in this zone are included in **Appendix A**. |
| **TSC Status** | This vegetation zone does not conform to a TEC listed under the TSC Act. |
| **EPBC Status** | This vegetation zone does not conform to a TEC listed under the EPBC Act. |
| **Habitat Value** | Moderate – this vegetation zone contains low to moderate numbers of hollow-bearing trees and fallen logs that provide habitat for local fauna species; and high amounts of rock and rocky structures that also provide habitat. |

| Feature | Description |
|---|---|
| Photo |  |

**Table 3.6 Zone 2: CW263 – Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes – Moderate to Good Condition**

| Feature | Description |
|---|---|
| Name | Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes |
| Condition | Moderate to Good |
| BVT ID | CW263 |
| PCT ID | 324 |
| Vegetation Formation | Dry Sclerophyll Forest (Shrubby sub-formation) |
| Vegetation Class | Western Slopes Dry Sclerophyll Forest |
| Hectares in Southern Extension Area | 36.50 |
| DEC (2006) Equivalent | MU 35 Tableland Gully Mountain Gum – Broad-leaved Peppermint Grassy Forest |
| Plots/Transects Undertaken | Six (Q2, Q3, Q5, Q6, Q8 and Q10) |

| Feature | Description |
|---|---|
| **Floristic Description** | This is the dominant vegetation community within the Southern Extension Area, occurring on the flats, low rises and along the small ephemeral drainage lines. A sparse canopy of mature eucalypt trees occurs throughout between 13 – 25 metres in height. Dominant canopy species include mountain gum (*Eucalytpus dalrympleana*) and inland scribbly gum (*Eucalyptus rossii*) with apple box (*Eucalyptus bridgesiana*), red stringybark (*Eucalyptus cannonii*) and narrow-leaved stringybark (*Eucalyptus sparsifolia*) also occurring. A very sparse emergent layer of tall, mature trees was also recorded in the north of the site, including narrow-leaved stringybark, inland scribbly gum and mountain gum.<br>A very sparse to sparse midstorey of recruiting canopy species occurs between 2 to 9 metres in height. In addition blunt leaf wattle (*Acacia obtusifolia*) and silver wattle (*Accacia dealbata*) also occur in the upper midstorey.<br>A sparse shrub layer of low shrubs also occurs in the midstorey, ranging between 0.4 to 2 metres in height. Dominant species include box-leaf wattle (*Acacia buxifolia*), peach heath (*Lissanthe strigosa*), blunt beard-heath (*Leucopogon muticus*), prickly tea-tree (*Leucopogon juniperinum*), prickly shaggy pea (*Podolobium ilicifolium*) and hoary guinea flower (*Hibbertia obtusifolia*).<br>The groundlayer of this community comprised two layers, an upper and lower. The upper was sparse, between 0.5 and 0.7 metres in height and comprised sub-shrubs, grasses and forbs. Dominant species included peach heath (*Lissanthe strigosa*), spiny-headed mat-rush (*Lomandra longifolia*), tussock (*Poa labillardierei*) and gorse bitter pea (*Daviesia ulicifolia*).<br>The very sparse to mid-dense lower sub-stratum of the groundlayer was less than 0.5 metres in height and was dominated by native grasses and forbs. Namely, mat-rush (*Lomandra confertifolia*), *Poa sieberiana*, silvertop wallaby grass (*Rytidosperma pallidium*), wattle mat-rush (*Lomandra filiformis*), smooth-flower wallaby grass (*Rytidosperma pilosum*), *Austrostipa rudis* and threeawn speargrass (*Aristida vagans*).<br>The introduced species St. Johns wort (*Hypericum perforatum*) and common centaury (*Centaurium erythraea*) were also common throughout this community.<br>Flora species recorded in this zone are included in **Appendix A**. |
| **TSC Status** | This vegetation zone does not conform to a TEC listed under the TSC Act. |
| **EPBC Status** | This vegetation zone does not conform to a TEC listed under the EPBC Act. |
| **Habitat Value** | Moderate – hollow-bearing trees and fallen logs provide moderate habitat for local fauna species. |

| Feature | Description |
|---|---|
| Photo |  |

**Table 3.7 Zone 3: CW263 – Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes – Moderate to Good_High Condition**

| Feature | Description |
|---|---|
| Name | Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes |
| Condition | Moderate to Good_High |
| BVT ID | CW263 |
| PCT ID | 324 |
| Vegetation Formation | Dry Sclerophyll Forest (Shrubby sub-formation) |
| Vegetation Class | Western Slopes Dry Sclerophyll Forest |
| Hectares in Southern Extension Area | 0.62 |
| DEC (2006) Equivalent | MU 11 Tableland Gully Snow Gum – Ribbon Gum Grassy Forest |
| Plots/Transects Undertaken | One (Q12) |

| Feature | Description |
|---|---|
| Floristic Description | Floristically, this vegetation zone is similar to zone 2. This community has been separated as a different condition classed in order to adequately depict the condition variations within the CW263 community across the site.<br>This vegetation zone occurs in a shallow depression and was separated mainly as it appeared to have ecotonal influences and contained cabbage gum (*Eucalyptus amplifolia*) in combination with the canopy species identified in zone 2.<br>Flora species recorded in this zone are included in **Appendix A**. |
| TSC Status | None |
| EPBC Status | None |
| Habitat Value | Moderate – hollow-bearing trees and fallen logs provide moderate habitat for local fauna species. |
| Photo |  |

**Table 3.8 Zone 4: CW263 – Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes – Moderate to Good_Moderate Condition**

| Feature | Description |
|---|---|
| Name | Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes |
| Condition | Moderate to Good_Moderate |
| BVT ID | CW263 |
| PCT ID | 324 |
| Vegetation Formation | Dry Sclerophyll Forest (Shrubby sub-formation) |
| Vegetation Class | Western Slopes Dry Sclerophyll Forest |
| Hectares in Southern Extension Area | 2.25 |

| Feature | Description |
|---|---|
| DEC (2006) Equivalent | MU 11 Tableland Gully Snow Gum – Ribbon Gum Grassy Forest |
| Plots/Transects Undertaken | Two (Q11 and Q13) |
| Floristic Description | Floristically, this vegetation zone is similar to zone 2. This community has been separated as a different condition classed in order to adequately depict the condition variations within the CW263 community across the site.<br>This vegetation zone occurs in a shallow depression and was separated mainly as it appeared to have ecotonal influences and contained a higher density of ribbon gum (*Eucalyptus viminalis*) in combination with the canopy species identified in zone 2.<br>Flora species recorded in this zone are included in **Appendix A**. |
| TSC Status | This vegetation zone does not conform to a TEC listed under the TSC Act. |
| EPBC Status | This vegetation zone does not conform to a TEC listed under the EPBC Act. |
| Habitat Value | Moderate – hollow-bearing trees and fallen logs provide moderate habitat for local fauna species. |
| Photo |  |

**Table 3.9 Zone 5: CW263 – Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes – Moderate to Good_Other Condition**

| Feature | Description |
|---|---|
| Name | Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes |
| Condition | Moderate to Good_Other |
| BVT ID | CW263 |
| PCT ID | 324 |

| Feature | Description |
|---|---|
| **Vegetation Formation** | Dry Sclerophyll Forest (Shrubby sub-formation) |
| **Vegetation Class** | Western Slopes Dry Sclerophyll Forest |
| **Hectares in Southern Extension Area** | 1.65 |
| **DEC (2006) Equivalent** | MU 35 Tableland Gully Mountain Gum – Broad-leaved Peppermint Grassy Forest |
| **Plots/Transects Undertaken** | Two (Q7 and Q9) |
| **Floristic Description** | This community is derived from the surrounding remnant woodland, which is the dominant community within the Southern Extension Area (described in **Table 3.5**). This vegetation zone occurs within the powerline easement and therefore has been cleared of remnant canopy trees, mid-storey trees and shrubs. The easement occurs in the west of the Southern Extension Area and extends from the southern boundary of the Southern Extension Area to the north, before forking into two easements, one which runs along the north western boundary and the other that extends through the northern woodland.<br>Despite the remnant canopy and mid-storey trees being removed, recruits of these species are present in this vegetation zone, including brittle gum (*Eucalyptus mannifera*) and narrow-leaved stringybark (*Eucalyptus sparsifolia*). These recruits are between 1 and 2 metres in height and very sparse in cover.<br>This community supports a sparse to mid-dense, low shrub layer that occurs between 0.3 and 1.5 metres in height. Common shrubs include box-leaf wattle (*Acacia buxifolia* subsp. *buxifolia*), sifton bush (*Cassinia arcuata*) and peach heath (*Lissanthe strigosa*).<br>The groundlayer of this community comprised two layers, an upper and lower. The upper was sparse, between 0.1 and 0.5 metres in height and comprised a mixture of native sub-shrubs, grasses and forbs. Dominant species included tussock (*Poa labillardierei*), threeawn speargrass (*Aristida vagans*), gorse bitter pea (*Daviesia ulicifolia*) and *Vittadinia muelleri*.<br>The lower sub-stratum in the groundlayer was mid-dense and commonly less than 0.1 metres in height but did reach 0.2 metres. Dominant species include common everlasting (*Chrysocephalum apiculatum*), *Leucochrysum albicans* subsp. *albicans*, wattle mat-rush (*Lomandra filiformis*) and silvertop wallaby grass (*Rytidosperma pallidium*).<br>Flora species recorded in this zone are included in **Appendix A**. |
| **TSC Status** | This vegetation zone does not conform to a TEC listed under the TSC Act. |
| **EPBC Status** | This vegetation zone does not conform to a TEC listed under the EPBC Act. |
| **Habitat Value** | Low – no mature trees and very few fallen logs, those that do occur were small in size. This vegetation zone provides minimal habitat for local fauna species. |

| Feature | Description |
|---|---|
| Photo |  |

#### 3.2.1.1 Disturbed land

Disturbed Land occupies a small portion of the Southern Extension Area (refer to **Figure 3.2**), occurring at only one location adjacent to the northern boundary with the existing mining land. It is an area of cleared land with no trees or shrubs remaining. Some introduced flora species remain present, including spear thistle (*Cirsium vulgare*), lantana (*Lantana camara* subsp. *camara*), kikuyu (*Pennisetum clandestinum*) and cobblers pegs (*Bidens pilosa*).

Disturbed Land on the site does not meet the definition of 'native vegetation' under the *Native Vegetation Act 2003* and therefore could not be aligned with a BVT or vegetation zone and is excluded from further assessment as per Section 9.5 of the FBA (OEH 2014b).

### 3.2.2 Current site value

**Table 3.10** below details the current site value scores for each of the vegetation zones in the Southern Extension Area, as determined by the BBCC. The raw site condition attribute data for each of the vegetation zones is provided in **Appendix B**.

**Table 3.10 Vegetation zone site value scores**

| Vegetation Zone No. | Vegetation Zone | Current Site Value Score |
|---|---|---|
| 1 | CW117 – Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion – Moderate to Good Condition | 82.29 |

| Vegetation Zone No. | Vegetation Zone | Current Site Value Score |
|---|---|---|
| 2 | CW263 – Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good Condition) | 93.75 |
| 3 | CW263 – Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good_High) | 58.85 |
| 4 | CW263 – Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good_Medium) | 53.12 |
| 5 | CW263 – Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate to Good_Easement Condition) | 34.90 |

### 3.2.3 Threatened ecological communities

No threatened ecological communities were recorded within Southern Extension Area. A review of the OEH Bionet website for TEC's within the Capertee sub-region identified two potentially occurring TECs listed under the TSC Act, being:

- Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions
- White Box Yellow Box Blakely's Red Gum Woodland.

A thorough review of the plot data from the Southern Extension Area and the Scientific Determination for these communities did not reveal any substantial similarities.

## 3.3 Threatened species within the Southern Extension Area

### 3.3.1 Ecosystem-credit species

**Table 3.11** below outlines the ecosystem-credit species predicted to occur by the BBCC and whether they were recorded or are considered likely to occur on site, based on the habitat attributes recorded during detailed fauna surveys of the Southern Extension Area.

**Table 3.11 Predicted ecosystem-credit species**

| Species Name | TSC Status | EPBC Status | Threatened Species Offset Multiplier | On Site?^ | Justification |
|---|---|---|---|---|---|
| **black-chinned honeyeater (eastern subspecies)** ***Melithreptus gularis* subsp. *gularis*** | V | - | 1.3 | Yes | Species has not been recorded in the Southern Extension Area. The closest record occurs approximately 10 km to the south-east of the site from 2004 (OEH 2016). The Southern Extension Area contains marginal foraging habitat for the species. |
| **brown treecreeper (eastern subspecies)** ***Climacteris picumnus* subsp. *victoriae*** | V | - | 2.0 | Yes | Species was recorded in the Southern Extension Area during surveys undertaken for this assessment (refer to **Figure 3.4** and **Section 3.3.1.2**). The Southern Extension Area contains foraging habitat and potential breeding habitat for the species. |
| **diamond firetail** ***Stagonopleura guttata*** | V | - | 1.3 | Yes | Species has not been recorded in the Southern Extension Area. The closest record occurs approximately 6 km to the south-east of the site from 2009 (OEH 2016). The Southern Extension Area contains marginal foraging habitat for the species. |
| **eastern false pipistrelle** ***Falsistrellus tasmaniensis*** | V | - | 2.2 | Yes | Species has not been recorded in the Southern Extension Area. The closest record occurs approximately 3 km to the north of the site from 2015 (OEH 2016). The Southern Extension Area contains marginal foraging and breeding habitat for the species. |
| **flame robin** ***Petroica phoenicea*** | V | - | 1.3 | Yes | Species has not been recorded in the Southern Extension Area. The closest record occurs approximately 200 m to the west of the site from 2005 (OEH 2016). The Southern Extension Area contains marginal foraging habitat for the species. |

| Species Name | TSC Status | EPBC Status | Threatened Species Offset Multiplier | On Site?^ | Justification |
|---|---|---|---|---|---|
| **gang-gang cockatoo** *Callocephalon fimbriatum* | V | - | 2.0 | Yes | Species was recorded in the Southern Extension Area during the surveys undertaken for this assessment (refer to **Figure 3.4** and **Section 3.3.1.2**). The Southern Extension Area contains foraging habitat for the species. |
| **little eagle** *Hieraaetus morphnoides* | V | - | 1.4 | Yes | Species as not been recorded in the Southern Extension Area. The closest record occurs approximately 2 km to the south-east of the site from 2009 (OEH 2016). The Southern Extension Area contains marginal foraging habitat for the species. |
| **little whipsnake** *Suta flagellum* | V | - | 2.3 | No | Species has not been recorded in the Southern Extension Area. The closest record occurs approximately 100 km to the north of the site from 2000 (OEH 2016). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |
| **masked owl** *Tyto novaehollandiae* | V | - | 3.0 | Yes | Species has not been recorded in the Southern Extension Area or in the immediate locality. The closest record occurs approximately 20 km to the south-east of the site from 2012 (OEH 2016). The Southern Extension Area contains marginal foraging habitat for the species. |

| Species Name | TSC Status | EPBC Status | Threatened Species Offset Multiplier | On Site?^ | Justification |
|---|---|---|---|---|---|
| **barking owl** *Ninox connivens* | V | - | 3.0 | Yes | Species has not been recorded in the Southern Extension Area or in the immediate locality. The closest record occurs approximately 10 km to the south-east of the site from 2007 (OEH 2016). The Southern Extension Area contains marginal foraging habitat for the species. |
| **painted honeyeater** *Granitella picta* | V | - | 1.3 | Yes | Species has not been recorded in the Southern Extension Area or in the immediate locality. The closest record occurs approximately 5 km to the south of the site from 2005 (OEH 2016). The Southern Extension Area contains marginal foraging habitat for the species. |
| **powerful owl** *Ninox strenua* | V | - | 3.0 | Yes | Species has not been recorded in the Southern Extension Area. The closest record occurs approximately 1 km to the south-east of the site from 2014 (OEH 2016). The Southern Extension Area contains potential foraging habitat for the species. |
| **scarlet robin** *Petroica boodang* | V | - | 1.3 | Yes | Species was recorded in the Southern Extension Area during the surveys undertaken for this assessment (refer to **Figure 3.4** and **Section 3.3.1.2**). The Southern Extension Area contains foraging habitat for the species. |
| **speckled warbler** *Chthonicola sagittata* | V | - | 2.6 | Yes | Species has not been recorded in the Southern Extension Area. The closest record occurs approximately 10 km to the south-east of the site from 2009 (OEH 2016). The Southern Extension Area contains potential foraging habitat for the species . |

| Species Name | TSC Status | EPBC Status | Threatened Species Offset Multiplier | On Site?^ | Justification |
|---|---|---|---|---|---|
| **spotted-tailed quoll** *Dasyurus maculatus* | V | E | 2.6 | Yes | Species has not been recorded in the Southern Extension Area. The closest record occurs approximately 5 km to the east of the site from 1996 (OEH 2016). This species is not likely to occur in the Southern Extension Area. |
| **turquoise parrot** *Neophema pulchella* | V | - | 1.8 | No | Species has not been recorded in the Southern Extension Area. The closest record occurs approximately 20 km to the north of the site from 2010 (OEH 2016). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |
| **varied sittella** *Daphoenositta chrysoptera* | V | - | 1.3 | Yes | Species has not been recorded in the Southern Extension Area, however the species was recorded 2 km to the south-east of the Southern Extension Area in 2009 (OEH 2016). The Southern Extension Area is likely to contain foraging habitat for the species. |
| **yellow-bellied glider** *Petaurus australis* | V | - | 2.3 | No | Species has not been recorded in the Southern Extension Area. The closest record occurs approximately 15 km to the north-east of the site from 2011 (OEH 2016). This species is not likely to occur in the Southern Extension Area. |
| **yellow-bellied sheathtail bat** *Saccolaimus flaviventris* | V | - | 2.2 | Yes | Species was recorded in the Southern Extension Area during the surveys undertaken for this assessment (refer to **Figure 3.4** and **Section 3.3.1.2**). The Southern Extension Area contains foraging habitat and potential roosting habitat for the species. |

^ As entered into the 'Site Survey Details' tab in the BBCC.

#### 3.3.1.1 Survey results

Six ecosystem credit species were recorded in the Southern Extension Area during the surveys undertaken for this assessment (refer to **Figure 3.3**). These were:

- brown treecreeper (eastern subspecies) (*Climacteris picumnus* subsp. *victoriae*)
- gang-gang cockatoo (*Callocephalon fimbriatum*)
- scarlet robin (*Petroica boodang*)
- large-eared pied bat (*Chalinolobus dwyeri*) (foraging habitat only)
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) (foraging habitat only)
- yellow-bellied sheathtail-bat (*Saccolaimus flaviventis*).

No other records of ecosystem-credit species are known to occur within the Southern Extension Area. A discussion on these records is provided below and a full fauna species list from the surveys undertaken by Umwelt in 2015/2016 is included in **Appendix C**.

**Brown treecreeper (eastern subspecies) - *Climacteris picumnus* subsp. *Victoriae***

The brown treecreeper (eastern subspecies) is listed as vulnerable under the TSC Act. It is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range.

The brown treecreeper was recorded on one occasion at one location within the Southern Extension Area. The species has also been previously recorded in the Cullen Bullen locality (OEH 2016). The Southern Extension Area is considered to comprise likely foraging and potential nesting habitat for this species as part of a wider foraging range in surrounding habitats.

**Gang-gang cockatoo – *Callocephalon fimbriatum***

The gang-gang cockatoo is listed as vulnerable under the TSC Act. The species occurs from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the gang-gang cockatoo is distributed from the Southern Coast to the Hunter region, and inland to the Central Tablelands and South-west Slopes.

Gang-gang cockatoos were recorded at one location within the Southern Extension Area during the surveys undertaken for this assessment. Two individuals were observed on 11 January 2016. The species has also been previously recorded in the Cullen Bullen locality (OEH 2016). The Southern Extension Area is considered to comprise foraging habitat for this species as part of a wider foraging range in the locality. A moderate density of tree hollows greater than 10 cm in diameter occurs within the woodland habitats in the Southern Extension Area. No nesting behaviour was recorded by the species during the surveys undertaken for this assessment however potential nesting habitat is present..

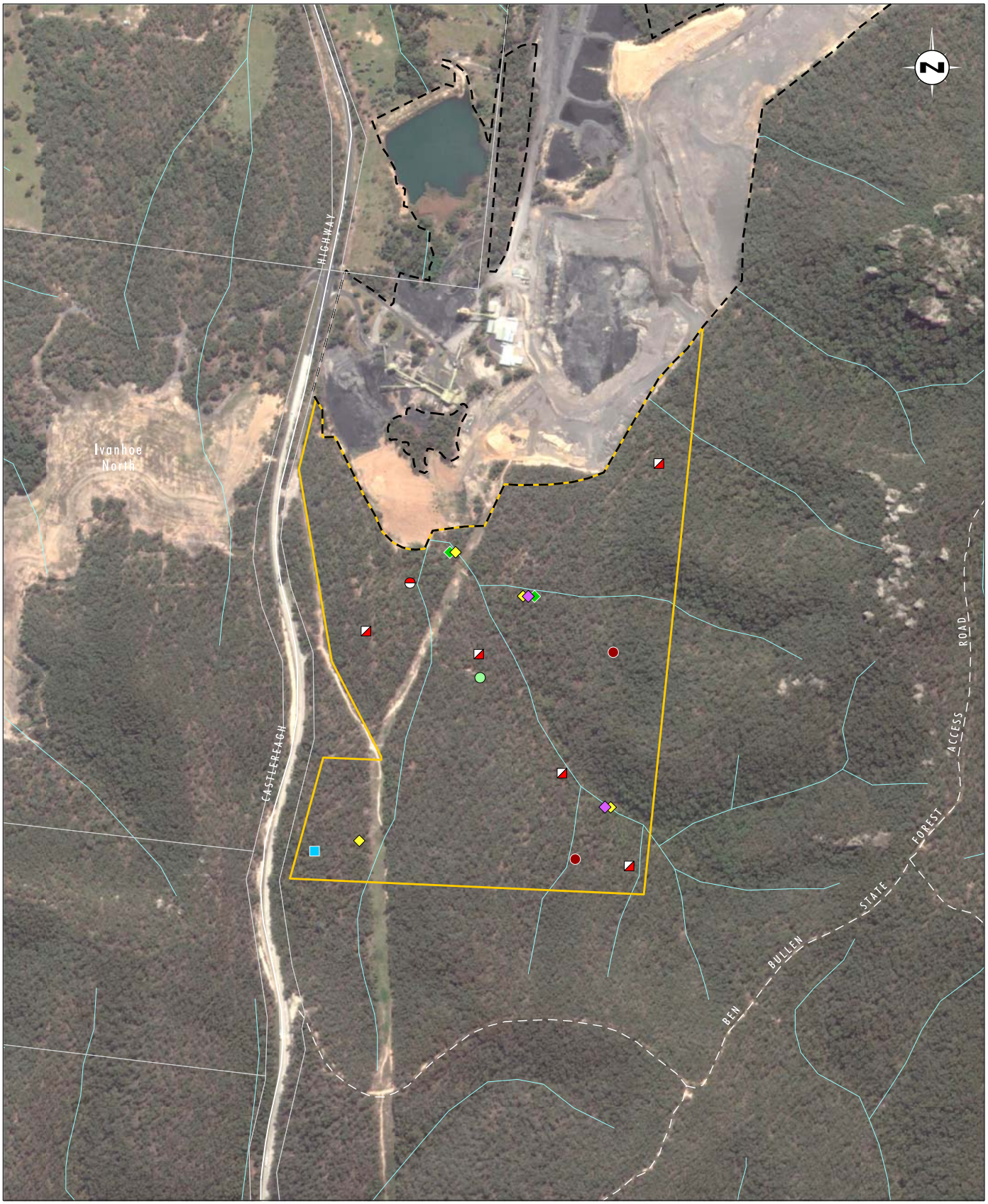



Image Source: Google Earth - CNES/Astrium (March 2015)
Data Source: LPI (2016)

0 100 250 500m

## Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Brown treecreeper (eastern subspecies)
- Eastern bentwing-bat
- Gang-gang cockatoo
- Large-eared pied bat
- Scarlet robin
- Squirrel glider
- Yellow-bellied sheathtail-bat
- *Eucalyptus cannonii*

FIGURE 3.3

**Ecosystem-credit Species Records in the Southern Extension Area**

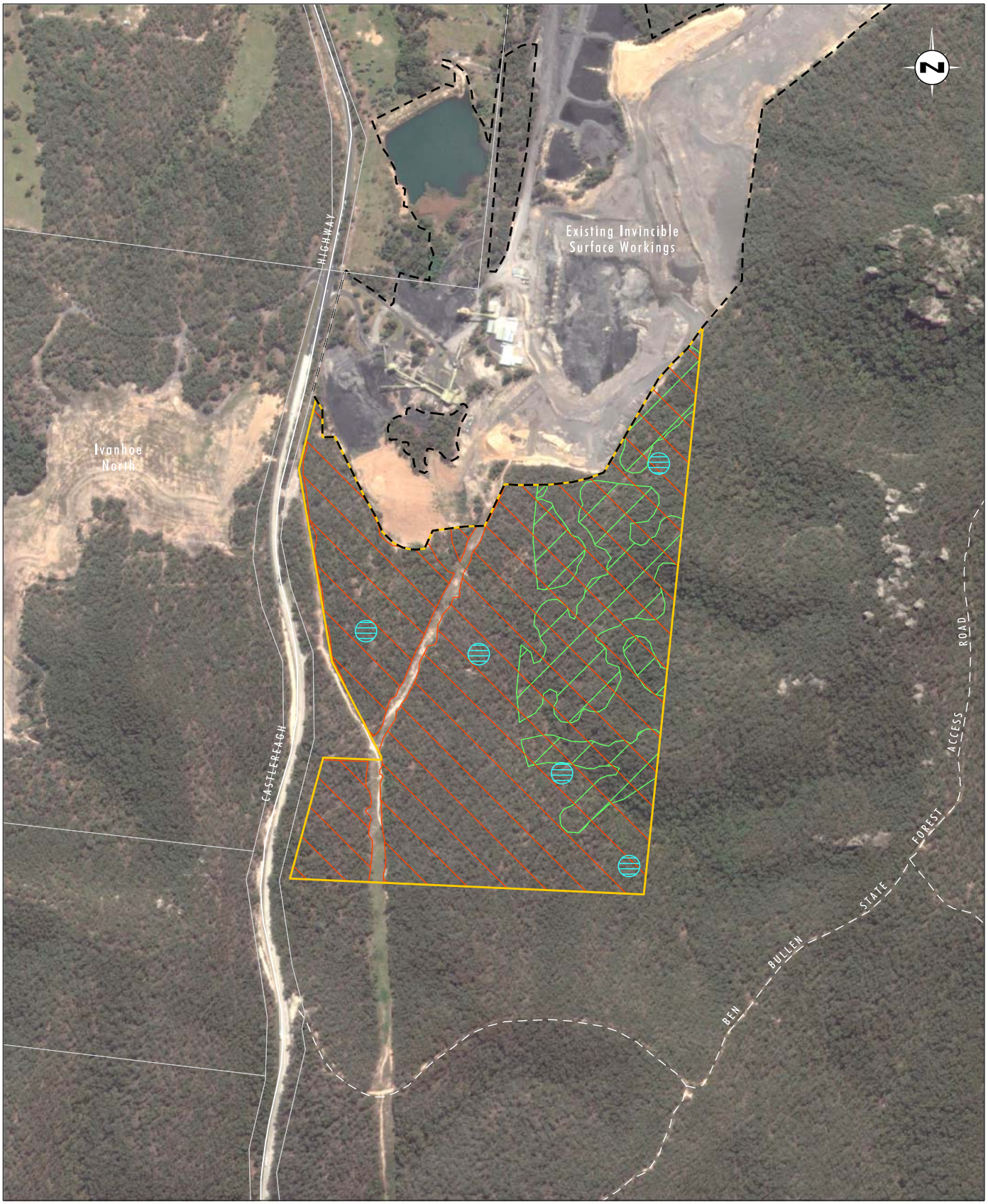



Image Source: Google Earth - CNES/Astrium (March 2015)
Data Source: LPI (2016)

0 100 250 500m

## Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- BHS Habitat Area 500/26
- Capertee Stringybark Species Polygon
- Squirrel Glider Species Polygon

FIGURE 3.4

**Species-credit Polygon in the Project Area**

**Scarlet robin – *Petroica boodang***

The scarlet robin is listed as vulnerable under the TSC Act. The species is found from south-east Queensland to south-east South Australia and also in Tasmania and south-west Western Australia. In NSW, it occurs from the coast to the inland slopes.

The scarlet robin was recorded on one occasion within the Southern Extension Area during the surveys undertaken for this assessment. Two individuals were observed at one location in the Southern Extension Area on 25 August 2015. The species has also been previously recorded in the Cullen Bullen locality (OEH 2016). The Southern Extension Area is considered to comprise likely foraging and potential nesting habitat for this species as part of a wider foraging range in surrounding habitats.

**Large-eared pied bat – *Chalinolobus dwyeri***

The large-eared pied bat-bat is listed as vulnerable under the TSC Act and vulnerable under the EPBC Act. The species is found along the east and north-west coasts of Australia and found mainly in areas with extensive cliffs and caves.

The large-eared pied bat was recorded at two locations within the Southern Extension Area during the surveys undertaken for this assessment. These records are based on definite and possible identification from echolocation recording analyses undertaken by Dr Anna McConville form Echo Ecology Pty Ltd which is provided in **Appendix D**. The species has also been previously recorded in Cullen Bullen locality (OEH 2016). The Southern Extension Area is considered to comprise woodland foraging habitat. No breeding habitat is present within the Southern Extension Area.

**Eastern bentwing-bat – *Miniopterus schreibersii oceanensis***

The eastern bentwing-bat is listed as vulnerable under the TSC Act. The species is found along the east and north-west coasts of Australia and roosts in caves, tunnels, buildings and other man-made structures.

The eastern bentwing-bat was recorded at two locations within the Southern Extension Area during the surveys undertaken for this assessment. These records are based on probable and possible identification from echolocation recording analyses undertaken by Dr Anna McConville form Echo Ecology Pty Ltd which is provided in **Appendix D**. The species has also been previously recorded in Cullen Bullen locality (OEH 2016). The Southern Extension Area is considered to comprise woodland foraging habitat. No breeding habitat is present within the Southern Extension Area.

**Yellow-bellied sheathtail-bat – *Saccolaimus flaviventis***

The yellow-bellied sheathtail-bat is listed as vulnerable under the TSC Act. The species is wide-ranging found across northern and eastern Australia, roosting in tree hollows and buildings.

The yellow-bellied sheathtail-bat was recorded at four locations within the Southern Extension Area during the surveys undertaken for this assessment. These records are based on probable and possible identification from echolocation recording analyses undertaken by Dr Anna McConville form Echo Ecology Pty Ltd which is provided in **Appendix D**. The species has also been previously recorded in Cullen Bullen locality (OEH 2016). The Southern Extension Area is considered to comprise woodland foraging habitat and potential roosting habitat.

## 3.3.2 Species-credit species

### 3.3.2.1 Geographic and habitat features

Three geographic and habitat features (refer to **Table 3.12**) were chosen in the BioBanking Credit Calculator as having broad features that match site habitats at the Southern Extension Area. Other geographic and habitat features were considered as not having broad features that match the Southern Extension Area habitats and were therefore not relevant to the Southern Extension Area and were filtered out of the subsequent steps of the assessment.

**Table 3.12 Geographic and habitat features in the Southern Extension Area**

| Geographic/Habitat Feature | Relevant Species-credit Species |
|---|---|
| **Land containing *Bursaria spinosa*** | Bathurst copper butterfly (*Paralucia spinifera*) |
| **Land within Capertee Valley in the Capertee CMA subregion** | Pale-headed snake (*Hoplocephalus bitorquatus*) |
| **land within 100 m of stream or creek banks** | Booroolong Frog (*Litoria booroolongensis*) |
| ***Land within 500 m of sandstone escarpments with hollow-bearing trees, rock crevices or flat sandstone rocks on exposed cliff edges** | Broad-headed snake (*Hoplocephalus bungaroides*) |

*This habitat feature did not appear in the calculator for the selected BVTs. This has been included based on a known local record and widespread sandstone habitat in the vicinity of the Southern Extension Area.

### 3.3.2.2 Predicted species

**Table 3.13** below outlines the predicted species-credit species predicted to occur by the BioBanking Credit Calculator (Major Project Assessment Type) and whether they are considered to occur on site.

**Table 3.13 Predicted species-credit species**

| Species Name | TSC Status | EPBC Status | Threatened Species Offset Multiplier | Impacted by the Southern Extension Project?^ | Justification |
|---|---|---|---|---|---|
| **Bathurst copper butterfly** *Paralucia spinifera* | E | V | 7.7 | No | Bathurst copper butterfly was not recorded within the Southern Extension Area despite targeted surveys in accordance with the seasonal and habitat requirements for this species. *Bursaria spinosa* is present within the Southern Extension Area however it occurs in small patches and is distributed sporadically. The closest record of the species occurs approximately 5 km to the south-east of the Southern Extension Area on the edge of Ben Bullen State Forest (OEH 2016). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |
| **Booroolong frog (*Litoria booroolongensis*)** | E | E | 1.3 | No | The Boorooloong frog was not recorded within the Southern Extension Area despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. Although a small area of riparian vegetation occurs within the Southern Extension Area, this area does not contain a permanent stream with substantial fringing vegetation as required for this species. The closest record of the species occurs approximately 6 km to the north-west of the Southern Extension Area along Williwa Creek (OEH 2016). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |
| **Broad-headed snake** *Hoplocephalus bungaroides* | E | V | 3.3 | Yes | The broad-headed snake was not recorded within the Southern Extension Area despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. Although a small area of scree occurs within the Southern Extension Area, this habitat does not comprise the substantial |

| Species Name | TSC Status | EPBC Status | Threatened Species Offset Multiplier | Impacted by the Southern Extension Project?^ | Justification |
|---|---|---|---|---|---|
| | | | | | sandstone outcrop/pagoda winter refuge habitat as required by the species. The Southern Extension Area contains hollow-bearing trees within 500 metres of potential rocky winter habitat which represents summer foraging habitat for this species. The closest record of the species occurs approximately 1.5 km to the north-east of the Southern Extension Area within Ben Bullen State Forest (OEH 2016). Although the probability of the species occurring in the Southern Extension Area is low, potential summer habitat has been identified within the Southern Extension Area. |
| **Brush-tailed phascogale** *Phascogale tapoatafa* | V | - | 2.0 | No | The brush-tailed phascogale was not recorded within the Southern Extension Area despite thorough surveys (including targeted spotlighting, arboreal Elliott trapping and remote camera surveys) undertaken in accordance with the seasonal requirements for this species. The closest record of the species occurs approximately 80 km to the south-east of the Southern Extension Area within Blue Mountains National Park (OEH 2016). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |
| **Capertee stringybark** *Eucalyptus cannonii* | V | - | 1.3 | Yes | The Capertee stringybark was recorded within the Southern Extension Area during the surveys undertaken for this assessment. 24 individuals were recorded across 5 locations during flora surveys in the north, south-eastern and centre of the Southern Extension Area. The species has also been previously recorded in the wider locality (OEH 2016). |
| **Clandulla geebung** | V | - | 1.3 | No | Clandulla geebung was not recorded within the Southern Extension Area despite thorough |

| Species Name | TSC Status | EPBC Status | Threatened Species Offset Multiplier | Impacted by the Southern Extension Project?^ | Justification |
|---|---|---|---|---|---|
| *Persoonia marginata* | | | | | vegetation surveys undertaken in accordance with the seasonal requirements for this species. The closest record of the species is approximately 5 km north-west of the Southern Extension Area (Cumberland 2014). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |
| *Derwentia blakelyi* | V | - | 2.1 | No | *Derwentia blakelyi* was not recorded within the Southern Extension Area despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. This species has been previously recorded 2 km to the east of the Southern Extension Area (OEH 2016). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |
| **eastern pygmy-possum** *Cercartetus nanus* | V | - | 2.0 | No | The eastern pygmy possum was not recorded within the Southern Extension Area despite thorough fauna surveys (including targeted spotlighting, arboreal Elliott trapping and remote camera surveys) undertaken in accordance with the seasonal requirements for this species. The closest record of the species occurs approximately 10 km to the east of the Southern Extension Area within Newnes State Forest (OEH 2016). This species feeds primarily on nectar and pollen collected from banksia and callistemon species which are generally absent or in very low densities throughout the Southern Extension Area. This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |

| Species Name | TSC Status | EPBC Status | Threatened Species Offset Multiplier | Impacted by the Southern Extension Project?^ | Justification |
|---|---|---|---|---|---|
| ***Eucalyptus alligatrix* subsp. *alligatrix*** | V | V | 7.7 | No | *Eucalyptus alligatrix* subsp. *alligatrix* was not recorded within the Southern Extension Area despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. This species has been previously recorded in an isolated area approximately 50 km to the north of the Southern Extension Area; its only known location (OEH 2016). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |
| ***Euphrasia arguta*** | CE | CE | 4.0 | No | *Euphrasia arguta* was not recorded within the Southern Extension Area despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. This species has been previously recorded approximately 50 km to the north of the Southern Extension Area (OEH 2016). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |
| **Evans grevillea**<br>***Grevillea evansiana*** | V | V | 1.5 | No | Evans grevillea was not recorded within the Southern Extension Area despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this specie. This species has been previously recorded approximately 50 km to the north-east of the Southern Extension Area within Blue Mountains National Park (OEH 2016). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |

| Species Name | TSC Status | EPBC Status | Threatened Species Offset Multiplier | Impacted by the Southern Extension Project?^ | Justification |
|---|---|---|---|---|---|
| **Grevillea obtusiflora** | E | E | 7.7 | No | *Grevillea obtusiflora* was not recorded within the Southern Extension Area despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. This species has been previously recorded approximately 15 km to the north-east of the Southern Extension Area within Gardens of Stone National Park (OEH 2016). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |
| **koala**<br>**Phascolarctos cinereus** | V | V | 2.6 | No | The koala was not recorded within the Southern Extension Area despite thorough fauna surveys (including spotlighting, call playback, remote camera and SAT searches) undertaken in accordance with the seasonal requirements for this species. The Southern Extension Area contains two known food tree species for this species (according to Appendix 2 of the Approved Recovery Plan (DECC 2008)). One record from 2007 occurs approximately 10 km south-east of the Southern Extension Area within Newnes State Forest (OEH 2016). No evidence of the koala (sightings, scats, scratchings) were recorded in the Southern Extension Area during the surveys undertaken for this assessment. It is acknowledged that the Southern Extension Area could be occasionally used as movement habitat for the species noting the sporadic local records, however this has not been recorded and it is considered highly unlikely the species would utilise the Southern Extension Area on any more permanent basis given the higher quality habitats in the wider locality. This species is unlikely to occur regularly in the Southern Extension Area and will not be impacted by the |

| Species Name | TSC Status | EPBC Status | Threatened Species Offset Multiplier | Impacted by the Southern Extension Project?^ | Justification |
|---|---|---|---|---|---|
| | | | | | Southern Extension Project. |
| **large-eared pied bat Chalinolobus dwyeri (breeding habitat only)** | V | V | 1.3 | No | The large-eared pied bat was recorded through an echolocation recording as a 'confident' record in one location within the Southern Extension Area in the January 2016 surveys undertaken for this assessment. The species has also been previously recorded in proximity but outside the Southern Extension Area between 2009 and 2015 (OEH 2016). The Development will not impact any cliffline or escarpment habitat that could be used as roosting or breeding habitat. No breeding or shelter/refuge habitat will be impacted. |
| **Pultenaea sp. Olinda** | E | - | 4.0 | No | *Pultenaea* sp. *Olinda* was not recorded within the Southern Extension Area despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this specie. This species has been previously recorded in an isolated area of pogoda rock formation approximately 50 km to the north of the Southern Extension Area (OEH 2016). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |

| Species Name | TSC Status | EPBC Status | Threatened Species Offset Multiplier | Impacted by the Southern Extension Project?^ | Justification |
|---|---|---|---|---|---|
| **regent honeyeater**<br>**Anthochaera phrygia** | CE | CE | 7.7 | No | The regent honeyeater was not recorded within the Southern Extension Area despite thorough fauna surveys (including targeted winter bird surveys in 2015) undertaken in accordance with the seasonal requirements for this species. Additionally, the Southern Extension Area did not contain known foraging tree species and is unlikely to provide substantial foraging resources for this species. The closest record of the species occurs approximately 4 km to the north of the Southern Extension Area on the edge of Ben Bullen State Forest (OEH 2016). Breeding habitat will not be impacted by the Southern Extension Project. This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |
| **Rosenbergs goanna**<br>**Varanus rosenbergii** | V | - | 3.3 | No | Rosenberg's goanna was not recorded within the Southern Extension Area despite targeted surveys in accordance with the seasonal and habitat requirements for this species. The closest record of the species occurs approximately 8 km to the east of the Southern Extension Area within Newnes State Forest (OEH 2016). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |

| Species Name | TSC Status | EPBC Status | Threatened Species Offset Multiplier | Impacted by the Southern Extension Project?^ | Justification |
|---|---|---|---|---|---|
| **Rylstone bell**<br>**Leionema sympetalum** | V | V | 1.8 | No | Rylestone bell was not recorded within the Southern Extension Area despite targeted surveys in accordance with the seasonal and habitat requirements for this species. The closest record of the species occurs approximately 30 km to the north-east of the Southern Extension Area within Wollemi National Park (OEH 2016). This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |
| **silky Swainson-pea**<br>**Swainsona sericea** | V | - | 1.8 | No | The silky Swainson-pea was not recorded within the Southern Extension Area despite thorough vegetation surveys (including targeted threatened flora searches) undertaken in accordance with the seasonal requirements for this species. The closest recent confirmed record of the species occurs approximately 50 km to the south-west of the Southern Extension Area near Bathurst (OEH 2016).This species is not likely to occur in the Southern Extension Area and will not be impacted by the Southern Extension Project. |
| **squirrel glider**<br>**Petaurus norfolcensis** | V | - | 2.2 | Yes | The squirrel glider was recorded on one occasion within the Southern Extension Area during the surveys undertaken for this assessment. One individual was recorded in woodland habitat during spotlighting surveys on the western boundary of the Southern Extension Area. The species has also been previously recorded in the wider locality (OEH 2016). The Project will result in the loss of approximately 48 hectares of woodland foraging, breeding, and/or roosting habitat for the species. |

^ As entered into the 'Threatened Species Survey Results' tab in the BBCC.

#### 3.3.2.3 Survey results

Three species-credit species were recorded in the Southern Extension Area during the surveys undertaken for this assessment (refer to **Figure 3.4**). These were:

- Capertee stringybark (*Eucalyptus cannoni*)
- large-eared pied bat (*Chalinolobus dwyeri*)
- squirrel glider (*Petaurus norfolcensis*).

The broad-headed snake is a species-credit species that has a habitat qualifier. Although this species was not recorded during the targeted surveys within the Southern Extension Area, there is a recent (2010) record of this species 1.5km to the north-east of the site. The Southern Extension Area is considered to contain appropriate summer habitat for this species and as the Southern Extension Area is "land within 500 metres of sandstone escarpments with hollow-bearing trees, rock crevices or flat sandstone rocks on exposed cliff edges and sandstone outcropping" The portion of the Southern Extension Area within 500 metres of sandstone escarpment and containing tree hollows has been mapped as potential habitat for this species and it has been discussed below and included in the calculator assessment.

The large-eared pied bat was recorded in one location within the Southern Extension Area during the surveys undertaken for this assessment. A 'confident' identification from an echolocation recording was obtained in the north-eastern portion of the Southern Extension Area on 28 August 2014. The species has also been previously recorded in the locality (OEH 2015). The Southern Extension Area is considered to contain an area of woodland foraging habitat for this species. However, the large-eared pied bat is only listed as a species-credit species when there is potential breeding habitat for the species likely to be impacted. This species breeds in caves, rock crevices and disused mineshaft, none of which occur within the Southern Extension Area or will be impacted by the Southern Extension Project. Further assessment of the large-eared pied bat has not been undertaken as part of this Project as the foraging component of the species habitat is considered as part of the ecosystem credit requirements of the Southern Extension Project.

A discussion on the Capertee stringybark, broad-headed snake and squirrel glider is provided below and a full fauna species list from the surveys undertaken in 2015/2016 is included in **Appendix C**.

**Squirrel glider – *Petaurus norfolcensis***

The squirrel glider is listed as vulnerable under the TSC Act. The species is widely, though sparsely, distributed in eastern Australia, from northern Queensland to western Victoria.

A squirrel glider was recorded on one occasion within the Southern Extension Area during the surveys undertaken for this assessment. One individual was observed in the south-western portion of the Southern Extension Area on 13 January 2016. The Southern Extension Area, and surrounding Ben Bullen State Forest, is considered to comprise foraging and breeding habitat for the species.

The species polygon shown for this species includes all woodland habitats within the Southern Extension Project area and excludes the cleared powerline easements. Specifically it includes:

| BVT | Area (hectares) |
|---|---|
| CW117_Moderate/Good | 8.24 |
| CW263_Moderate/Good | 36.5 |
| CW263_Moderate/Good_High | 0.62 |
| CW263_Moderate/Good_Medium | 1.65 |
| **Total** | **47.61** |

**Capertee stringybark – (*Eucalyptus cannonii*)**

The Capertee stringybark is listed as vulnerable under the TSC Act. The Capertee stringybark is predominantly restricted to the central tablelands and slopes of NSW. The species' distribution is bounded from east of Bathurst, to Wallerawang near Lithgow, north along the western edge of Wollemi National Park and north-west to Mudgee; isolated occurrences are known from north of Goulburn River National Park between Dunedoo and Merriwa. Within this area the species is often locally frequent.

A total of 24 Capertee stringybark trees were located within the Southern Extension Area during targeted surveys. Specimens were collected and examined to distinguish each from the similar and commonly occurring red stringybark (*E. macroryncha*). The 24 Capertee stringybark trees were recorded at 5 general locations within the Southern Extension Area as shown on **Figure 3.4**.

**Broad-headed snake (*Hoplocephalus bungaroides*)**

The broad-headed snake is listed as endangered under the TSC Act and vulnerable under the EPBC Act. It is restricted to the sandstone ranges in the Sydney Basin and within a radius of approximately 200 km of Sydney. This species occupies rocky outcrops and adjacent sclerophyll forest and woodland. During winter, this species utilises the rocky habitats, sheltering under exfoliated sandstone slabs predominately on western facing outcrops (Cogger 2014). In summer however, this species moves into the surrounding dry sclerophyll forests to forage and shelters during the day in hollows of large eucalypts (Webb and Shine 1997, Croak et al 2013).

Given its specific habitat requirements and affinities to exposed sandstone, the broad-headed snake is predicted to occur (by the BBCC) in the Hawkesbury Nepean CMA region, with in excess of 65 BVTs identified as containing habitat attributes for this species. However, the Southern Extension Area is located on the western edge of the Hawkesbury Nepean CMA, residing within the Central West CMA. Within the Central West CMA, only five BVTs will predict the occurrence of this species, none of which are present within the Southern Extension Area. The species is known to occur approximately 1.5 km from the eastern boundary of the Southern Extension Area, within the Hawkesbury Nepean CMA region. On this basis, the assessment of this species in relation to the Southern Extension Project has taken a precautionary approach and it has been considered that the species may occur in the marginal habitats of the Southern Extension Area.

Detailed surveys of the Southern Extension Area did not identify winter habitat for this species. In accordance with the Threatened Species Profile Database land within 500 metres of the project area was investigated to determine whether rocky habitats that could provide winter habitat were present. An area of sandstone outcrop was identified approximately 210 metres to the east of the Southern Extension Area boundary. Further pagoda formations are located approximately 300-350 metres to the east of the Southern Extension Area. Field investigations of these outcrops and pagodas, identified on **Figure2.2**, found that appropriate microhabitat requirements, exfoliated slabs and crevices, required by the species were generally absent or sparse. This lack of preferred habitat was also noted in the ecological studies for the previously proposed Coalpac Project (Cumberland 2012) and is considered to be a result of a bushrock collection. Notwithstanding this, the precautionary principle was applied and these exposed sandstone areas were considered to have the potential to provide winter habitat for the species and therefore adjacent woodland/sclerophyll forest habitats containing appropriate tree hollows within 500 metres of this marginal habitat has been assessed as potential summer habitat for the snake.

**Figure 3.4** shows the species polygon for the broad-headed snake that was used to calculate the credits required to offset the impacts on the species. As detailed, the consideration of sandstone outcropping within 500 metres of the Southern Extension Area has resulted in the conservative assessment of summer habitat on-site. That is, tree hollows that occur within the 500 metre buffer of the sandstone outcropping have been assumed to provide potential summer habitat despite the biometric vegetation types not conforming to the species habitat preferences, as identified by the Threatened Species Profile Database. As a result, the maximum potential impact has been assumed despite preferred habitat not being identified in the Southern Extension Area.

Several published studies have considered the movements of this species between their winter and summer habitats (Webb and Shine 1997, Croak et al 2013). Webb and Shine (1997) documented a maximum of 780 metres moved between winter and summer habitat with a mean of 318 metres from 20 radio-tracked individuals. Croak et al (2013) depict a mean movement per habitat shift of approximately 100 metres for males and 185 metres for female snakes from a samples size of 11 (four males and 7 females). Based on this information, among other considerations, the PAC assessment of the Coalpac Expansion Modification recommended a minimum setback of 300 metres from the pagodas and escarpments (NSW Planning and Assessment Commission 2012, Recommendation 47) proximate to the current Southern Extension Area.

However, the threatened species profile database (TSPD) (OEH 2016) list the habitat for this species as rock crevices or flat sandstone rocks on exposed cliff edges or rocky outcrops (autumn, winter, spring) or hollows in large trees within 500 metres of escarpments (summer). For the purpose of this assessment and in accordance with the BBAM, summer habitat within 500 metres of pagoda or escarpment features has been mapped as potential habitat and included in the calculator assessment.

To map the potential summer habitat for the broad-headed snake within the Southern Extension Area, all trees within 500 metres of the exposed sandstone outcrop and pagodas which contained hollows potentially suitable for broad-headed snake retreat were identified and mapped. Each habitat tree was then buffered by 26 metres to reflect the mean straight-line distance travelled by this species between retreat sites (Webb and Shine 1997). Overlaps in the buffers surrounding trees were joined and the broad-headed snake species-credit polygon was created through joining connected areas (refer to **Figure 3.4**).

#### 3.3.2.4 Species habitat polygons

Species habitat polygons have been prepared for all the species recorded and assumed present at the site as described above. The species polygons were prepared:

- using satellite imagery dated 2013(LPI 2016)and 2015 (Google 2016)
- using the unit of measurement identified for those species in the Threatened Species Profile Database
- including the location of the species or areas likely occupied by the species
- containing the specific habitat feature associated with the species at the Southern Extension Area
- using GPS to confirm the location of the species polygon on the best available aerial photography of the Southern Extension Area.

Species polygons are shown on **Figure 3.4**.

# 4.0 Avoidance and mitigation measures

## 4.1 Site selection and planning phase avoidance

As detailed in **Section 1.3**, the Southern Extension Project has been sited and designed to avoid and minimise potential impacts on biodiversity values. Key site selection and planning phase avoidance measures included:

- The Southern Extension Project does not include any highwall mining or other underground mining and will not have any subsidence impacts that may affect the pagodas
- Locating the Southern Extension Project to the south of Invincible, which avoids direct impacts on the steep valleys between pagoda formations located to the northeast of the Southern Extension Area, previously identified as providing a diverse range of vegetation communities and rocky habitat features in close proximity to pagoda structures for key species, including the broad headed snake
- The pagodas located directly to the east of the Southern Extension Area are typically smaller in scale and are associated with much drier vegetation communities that the more significant terrain features associated with the more northerly pagodas
- The area to the south of Invincible represents an area of relatively homogenous vegetation types and relatively low threatened species diversity and habitats compared to other areas of vegetation in proximity to Invincible
- The limit of disturbance associated mining was initially setback at least 300 metres from all pagoda formations. The setback from the nearest pagoda was reduced to approximately 210 metres following further investigations which identified that the vegetation in the area closest to that pagoda contained fewer tree hollows was generally less suitable to the broad headed snake during spring and summer foraging periods
- The setback has resulted in an area of potentially mineable resources in the north east of the Invincible South area not being mined. Future extraction of the coal in this area is unlikely once the disturbed areas to the west of it are rehabilitated as part of the Southern Extension Project.

## 4.2 Construction phase

Castlereagh Coal is committed to the design and implementation of a comprehensive strategy to mitigate adverse impacts during the Southern Extension Project. This includes specific measures to manage potential impacts on fauna species in the Southern Extension Area during vegetation clearing activities.

Castlereagh Coal will update the existing Biodiversity Management Plan and Landscape Management Plan in accordance with the requirements of the modified project approval to minimise impacts on biodiversity values. Further discussion of the proposed management and mitigation measures to be implemented is included in the following sections.

### 4.2.1 Management of arboreal species and habitat

A robust tree felling procedure will be implemented to minimise the potential for impacts on native fauna species (focusing on threatened species) as a result of the clearing of hollow-bearing trees. The tree felling procedure is designed to minimise impacts to hollow-dependent fauna, particularly the squirrel glider and hollow-dependent micro-bats.

#### 4.2.1.1 Pre-clearance surveys

Pre-clearance surveys will be required within areas of woody native vegetation (including scattered trees within grassland) that are to be cleared. Pre-clearance surveys will be undertaken by suitably qualified and experienced ecologist and involve the following:

- the demarcation of areas approved for clearing to reduce risk of accidental clearing
- habitat resources and habitat trees should be identified and marked (Note: habitat trees are those containing hollows, cracks or fissures and spouts, active nests, dreys or other signs of recent fauna usage. Other habitat features to be identified include fallen timber/hollow logs, burrows and boulder piles)
- the potential presence of threatened flora and fauna species should be identified
- the identification of species or habitat features that are suitable for translocation or salvage
- the presence of weed species and vertebrate pest species should be assessed, if relevant
- disturbance activities should be targeted for specific times of the year to minimise impacts to target species usage of habitat features for breeding and roosting, where practicable.

#### 4.2.1.2 Tree-felling supervision

Tree clearing will be completed as close to the completion of pre-clearance surveys as practicable to limit the potential for new issues to arise (such as new active nests being built). Tree felling supervision will be undertaken by an appropriately qualified and experienced person after pre-clearance surveys have identified potential threatened species habitat. The supervising person will be licensed by the relevant field survey and ethics authorities to allow for capture, housing, transport and possibly ethical euthanizing of injured fauna. The tree-felling procedure will include the following:

- Prior to clearing identified habitat trees, the felling of non-habitat trees will be completed as close to the felling of habitat trees as possible, with all surrounding habitat trees to be vigorously shaken with heavy machinery.
- On the day of habitat tree felling, the following is to be undertaken:
    - all habitat trees will be subject to a visual inspection to survey for threatened species
    - trees previously identified as containing fauna will be shaken and then felled, providing no threatened species are identified
    - all reasonable attempts will be made to reduce the impact of felling on all fauna species. This may include delaying felling trees with fauna present or felling in sections to reduce potential for injury
    - the lowering of hollow-bearing trees will be done as gently as possible with heavy machinery

- if a threatened species is identified in a habitat tree on the day of felling, the supervising person is to advise the most appropriate method to minimise potential harm. This may include leaving the tree overnight, further shaking to encourage the animal to vacate the tree, gradual removal of branches to discourage ongoing use, soft-felling of the tree with the animal in the tree, or measures to capture and relocate the animal to secure habitats

- uninjured animals should be released on the day of capture into nearby suitable secure habitat and should not be held for extended periods of time

- injured animals will be taken to the nearest veterinary clinic or wildlife carer as soon as possible for assessment and treatment. If required, the supervising person may ethically euthanize fauna

- Following felling, habitat trees will be inspected for remaining or injured fauna species and to ensure that no hollows are blocked against the ground. This may require the tree to be rolled to ensure adequate access

- All felled habitat trees should remain in place for a least one night to allow any fauna still present to move on

- Habitat features identified for translocation or salvage operations should be extracted and stored appropriately.

### 4.2.2 Weed control

Weed species could be inadvertently brought into the Southern Extension Area with imported materials, or could invade naturally through removal of native vegetation. The increased presence of weed species within the Southern Extension Area has the potential to decrease the value of adjacent vegetation to native species, particularly threatened species.

The following management measures will be undertaken to minimise the potential impacts and spread of weeds during the construction of the Southern Extension Project:

- the limits of ground disturbance will be clearly demarcated and no unnecessary disturbance will be undertaken outside of these areas

- rehabilitation will be undertaken on disturbed areas as soon as practical following disturbance. This may include respreading of topsoil, seeding and/or planting of natives

- regular inspections will be undertaken in the Southern Extension Area and adjacent areas to monitor the spread of weed species

- training of environmental personnel on the identification of target weed species.

Any outbreak of noxious weeds will be controlled and eradicated as required under the *Noxious Weeds Act 1993*, and as required by the Local Land Services and other relevant authorities. Weed control and eradication techniques may include:

- spraying with herbicides

- physical removal e.g. chipping,

- minimisation of area available for weed infestation, through prompt revegetation of bare areas.

### 4.2.3 Sediment and erosion control

Surface water management procedures are proposed for the Southern Extension Project.

As part of construction works, the specific inspection, maintenance and revegetation requirements for each works area will be determined and implemented. These control measures will be in accordance with relevant guidelines for erosion and sediment control, including the relevant volumes of the Blue Book, including:

- Landcom (2004) Managing Urban Stormwater – Soils and Construction, Volume 1, 4th Edition.
- Department of Environment and Climate Change (DECC) (2008) Managing Urban Stormwater – Soils and Construction, Volume 2A – Installation of Services.
- Department of Environment and Climate Change (DECC) (2008) Managing Urban Stormwater – Soils and Construction, 2C – Unsealed Roads.
- Department of Environment and Climate Change (DECC) (2008) Managing Urban Stormwater – Soils and Construction, Volume 2E – Mines and Quarries.

### 4.2.4 Rehabilitation

Disturbed areas within the mining leases will be progressively revegetated and regenerated to self-sustaining native vegetation communities. The proposed final land use aims to emulate the pre-mining environment including the reestablishment of vegetation communities present in the area impacted by mining. The proposed rehabilitation strategy will enhance local and regional ecological linkages across the site and with proximate areas. Revegetation works will use local provenance species wherever possible.

The primary objective of site revegetation and regeneration is to create a stable final landform with acceptable post-mining land use and suitability. Rehabilitation areas are to be established progressively once mining operations recommence and will be managed in accordance with the Landscape Management Plan. In the long term, rehabilitation areas are to become integrated with adjacent native vegetation communities. Rehabilitation areas are to be monitored on an annual basis and will be managed until self-sustaining. Final rehabilitation areas are to achieve the rehabilitation completion criteria specified in the Landscape Management Plan.

### 4.2.5 General mitigation measures

A range of general mitigation measures will be employed across the site during the construction phase to minimise impacts to biodiversity values, including:

- Employee education and training including inductions for staff, contractors and visitors to the site will be conducted to inform personnel of the biodiversity issues present at the site and so they know their role and responsibilities in relation to the protection and/or minimisation of impacts to native biodiversity.
- Areas of biodiversity value outside the Southern Extension Area will be fenced or signposted, where appropriate, to prevent the unnecessary disturbance during the construction phase.

## 4.3 Direct impacts

The construction and operation of the Southern Extension Project will result in a range of direct impacts on biodiversity values within the Southern Extension Area. Direct impact includes loss of native vegetation and fauna habitats as a result of direct clearance works and construction of the mine.

**Table 4.1** below outlines these impacts as they were entered into the BBC (Major Project Assessment Type). Avoidance and mitigation measures associated with minimising the impacts of these direct impacts are discussed in **Sections 4.1**, **4.2** and **4.3** above.

**Table 4.1 Direct impacts of the Southern Extension Project**

| Ecological Feature | Area within the Southern Extension Area Impact (ha) |
|---|---|
| **Biometric Vegetation Types** | |
| CW117 - Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion (Moderate/Good) | 8.24 |
| CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good) | 36.50 |
| CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good_High) | 0.62 |
| CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good_Medium) | 2.25 |
| CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good_Other) | 1.65 |
| **Threatened Flora Species** | |
| Capertee stringybark (*Eucalyptus cannonii*) | 24 Individuals |
| **Threatened Fauna Habitats** | |
| Land within 500 m of sandstone escarpments with hollow-bearing trees, rock crevices or flat sandstone rocks on exposed cliff edges and sandstone outcropping | 11.76 |
| Native woodland vegetation within 75 metres of high quality woodlands for squirrel glider | 47.61 |

# 5.0 Impact assessment

## 5.1 Impacts not requiring further assessment

Impacts not requiring further assessment under the FBA include areas of land without native vegetation. The Southern Extension Area contains approximately 0.06 hectares of cleared land that will be removed as a result of the Southern Extension Project that does not meet the definition of 'native vegetation' under the *Native Vegetation Act 2003*. This impact does not require further assessment under the FBA.

## 5.2 Impacts not requiring offset

Impacts on native vegetation not requiring offsets under the FBA include native vegetation that has a site value score of less than 17, including native vegetation that is an endangered or critically endangered ecological community, and/or vegetation that is associated with threatened species habitat (as represented by ecosystem credits).

Impacts on species and populations not requiring offsets under the FBA include threatened species habitat associated with a PCT that has a site value score of less than 17 or species or populations that are not threatened and do not form part of a EEC or CEEC.

No BVTs within the Southern Extension Area have a site value score of less than 17 and are predicted to be habitat for threatened ecosystem species; accordingly, all will require offsetting as discussed in **Section 5.3**.

A range of non-threatened flora and fauna species were recorded within the Southern Extension Area during the surveys undertaken for this assessment. These species do not require offsets under the FBA.

## 5.3 BVTs and threatened species requiring offset

A range of BVTs, ecosystem-credit species and species-credit species were found to require offsetting as discussed in the sections below.

### 5.3.1 Ecosystem credits

**Table 5.1** outlines the ecosystem-credit species requiring offset as a result of the Southern Extension Project. The highest threatened species offset multiplier determines the credit requirements for the BVTs these species are predicted to occur in.

**Table 5.1 Ecosystem-credit species requiring offset as a result of the Southern Extension Project**

| Common Name | Species Name | Threatened Species Offset Multiplier |
|---|---|---|
| black-chinned honeyeater (eastern subspecies) | *Melithreptus gularis* subsp. *gularis* | 1.3 |
| brown treecreeper (eastern subspecies) | *Climacteris picumnus* subsp. *victoriae* | 2.0 |
| bush stone-curlew | *Burhinus grallarius* | 2.6 |
| corbens long-eared bat | *Nyctophilus corbeni* | 2.1 |

| Common Name | Species Name | Threatened Species Offset Multiplier |
|---|---|---|
| diamond firetail | *Stagonopleura guttata* | 1.3 |
| eastern false pipistrelle | *Falsistrellus tasmaniensis* | 2.2 |
| flame robin | *Petroica phoenicea* | 1.3 |
| gang-gang cockatoo | *Callocephalon fimbriatum* | 2.0 |
| glossy black-cockatoo | *Calyptorhynchus lathami* | 1.8 |
| grey-crowned babbler | *Pomatostomus temporalis subsp. temporalis* | 1.3 |
| hooded robin | *Melanodryas cucullata subsp. cucullata* | 1.7 |
| little eagle | *Hieraaetus morphnoides* | 1.4 |
| little lorikeet | *Glossopsitta pusilla* | 1.8 |
| little whip snake | *Suta flagellum* | 2.3 |
| masked owl | *Tyto novaehollandiae* | 3.0 |
| painted honeyeater | *Grantiella picta* | 1.3 |
| powerful owl | *Ninox strenua* | 3.0 |
| scarlet robin | *Petroica boodang* | 1.3 |
| speckled warbler | *Chthonicola sagittata* | 2.6 |
| spotted harrier | *Circus assimilis* | 1.4 |
| spotted-tailed quoll | *Dasyurus maculatus* | 2.6 |
| square-tailed kite | *Lophoictinia isura* | 1.4 |
| swift parrot | *Lathamus discolor* | 1.3 |
| turquoise parrot | *Neophema pulchella* | 1.8 |
| varied sittella | *Daphoenositta chrysoptera* | 1.3 |
| yellow-bellied glider | *Petaurus australis* | 2.3 |
| yellow-bellied sheathtail bat | *Saccolaimus flaviventris* | 2.2 |

**Table 5.2** below outlines the BVTs to be impacted as a result of the Southern Extension Project and the ecosystem credits required to offset those impacts. A full Credit Calculator report is included in **Appendix E**.

**Table 5.2 Biometric vegetation types requiring offset and the ecosystem credits required**

| Biometric Vegetation Type | Vegetation Zone | Area to be Impacted (ha) | Loss in Landscape Value | Current Site Value Score | Future Site Value Score | Threatened Species Offset Multiplier | Ecosystem Credits Required |
|---|---|---|---|---|---|---|---|
| CW117 - Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion (Moderate/Good) | 1 | 8.24 | 17 | 82.29 | 0.0 | 3.0 | 542 |
| CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good) | 2 | 36.50 | 17 | 93.75 | 0.0 | 3.0 | 2714 |
| CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good_High) | 3 | 0.62 | 17 | 58.85 | 0.0 | 3.0 | 30 |
| CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good_Medium) | 4 | 2.25 | 17 | 53.12 | 0.0 | 3.0 | 99 |
| CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good_Easement) | 5 | 1.65 | 17 | 34.9 | 0.0 | 3.0 | 50 |

### 5.3.2 Species credits

**Table 5.3** below outlines the species-credit species to be impacted as a result of the Southern Extension Project and the species credits required to offset those impacts. A full Credit Calculator report is included in **Appendix E**.

**Table 5.3 Species-credit species requiring offset and the species credits required**

| Common Name | Species Name | Threatened Species Offset Multiplier | Species Credits Required |
|---|---|---|---|
| Broad-headed snake | *Hoplocephalus bungaroides* | 3.3 | 388 |
| Capertee stringybark | *Eucalyptus cannonii* | 1.3 | 312 |
| squirrel glider | *Petaurus norfolcensis* | 2.2 | 1047 |

## 5.4 Impacts that require further consideration

Under the FBA, certain impacts on biodiversity values may require further consideration by the consent authority. These are impacts that are considered to be complicated or severe and include:

- impacts on landscape features, being:
    - impacts that will reduce the width of vegetation in the riparian buffer zone bordering significant streams and rivers, important wetlands or estuarine areas, or
    - impacts that will prevent species movement along corridors that have been identified as providing significant biodiversity linkages across the state, and
- impacts on native vegetation that are likely to cause the extinction of an EEC/CEEC from an IBRA subregion or significantly reduce its viability, and
- impacts on critical habitat or on threatened species or populations that are likely to cause the extinction of a species or population from an IBRA subregion or significantly reduce its viability.

The Southern Extension Project will not have an impact on any biodiversity features that would result in one or more of the above severe impacts. Therefore there are no impacts that require further consideration by the consent authority.

## 5.5 Impacts on aquatic species

No *Fisheries Management Act 1994* (FM Act) listed threatened aquatic flora or fauna species were recorded or are expected to occur within the Southern Extension Area.

## 5.6 Seven part tests of significance

Threatened species impact assessment is an integral part of environmental impact assessment. The objective of s. 5A of the EP&A Act, the *assessment of significance*, is to improve the standard of consideration afforded to threatened species, populations and ecological communities, and their habitats through the planning and assessment process, and to ensure that the consideration is transparent.

Although it is understood that the preparation of a BioBanking Assessment under the FBA supersedes the requirement to prepare Seven Part Tests, DP&E has advised that the requirements of Section 5A of the EP&A Act are required to be considered in the BAR. The preparation of a BAR under the FBA addresses the components of the Seven Part Tests by use of the BBCC. A summary of the requirements of the Seven Part Tests of Significance and where they are addressed in the FBA Assessment is outlined in **Table 5.4** below.

**Table 5.4 Seven part tests of significance and the FBA**

| Seven Part Test of Significance | Where Addressed in the FBA Process |
|---|---|
| a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction; | Threatened species (ecosystem-credit and species-credit) are predicted in the BBCC by the landscape features of the Southern Extension Area (native vegetation cover, IBRA regions, patch sizes, condition and plant community types) and assessed by the impact on these features.<br>Impacts requiring further consideration (Section 9.2 of the FBA (OEH 2014b) identify impacts on critically endangered threatened species, impacts that may cause the extinction of a species in a IBRA subregion and impacts that significantly reduce the viability of a species. |
| b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction | Endangered populations are predicted in the BBCC by the landscape features of the Southern Extension Area (native vegetation cover, IBRA regions, patch sizes, condition and plant community types) and assessed by the impact on these features.<br>Impacts requiring further consideration (Section 9.2 of the FBA (OEH 2014b) identify impacts that may cause the extinction of an endangered population in a IBRA subregion and impacts that significantly reduce the viability of a population. |
| c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;<br>i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; and<br>ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction; | Endangered ecological communities are predicted in the BBCC by the plant community types and biometric community types identified from the field surveys and entered into the BBCC.<br>Impacts requiring further consideration (Section 9.2 of the FBA (OEH 2014b) are identified as impacts on any critically endangered or endangered ecological community that may cause the extinction of the EEC/CEEC in a IBRA subregion or significantly reduce the viability of an EEC/CEEC. |

| Seven Part Test of Significance | Where Addressed in the FBA Process |
|---|---|
| d) in relation to the habitat of a threatened species, population or ecological community;<br>i. the extent to which habitat is likely to be removed or modified as a result of the action proposed;<br>ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and<br>iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality; | Habitat loss is assessed in the BBCC via the 'Site Values' tab and the loss in site value score entered for each vegetation zone.<br>Fragmentation of habitat is addressed as part of the 'Landscape Value' score including consideration of features before and after the development including per cent native vegetation cover, connectivity value and vegetation condition. The per cent cleared scores for the dominant Mitchell Landscape is also calculated in the 'Landscape Value' score.<br>Important habitat features are identified through determining geographic and habitat features relevant for particular species-credit species and the assessment of landscape features (such as riparian buffers, important wetlands and state or regionally significant biodiversity links).<br>The extent of habitat loss is ultimately determined by the measure of ecosystem credits and species credits calculated in the BBCC. |
| e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly); | Critical habitat is addressed under impacts that require further consideration by the consent authority (refer to Section 9.2 of the FBA (OEH 2014b)). |
| f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and | Recovery plans are not directly addressed in the FBA. It is likely that the Southern Extension Project would be inconsistent with any recovery plans prepared for the threatened species impacted by the Southern Extension Project as it relates to impacts on the habitat for the species. However the Southern Extension Project will not impede the implementation of these recovery plans.<br>If supplementary offsetting measures are used (as per Appendix B of the NSW Biodiversity Offset Policy for Major Projects) to offset species or communities impacted by projects, reference can be made to the key objectives and actions in the relevant recovery plans. |

| Seven Part Test of Significance | Where Addressed in the FBA Process |
|---|---|
| g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process. | Key threatening processes are not directly assessed under the FBA.<br>In this case, the Southern Extension Project may contribute to the following key threatening processes:<br>• Aggressive exclusion of birds by noisy miners (*Manorina melanocephala*)<br>• Clearing of native vegetation<br>• Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*)<br>• Invasion of native plant communities by exotic perennial grasses<br>• Predation by the European red fox (*Vulpes vulpes*)<br>• Removal of dead wood and dead trees. |

## 5.7 Impacts on matters of national environmental significance

Under the Commonwealth EPBC Act, the approval of the Commonwealth Minister for the Environment is required for any action that may have a significant impact on matters of national environmental significance (MNES). These matters are:

- listed threatened species and communities
- migratory species protected under international agreements
- Ramsar wetlands of international importance
- the Commonwealth marine environment
- the Great Barrier Reef Marine Park
- World Heritage properties
- National Heritage places
- nuclear actions
- a water resource, in relation to coal seam gas development and large coal mining development.

If an 'activity' is likely to have a significant impact on a matter of national environmental significance then it may be a 'controlled action' and should be referred to the Commonwealth Minister for Environment for consideration. Actions not considered to have a significant impact on MNES may also be referred for a conclusive determination by the Minister to that effect. If declared to be a controlled action by Minister (or delegate) the action must obtain approval under the EPBC Act before it can be carried out.

The 2014 Modification Project was referred to the Minister for Environment on 3 March 2014 (EPBC Act referral 2014/147). The description of the proposed action referred is set out below:

> *Coalpac is seeking to modify the existing Project Approval for Invincible Colliery (PA 07_0127) and Development Consent for Cullen Valley Mine (DA 200-5-2003) under Section 75W of the former Part 3A of the EP&A Act. The proposed Modifications to the approved operations include:*
>
> - *Extension to PA 07_0127 for four years from December 2016 to December 2020;*
> - *Extension of 150 ha to areas approved for open cut mining;*
> - *Extension of 165 ha to areas approved for highwall mining. These highwall mining operations will not result in additional surface disturbance to that from the proposed extension to open cut mining areas; and*
> - *Installation of a water pipeline which will result in the ability to transfer water between Invincible Colliery and Cullen Valley Mine. The pipeline alignment will largely remain on or adjacent to existing access tracks within the Ben Bullen State Forest; and*
> - *Backfilling and rehabilitation of the residual final voids resulting from existing mining operations and the rehabilitation of areas affected by subsidence from historic underground mining operations in the area to create a stable, free-draining final landform.*
>
> *All other aspects of operations on site, including coal production and processing (at a maximum rate of up to 2.2 Mtpa product coal from combined open cut and highwall mining methods), coal transport, operational hours and employment would remain generally consistent with that currently approved under the EP&A Act (Project Approval PA 07_0127 and Development Consent DA 200-5-2003)*

The referral concluded that the proposed action described in the referral was unlikely to significantly impact any MNES. The referred action was declared to not be a controlled action for the purposes of the EPBC Act on 31 March 2014. Approval under the EPBC Act for the referred action is therefore not required.

The Southern Extension Project is a subset of the earlier 2014 Modification Project design and was largely included in the area previously referred an declared to not be a controlled action in 2014. The proposed open cut mining area for the Invincible component of the referral was 88 hectares. The Southern Extension Project does not include open cut mining to the north of the existing Invincible open cut mining area and an area to the immediate north west of the Southern Extension Area which formed part of the referred Project. The Southern Extension Project does not include any highwall mining. The Southern Extension Project will remove approximately 38 hectares less vegetation than the referred project, much of which was located within 500 metres of pagoda formations.

A small area of the Southern Extension Area (approximately 1 hectare) lies outside the approved disturbance area under the Invincible Project Approval and the area that was referred in EPBC Act referral 2014/147 (refer to **Figure 1.2**). There are no records of flora species listed as MNES under the EPBC Act within the Southern Extension Area and the vegetation does not conform to any threatened or endangered ecological communities listed under the EPBC Act. While there is potential habitat for some threatened fauna species listed under the EPBC Act in this area, the potential impact of the Southern Extension Project will be the same as or less than that considered in the referral due to the overall reduced scale of impact associated with the Southern Extension Project relative to the referred action. Potential impacts on other MNES (including water resources) will be the same as or less than that considered in the referral due to the overall reduced scale of impact associated with the Southern Extension Project relative to the referred action.

An assessment of significance for ecological related MNES has been prepared and is included in **Appendix F**. The assessment of significance in accordance with the DoE Significant Impact Guidelines 1.1 (DoE 2016) concluded that the Southern Extension Project is similarly considered to be unlikely to have a significant impact on any biodiversity related MNES and approval under the EPBC Act is therefore not required..

# 6.0 Offsetting requirements

## 6.1 Biodiversity credit report

A full Credit Calculator report is included in **Appendix E**.

**Table 6.1** below provides a summary of the ecosystem and species credits that require offsetting as a result of this Project.

**Table 6.1 Ecosystem and species credits required for the Modification Project**

| Name | Credits Required |
|---|---|
| **Ecosystem Credits** | |
| CW117 - Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion (Moderate/Good) | 542 |
| CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good) | 2714 |
| CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good_High) | 30 |
| CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good_Medium) | 99 |
| CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good_Other) | 50 |
| **Total** | **3435** |
| **Species Credits** | |
| Broad-headed snake(*Hoplocephalus bungaroides*) | 388 |
| Capertee stringybark (*Eucalyptus cannonii*) | 312 |
| squirrel glider (*Petaurus norfolcensis*) | 1047 |
| **Total** | **1747** |

## 6.2 Offsetting options for ecosystem credits

### 6.2.1 Offset location

Ecosystem credits for any of the PCTs in the Southern Extension Area can be located in any IBRA subregion that adjoins the IBRA subregion in which the Southern Extension Project occurs. The Project occurs in the Capertee Uplands IBRA subregion and therefore, ecosystem credits can be sourced from the following IBRA subregions:

***South Eastern Highlands Bioregion***

- Capertee Uplands
- Hill End

***NSW Western Slopes Bioregion***

- Capertee Valley
- Inland Slopes

***Sydney Basin Bioregion***

- Wollemi

### 6.2.2 Biometric vegetation types

Under the FBA, there is some flexibility around the types of BVTs which can be used to offset impacts on a specific BVT. This includes:

a) the PCT for which the ecosystem credit is required for the impacts of development

b) any PCT of the same vegetation class as identified in a) that is in the same or adjoining IBRA sub-region and has:

- a percent cleared value of the PCT in the major catchment area equal to or greater than the percent cleared of the PCT specified in a) or
- a percent cleared value up to 10 per cent lower than the PCT specified in a), if the percent cleared of the PCT specified in a) is less than or equal to 70 per cent cleared.

A discussion of the PCT offset availability for the communities occurring in the Southern Extension Area is discussed below.

#### 6.2.2.1 CW117 - Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion

There are five PCTs that could be used to offset CW117 - Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion under the FBA. The full list of suitable PCTs is provided in the full Credit Calculator report is included in **Appendix E**.

#### 6.2.2.2 CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes

There are 51 PCTs that could be used to offset CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes under the FBA. The full list of suitable PCTs is provided in the full Credit Calculator report in **Appendix E**.

## 6.3 Offsetting options for species credits

A required species credit must be offset with a species credit created for the same species, determined in accordance with the BBAM. Under the FBA and strictly in accordance with the rules set out in Section 10.5.7 of the FBA methodology (OEH 2014b), the consent authority may also approve:

a) a variation of the offset rules for matching species credits by allowing a different species to that impacted by the proposed development to be used to meet the offset requirement, or

b) a supplementary measure to be proposed as an offset for the species impacted by the development.

A Biodiversity Offset Strategy is required to be prepared and is to include justification of the need for the variation rules and demonstrated consultation with OEH during the process.

# 7.0 References


Anstis, M, (2013) *Tadpoles and Frogs of Australia*. New Holland, Sydney.

Barker, J, Grigg, G, C, & Tyler, M, J, (1995) *A Field Guide to Australian Frogs*. Surrey Beatty & Sons, Sydney.

Birdlife International (2013) *Taxonomic Checklist*, Version 6.0, November 2013.

Botanic Gardens Trust, (2015) *PlantNET* – The Plant Information Network System of Botanic Gardens Trust, Sydney, Australia (version 2.0). <http://plantnet.rbgsyd.nsw.gov.au> accessed February 2015.

Braun-Blanquet, J, (1927) *Pflanzensoziologie*. Springer, Vienna.

Cumberland Ecology (2012) *Ecological Assessment for the Coalpac Consolidated Project*.

Cumberland Ecology (2014) *Ecological Assessment for the Cullen Valley Modification and Invincible Quarry Modification*

Cogger, H, G. (2014) *Reptiles and Amphibians of Australia.* CSIRO Publishing, Collingwood.

Council of Heads of Australian Berbaria (CHAH) (2011) *Australian Plant Census (APC),* accessed August 2015.

Croak, B. M., Crowther, M.S., Webb, J. K. and Shine, R.S. (2013) *Movements and Habitat Use of an Endangered Snake, Hoplocephalus bungaroides (Elapidae): Implications for Conservation*. Plos One. April 22, 2013.

Cronquist, A, (1981) *An Integrated System of Classification of Flowering Plants*. Columbia University Press, New York. Department of the Environment (2013) Significant Impact Guidelines 1.1 – Matters of National Environmental Significance.

Department of Environment and Climate Change (DECC) (2008) *Approved Recovery Plan for the Koala (Phascolarctos cinereus)*, November 2008.

Department of Environment and Climate Change (DECC) (2008) *Managing Urban Stormwater – Soils and Construction, Volume 2A, 2C, 2D and 2E* (the Blue Book).

Department of Environment and Conservation (DEC) (2004) *Threatened Species Survey and Assessment: Guidelines for development and activities (working draft)*, November 2004.

Department of Environment and Conservation (DEC) (2006a) *The vegetation of the Western Blue Mountains*

Department of Environment and Conservation (DEC) (2006b) *Reconstructed and Extant Distribution of Native Vegetation in the Central West and Lachlan Catchment* (DEC 2006)

Department of Environment and Climate Change (OEH) (2008) BioBanking Assessment Methodology, July 2008.

Department of Environment and Resource Management (DERM) (2011) National recovery plan for the large-eared pied bat Chalinolobus dwyeri. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Department of Environment, Climate Change and Water NSW (DECCW) (2011) National Recovery Plan for White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland. Department of Environment, Climate Change and Water NSW, Sydney

Department of Infrastructure, Planning and Natural Resources (DIPNR) (2003) *Soil Landscapes of the Goulburn Region 1:100 000 Sheet*, Soil Conservation Service of NSW, Sydney.

Department of Sustainability, Environment, Water, Population and Communities (DSWEPC) (2011) Survey Guidelines for Australia's Threatened Reptiles.

Department of the Environment (DoE) (2015) Protected Matters Search Tool http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf accessed February 2015.

Department of the Environment (DoE) (2016) *National Recovery Plan for the Regent Honeyeater (Anthochaera phrygia)*, Department of the Environment, Canberra.

Google Earth Satellite Imagery (2016) Google Earth Version 7.1.5.1557.

Harden, G, J, editor, (1992) *Flora of New South Wales. Volume 3*. Royal Botanic Gardens Sydney & New South Wales University Press, Sydney.

Harden, G, J, editor, (1993) *Flora of New South Wales. Volume 4*. Royal Botanic Gardens Sydney & New South Wales University Press, Sydney.

Harden, G, J, editor, (2000) *Flora of New South Wales. Volume 1*. 2nd edition. New South Wales University Press and Royal Botanic Gardens, Sydney.

Harden, G, J, editor, (2002) *Flora of New South Wales. Volume 2*. Revised edition. Royal Botanic Gardens Sydney & New South Wales University Press, Sydney.

Jacobs, S., Whalley, R., and Wheeler, D. 2008. Grasses of New South Wales.

Land and Property Information (LPI) (2016) SIX Maps < https://maps.six.nsw.gov.au/>

Landcom (2004) Managing Urban Stormwater – Soils and Construction, Volume 1, 4th Edition.

Menkhorst, P, and Knight, F, (2010) *A Field Guide to the Mammals of Australia*, Oxford University Press, South Melbourne.

NSW Planning and Assessment Commission (2012), NSW Planning Assessment Commission Coalpac Consolidation Project Review: Main Report

NSW Scientific Committee (2002) White Box Yellow Box Blakely's Red Gum Woodland – endangered ecological community final determination, gazetted 15 March 2002.

Office of Environment and Heritage (OEH) (2014a) BioBanking Assessment Methodology, September 2014.

Office of Environment and Heritage (OEH) (2014b) Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major Projects, September 2014

Office of Environment and Heritage (OEH) (2016) Threatened Species Profile Database, accessed June 2016.

Office of Environment and Heritage (OEH) (2016) BioNet Atlas of NSW Wildlife, accessed June 2016.

Office of Environment and Heritage (OEH) (2016) Vegetation Information System (VIS).

Pizzey, G, and Knight, F (2012) *A Complete Guide to the Birds of Australia*. Harper Collins, Sydney.

Robinson, M, (1998) *A Field Guide to Frogs of Australia*. Australian Museum/Reed New Holland, Sydney

Strahan, R, (ed) (2002) *The Mammals of Australia* Revised Edition. Reed New Holland, Sydney.

Strahler, A. N., (1952) Hypsometric (area-altitude) analysis of erosional topography, *Geological Society of America Bulletin* 63 (11): 1117-1142.

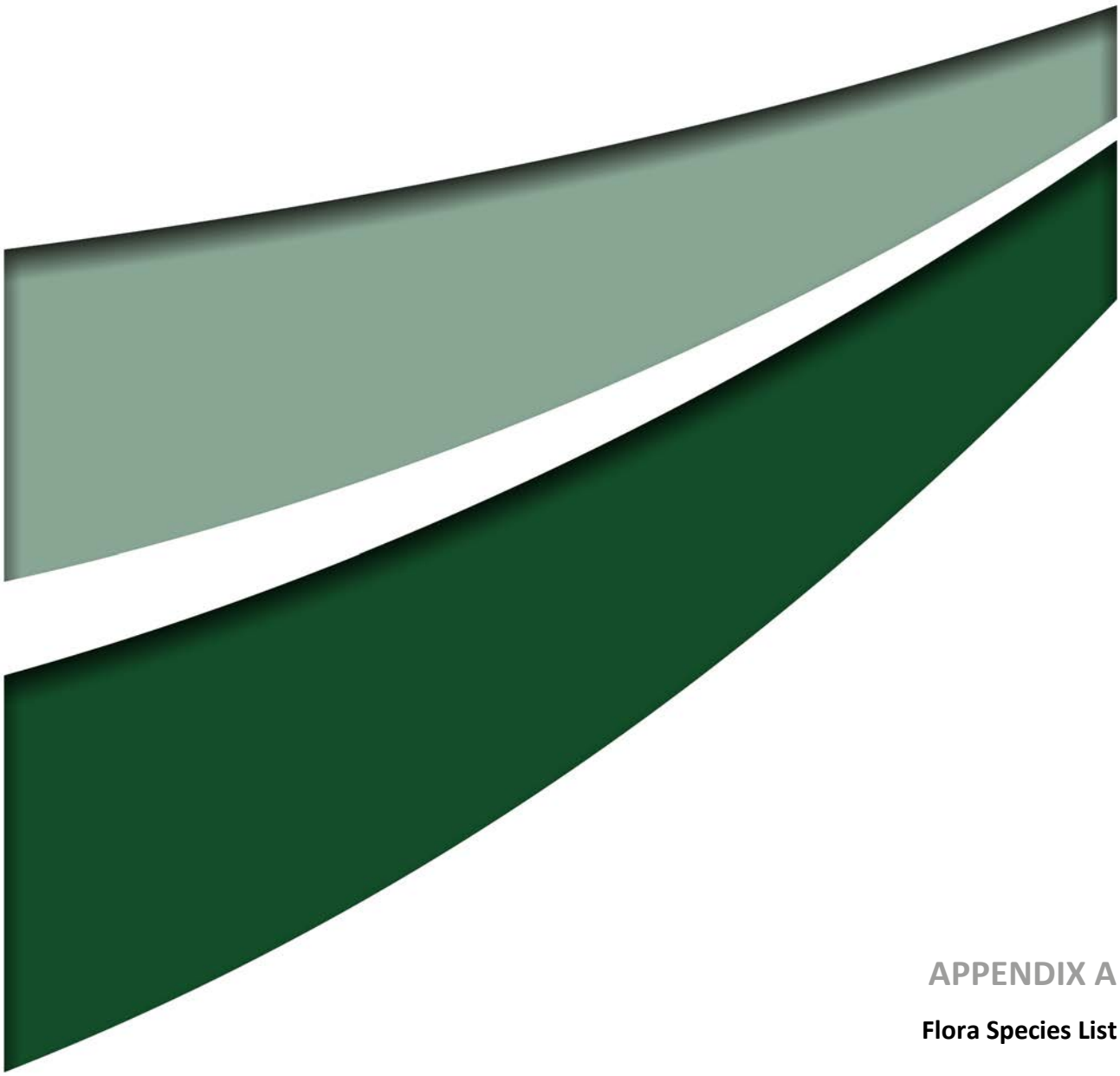
Threatened Species Scientific Committee (TSSC) (2006) White Box - Yellow Box - Blakely's Red Gum Grassy

Van Dyck & Strahan (2008) *The Mammals of Australia* Revised Edition. Reed New Holland, Sydney.

Webb, J. K.and Shine, R. (1997). A Field Study of Spatial Ecology and Movements of a Threatened Snake Species, *Hoplocephalus bungaroides*. Biological Conservation. 82 (203-217). 1997.

Wheeler D, J, B, Jacobs S, W, L, and Whalley R, D, B, (2002) *Grasses of New South Wales*, 3rd Edition. The University of New England, Armidale.

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



# APPENDIX A

**Flora Species List**

## Appendix A - Flora Species List

The following list was developed from surveys of the Southern Extension Area undertaken by Umwelt over 14 days and five survey periods, being:

- 25 to 26 August 2015
- 11 to 13 November 2015
- 11 to 15 January 2016
- 7 to 8 April 2016 and
- 18 to 19 April 2016.

It includes all species of vascular plants observed during these surveys. It is acknowledged that the list is not comprehensive, as not all species are readily detected at any one time of the year. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many of these species cannot be identified, or even detected.

Names of classes and families follow a modified Cronquist (1981) System.

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

| | |
|---|---|
| sp. | specimens that are identified to genus level only. |

The following abbreviations or symbols are used in the list:

| | |
|---|---|
| 1 to 1000 | actual abundance score |
| X | species recorded in proximity to, but outside of, quantitative floristic quadrat |
| ✓ | species recorded opportunistically during surveys |
| asterisk (*) | denotes species not native to the Cullen Bullen area |
| subsp. | subspecies and |
| var. | variety. |

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler *et al.* (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust 2016), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

| | | | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Opps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Filicopsida** | | | | | | | | | | | | | | | | |
| Adiantaceae | *Cheilanthes sieberi* subsp. *sieberi* | poison rock fern | | 5 | 20 | | | 5 | 50 | 20 | | 5 | | | | |
| Dennstaedtiaceae | *Pteridium esculentum* | bracken fern | | 10 | | | | | | | 1 | | | | 50 | |
| **Magnoliopsida (Flowering Plants) - Lillidae** | | | | | | | | | | | | | | | | |
| Cyperaceae | *Lepidosperma laterale* | | | | | | | | | | | | | 1 | | |
| Iridaceae | *Pattersonia sericea* | silky purple-flag | | | | 3 | | | | | | | | | | |
| Lomandraceae | *Lomandra confertifolia* | | | 50 | 1000 | 50 | | | | | | | | | | |
| Lomandraceae | *Lomandra filiformis* | | | | | | 1000 | 500 | 500 | 500 | 500 | 100 | 2 | 1000 | 100 | |
| Lomandraceae | *Lomandra longifolia* | spiny-headed mat-rush | | | | | | | | 100 | | | | 500 | | |
| Lomandraceae | *Lomandra multiflora* subsp. *multiflora* | many-flowered mat-rush | | | 20 | | | | | | | | | | 2 | |
| Lomandraceae | *Lomandra sp.* | | 50 | | | | | | | | | | | | | |
| Orchidaceae | *Dipodium roseum* | | | | | | | | | | | 1 | | | | |
| Orchidaceae | *Dipodium sp* | | 1 | | | | | | | | | | | | | |
| Orchidaceae | *Diuris sulphurea* | tiger orchid | | | | | | | | | | | | | | X |
| Phormiaceae | *Dianella revoluta* var. *revoluta* | a blue flax lily | 5 | 10 | 10 | | 10 | 5 | | 5 | | 5 | | | | |
| Phormiaceae | *Stypandra glauca* | nodding blue lily | | 2 | | | | | | | | | | | | |
| Poaceae | **Aira cupaniana* | silvery hairgrass | | | | | | | 10 | | | | | | | |

| | | | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Opps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Poaceae | *Aristida vagans* | threeawn speargrass | | | | | | | 50 | 10 | 20 | 20 | | 100 | | |
| Poaceae | *Austrodanthonia laevis* | wallaby grass | | | | | | | | | 50 | 20 | | | | |
| Poaceae | *Austrodanthonia pilosa* | smooth-flowered wallaby grass | | | | | | | 50 | 50 | | | | | | |
| Poaceae | *Austrostipa bigeniculata* | yanganbil | | 100 | | | | | | | | | | | | |
| Poaceae | *Austrostipa rudis* | foxtail speargrass | | 50 | | | | | | 10 | 5 | 10 | | | | |
| Poaceae | *Austrostipa scabra* | rough speargrass | | 50 | | | | | | | | | | | | |
| Poaceae | *Austrostipa* sp. | a speargrass | | | | | | | | | | | | | 50 | |
| Poaceae | *Echinopogon ovatus* | forest hedgehog grass | | | | | | | | 5 | | | | 100 | | |
| Poaceae | *Entolasia stricta* | wiry panic | | | | | | | 3 | | | | | | | |
| Poaceae | *Microlaena stipoides* var. *stipoides* | | | | | | | | | | | | 1000 | 1000 | 500 | |
| Poaceae | *Paspalidium distans* | | | | | | 20 | | | | | | | | | |
| Poaceae | *Paspalidium sp.* | | 20 | | | | | | | | | | | | | |
| Poaceae | *Poa labillardierei* | tussock grass | | | | | | | 20 | 10 | | | | | 2 | |
| Poaceae | *Poa sieberiana* | snowgrass | | 100 | 100 | 50 | 500 | | 20 | | | 10 | 500 | 100 | 500 | |
| Poaceae | *Rytidosperma pallidum* | silver-top wallaby grass | | 50 | | | | | | | | | | | | |
| Poaceae | *Rytidosperma sp* | silver-top wallaby grass | 100 | | 20 | 5 | 20 | 100 | 3 | 10 | | 500 | 1000 | 100 | 500 | |
| Poaceae | *Themeda triandra* | kangaroo grass | | | | | | | | | | | 50 | | | |

| | | | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Opps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Magnoliopsida (Flowering Plants) - Magnoliidae** | | | | | | | | | | | | | | | | |
| Acanthaceae | *Brunoniella australis* | Blue trumpet flower | | | 10 | | 1 | 5 | | | | | | | | |
| Aizoaceae | **Galenia pubescens* | Galenia | | 1 | | | | | | | | | | | | |
| Apiaceae | *Hydrocotyle laxiflora* | stinking pennywort | | 20 | 20 | | 20 | 10 | | 20 | | | 100 | 100 | 100 | |
| Apiaceae | *Platysace lanceolata* | shrubby Platysace | 5 | | | | | | | | | | | | | |
| Asteraceae | *brachyscome spathulata* | | | | | | | | | | | | | 1 | | |
| Asteraceae | *Cassinia arcuata* | sifton bush | | | | | | | 5 | | 10 | | | | 1 | |
| Asteraceae | *Chrysocephalum apiculatum* | common everlasting | | | | | | | 500 | | | | | | | |
| Asteraceae | *Circium vulgare* | spear thistle | | | | | | | | | | | 1 | | | |
| Asteraceae | *Cymbonotus sp.* | | | | | | | | | | | | 1 | | | |
| Asteraceae | *Euchiton involucratus* | star cudweed | | | 5 | | | | | | | | | | | |
| Asteraceae | **Hypochaeris radicata* | catsear | | | 5 | | | | | 10 | 10 | | | 5 | | |
| Asteraceae | *Lagenophora stipitata* | common lagenophora | 1 | | | | | | | | | | | | | |
| Asteraceae | *Leucochrysum albicans* subsp. *albicans c* | | | 5 | | | | | | | | | | | | |
| Asteraceae | *Senecio quadridentatus* | cotton fireweed | | | | | | | 100 | | | 5 | | | | |
| Asteraceae | *Solenogyne gunnii* | Solenogyne | | | | | 2 | | | | | | | | | |
| Asteraceae | **Tolpis barbata* | yellow hawkweed | | | | | | 2 | | | | | | | | |

| | | | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Opps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Asteraceae | *Vernonia cinerea* | | | | | | | | 5 | | | | | | | |
| Asteraceae | *Vittadinia muelleri* | fuzzweed | | | | | | | | 5 | | | | | | |
| Asteraceae | *Vittadinia gracilis* | woolly New Holland daisy | | | | | 2 | | 10 | | 20 | | | | | |
| Boraginaceae | *Cynoglossum suaveolens* | sweet hounds-tongue | | 5 | 5 | | | | | | | | | | | |
| Boraginaceae | *Echium plantagineum* | Patterson's curse | | 10 | | | | | | | 2 | | 1 | | 5 | |
| Campanulaceae | *Wahlenbergia* sp. | bluebell | | | | | 2 | | | | | | | | 1 | |
| Clusiaceae | *Hypericum gramineum* | small St Johns wort | | 50 | 20 | | 20 | 10 | 20 | 50 | 10 | 5 | | | | |
| Clusiaceae | **Hypericum perforatum* | St. Johns wort | | 10 | 10 | | 20 | | 10 | | 20 | | 20 | | 20 | |
| Convolvulaceae | *Dichondra repens* | kidney weed | | | 20 | | 20 | | | 10 | | | 200 | 500 | 50 | |
| Dilleniaceae | *Hibbertia obtusifolia* | hoary guinea flower | 5 | 5 | | 3 | | | | | | | | | | |
| Dilleniaceae | *Hibbertia spp.* | | | | | | | 20 | | | | 2 | | | | |
| Ericaceae | *Astroloma humifusum* | native cranberry | 2 | | | | | | | | | | | | | |
| Ericaceae | *Brachyloma daphnoides* | Daphne heath | 2 | | | 10 | | | | | | | | | | |
| Ericaceae | *Leucopogon lanceolatus* | | 5 | | | | | | | | | | | | | |
| Ericaceae | *Leucopogon muticus* | blunt beard-heath | | | | | | 10 | | | | | | 2 | | |
| Ericaceae | *Lissanthe strigosa* | peach heath | | 20 | 100 | | 25 | 10 | 20 | | | 50 | | | | |
| Ericaceae | *Melichrus urceolatus* | urn-heath | | | | | | | | | | | | | 1 | |

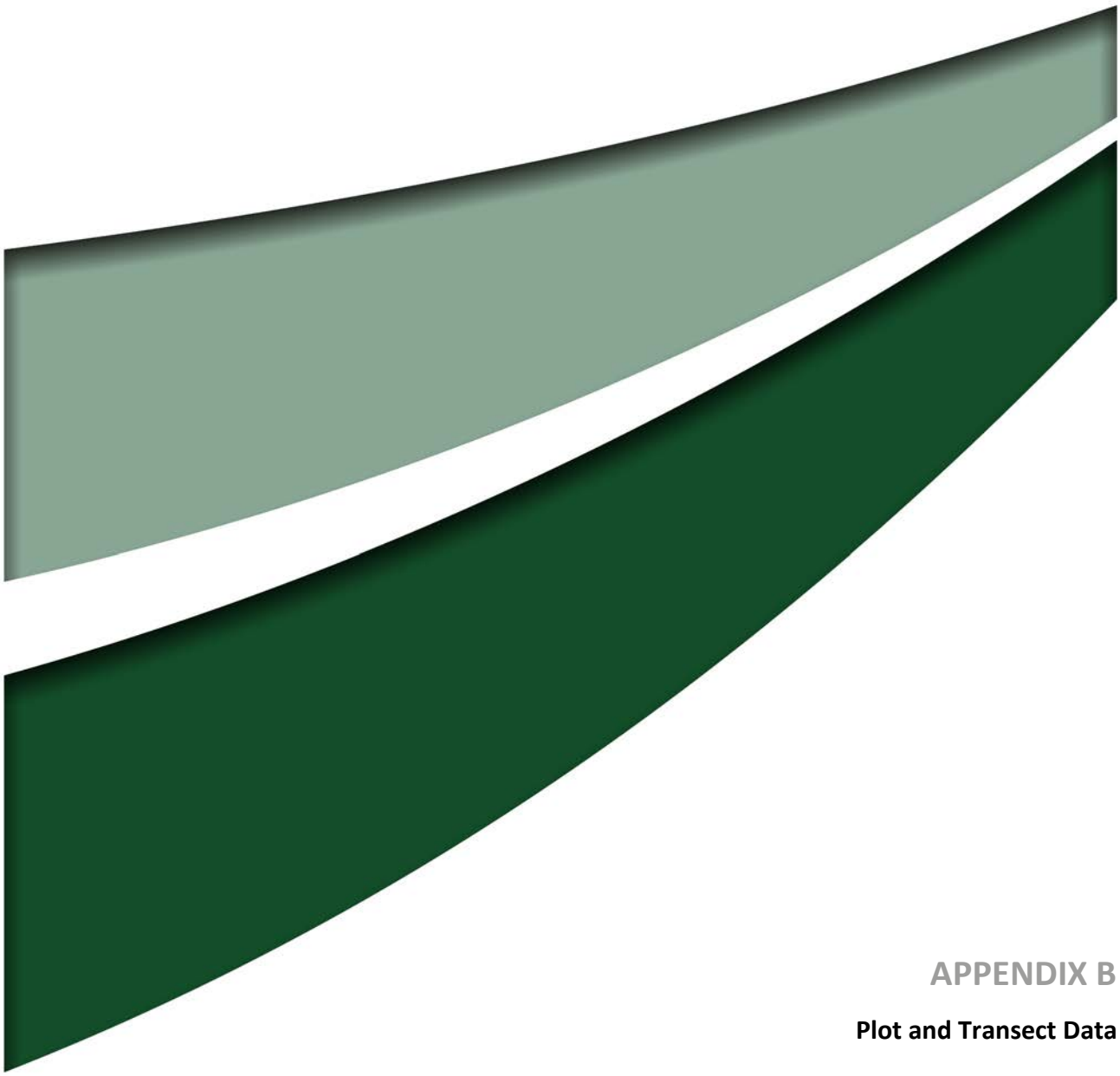
| | | | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Opps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ericaceae | *Monotoca elliptica* | Tree broom-heath | | | | | | 20 | | | | | | | | |
| Fabaceae (Faboideae) | *Bossiaea buxifolia* | | | | | | 1 | | | | | | | | | |
| Fabaceae (Faboideae) | *Bossiaea prostrata* | | | 1 | | | | | | | | | | | | |
| Fabaceae (Faboideae) | *Daviesia ulicifolia* | gorse bitterpea | | | | | | | | 50 | 50 | | | | | |
| Fabaceae (Faboideae) | *Desmodium gunnii* | tick-trefoil | | | | | | 10 | | | | | | | | |
| Fabaceae (Faboideae) | *Desmodium varians* | slender tick-trefoil | | 50 | | | 5 | | 5 | | | | | | | |
| Fabaceae (Faboideae) | *Dillwynia phylicoides* | parrot-pea | | | | | | | | 3 | 1 | | | | | |
| Fabaceae (Faboideae) | *Glycine clandestina* | twining glycine | | | | | | | | 5 | | | | 100 | | |
| Fabaceae (Faboideae) | *Glycine microphylla* | small-leaf glycine | | | | | 3 | | | | | | | | | |
| Fabaceae (Faboideae) | *Glycine tabacina* | | | | | | | | | | | | 100 | | 500 | |
| Fabaceae (Faboideae) | *Hardenbergia violacea* | false sarsaparilla | | 2 | | 1 | 3 | 5 | | | 2 | 10 | | | | |
| Fabaceae (Faboideae) | *Hovea spp.* | | | | | | | 1 | | | | | | | | |
| Fabaceae (Faboideae) | *Indigofera australis* | Australian indigo | | 5 | | | 5 | | | | | | | | | |
| Fabaceae (Faboideae) | *Podolobium ilicifolium* | prickly shaggy pea | 100 | 20 | | 10 | | 50 | | | | | | | | |

| | | | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Opps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fabaceae (Mimosoideae) | *Acacia buxifolia* | box-leaved wattle | 20 | | 50 | 8 | | 20 | 20 | 20 | 50 | 20 | | | | |
| Fabaceae (Mimosoideae) | *Acacia dealbata* | silver wattle | | | 3 | | 7 | 1 | | 5 | 20 | | 3 | | 1 | |
| Fabaceae (Mimosoideae) | *Acacia deanei* | green wattle | | 5 | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | *Acacia falcata* | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | *Acacia gunnii* | ploughshare wattle | 1 | 3 | | | 3 | 1 | | | | | | | | |
| Fabaceae (Mimosoideae) | *Acacia longifolia* | Sydney golden wattle | | | | | | | | | | | | 1 | | |
| Fabaceae (Mimosoideae) | *Acacia obtusifolia* | | | 5 | | | | 2 | | 1 | | 2 | | | | |
| Fabaceae (Mimosoideae) | *Acacia spp.* | wattle | | | | | 1 | | | | | | | | | |
| Fabaceae (Mimosoideae) | *Acacia terminalis* | sunshine wattle | | | | 20 | | | | | | | | | | |
| Fabaceae (Mimosoideae) | *Acacia ulicifolia* | prickly moses | | | | | | | 2 | | | 1 | | | | |
| Gentianaceae | *Centaurium erythraea* | common centaury | | 100 | | | | 2 | 20 | | 10 | | | 1 | 100 | |
| Geraniaceae | *Geranium solanderi* | native geranium | | | | | | | | | | | 2 | | | |
| Goodeniaceae | *Goodenia hederacea* subsp. *hederacea* | ivy goodenia | 20 | 10 | | 10 | | 50 | | 5 | 5 | 10 | | | | |
| Haloragaceae | *Gonocarpus tetragynus* | poverty raspwort | | | 10 | | 20 | 10 | 2 | 20 | 5 | 20 | | 100 | 100 | |

| | | | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Opps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lamiaceae | *Mentha diemenica* | slender mint | | | | | | | | | | | 5 | | 100 | |
| Lauraceae | *Cassytha glabella* | | | | | | | | | | | | | | | |
| Loranthaceae | *Amyema miquelii* | box mistletoe | | | | | 1 | 2 | | 8 | | 2 | | | | |
| Loranthaceae | *Amyema spp.* | mistletoe | | | 1 | | | | | | | | | | | |
| Myrtaceae | *Eucalyptus albens* | white box | | | | | | | | | | | | | | |
| Myrtaceae | *Eucalyptus amplifolia* | cabbage gum | | | | | | | | | | | | 7 | | |
| Myrtaceae | *Eucalyptus blakelyi* | Blakely's red gum | | | 2 | | | | | | | | | 1 | | |
| Myrtaceae | *Eucalyptus blaxlandii* | Blaxland's stringybark | | | | | | | | | | | | | | |
| Myrtaceae | *Eucalyptus bridgesiana* | apple box | | 4 | 3 | 1 | | | | | | | | | | |
| Myrtaceae | *Eucalyptus cameronii* | diehard stringybark | | | | | 5 | | | | | | | | | |
| Myrtaceae | *Eucalyptus cannonii* | capertee stringybark | | 5 | 5 | | | | | | | | 4 | | | |
| Myrtaceae | *Eucalyptus dalrympleana* | mountain gum | | | | | | | 20 | 6 | 20 | 5 | | | | |
| Myrtaceae | *Eucalyptus dives* | broad-leaved peppermint | | | | | | | | | | | | | 8 | |
| Myrtaceae | *Eucalyptus mannifera* | brittle gum | 3 | 5 | | | | | | | | | | | | |
| Myrtaceae | *Eucalyptus melliodora* | yellow box | | | | | | | | | | | 2 | 1 | | |
| Myrtaceae | *Eucalyptus piperita* | Sydney peppermint | | | 1 | | | | | | | 2 | | | | |
| Myrtaceae | *Eucalyptus praecox* | brittle gum | | | 8 | | 10 | 2 | | | | | | | | |

| | | | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Opps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Myrtaceae | *Eucalyptus radiata* | narrow-leaved peppermint | | | | | 2 | 2 | | | | | | | | |
| Myrtaceae | *Eucalyptus rossii* | inland scribbly gum | 2 | 1 | 4 | 3 | | 10 | | | | 14 | | | | |
| Myrtaceae | *Eucalyptus sieberi* | silvertop ash | 10 | | | | | | | | | | | | | |
| Myrtaceae | *Eucalyptus sparsifolia* | narrow-leaved stringybark | | | | 20 | | 20 | 1 | 7 | 10 | 7 | | | 2 | |
| Myrtaceae | *Eucalyptus viminalis* | ribbon gum | | | | | | | | | | | 20 | 1 | 8 | |
| Myrtaceae | *Leptospermum juniperinum* | prickly tea-tree | | | | | | | | 50 | | 1 | | | | |
| Myrtaceae | *Leptospermum polygalifolium* | | | 1 | | | | | | | | | | | | |
| Oxalidaceae | *Oxalis* sp. | | 3 | 20 | 50 | | 5 | 5 | | 3 | 20 | | 100 | 50 | | |
| Phyllanthaceae | *Poranthera microphylla* | small poranthera | | | 1 | | | 5 | | | | | | | | |
| Pittosporaceae | *Billardiera scandens* | hairy apple berry | 1 | | 10 | | | | | | | | | 1 | | |
| Pittosporaceae | *Bursaria spinosa* | native blackthorn | | | 1 | | 3 | | | | | | | | | |
| Plantaginaceae | **Plantago debilis* | | | 20 | | | | | | | | | | | | |
| Plantaginaceae | *Plantago lanceolata* | lambs tongue | | | | | | | | | | | | | 5 | |
| Plantaginaceae | *Plantago* sp. | plantain | | | | | 20 | | | | | | | | 5 | |
| Plantaginaceae | *Veronica calycina* | hairy speedwell | | | | | | | | | | | 1 | | | |
| Plantaginaceae | *Veronica plebeia* | trailing speedwell | | | 1 | | | | | | | | | | | |
| Proteaceae | *Persoonia laurina* | laurel geebung | 10 | 10 | | 8 | | 5 | | 2 | | 1 | | | | |
| Proteaceae | *Persoonia linearis* | narrow-leaved geebung | | | | | | | | | | 1 | | 1 | | |
| Proteaceae | *Persoonia rigida* | | | 5 | | | | | | | 3 | | | | | |

| | | | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Opps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ranunculaceae | *Clematis aristata* | old man's beard | | | | | | | | | | | 1 | | | |
| Rhamnaceae | *Pomaderris andromedifolia* | | | | | | | | | | | | | 1 | | |
| Rosaceae | *Acaena novae-zelandiae* | bidgee-widgee | | | | | 10 | | | | | | | | | |
| Rosaceae | *Rosa rubiginosa* | sweet briar | | | | | | | | | | | 1 | | | |
| Rubiaceae | *Galium sp.* | | | | | | 1 | | | | | | 1000 | | | |
| Santalaceae | *Exocarpos cupressiformis* | cherry ballart | | | | | | 3 | | | | | | | | |
| Stackhousiaceae | *Stackhousia muricata* | | 13 | | | 5 | | | | | | | | | | |
| Stackhousiaceae | *Stackhousia sp.* | | | | | | | | | | 1 | 1 | | | | |
| Stackhousiaceae | *Stackhousia viminea* | | 10 | 10 | | 8 | | 5 | | 2 | | 1 | | | | |
| Violaceae | *Viola hederaceae* | ivy-leaved violet | | | | | | | | | | | | | 10 | |



# APPENDIX B

**Plot and Transect Data**

## Appendix B - Plot and Transect Data

The following plot and transect data was collected from surveys of the Southern Extension Area undertaken by Umwelt over 14 days and five survey periods, being:

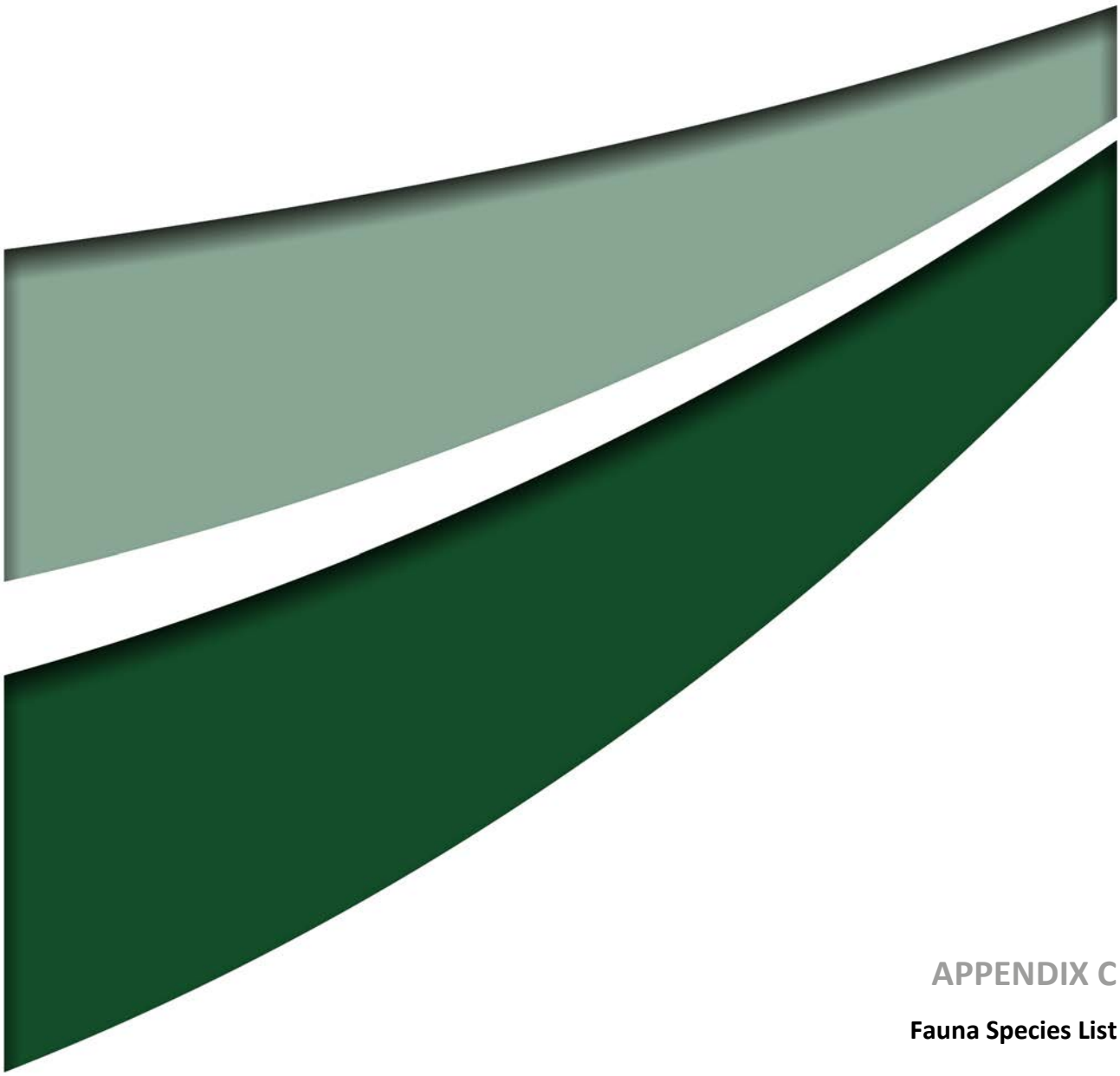
- 25 to 26 August 2015
- 11 to 13 November 2015
- 11 to 15 January 2016
- 7 to 8 April 2016 and
- 18 to 19 April 2016.

It includes the ten site attributes that are recorded in each Biometric plot and transect as per Table 2 of the FBA (OEH 2014b). This data is assessed against benchmark data for PCTs and then entered into the BioBanking Calculator to assess the site value of each PCT in the Southern Extension Area.

The following abbreviations or symbols are used in the list:

| | |
|---|---|
| NPS | native plant species |
| NOC | native overstorey cover |
| NMC | native midstorey cover |
| NGCG | native ground cover (grasses) |
| NGCS | native ground cover (shrubs) |
| NGCO | native ground cover (other) |
| EPC | exotic plant cover |
| NTH | number of trees with hollows |
| OR | overstorey regeneration, and |
| FL | total length of fallen logs. |

| Plot Name | NPS | NOS | NMS | NGCG | NGCS | NGCO | EPC | NTH | OR | FL | Easting | Northing | Zone |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Zone 1: CW117 - Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion (Moderate/Good)** | | | | | | | | | | | | | |
| **Q1** | 25 | 26.5 | 8.5 | 36 | 26 | 4 | 0 | 14 | 1 | 43 | 224847 | 6308034 | 56 |
| **Q4** | 16 | 17.5 | 9 | 26 | 22 | 16 | 0 | 4 | 1 | 24.5 | 224849 | 6308229 | 56 |
| **Zone 2: CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good)** | | | | | | | | | | | | | |
| **Q2** | 36 | 15.7 | 0.7 | 62 | 2 | 68 | 0 | 9 | 1 | 68.5 | 224812 | 6307825 | 56 |
| **Q3** | 33 | 23.23 | 13.8 | 28 | 4 | 66 | 0 | 7 | 1 | 47 | 224542 | 6308239 | 56 |
| **Q5** | 33 | 16.5 | 9.5 | 42 | 2 | 46 | 0 | 3 | 1 | 75 | 224327 | 6308271 | 56 |
| **Q6** | 31 | 17.5 | 8 | 56 | 10 | 10 | 0 | 3 | 1 | 110 | 224455 | 6307927 | 56 |
| **Q8** | 29 | 22.5 | 5.5 | 32 | 10 | 38 | 0 | 5 | 1 | 135 | 224284 | 6307932 | 56 |
| **Q10** | 27 | 18.5 | 7.5 | 48 | 14 | 24 | 2 | 2 | 1 | 85 | 224686 | 6308447 | 56 |
| **Zone 3: CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good_High)** | | | | | | | | | | | | | |
| **Q12** | 24 | 29 | 2 | 20 | 2 | 42 | 0 | 0 | 1 | 26 | 224909 | 6308662 | 56 |
| **Zone 4: CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good_Moderate)** | | | | | | | | | | | | | |
| **Q11** | 22 | 18 | 4 | 88 | 0 | 2 | 2 | 0 | 1 | 12 | 224629 | 6308157 | 56 |
| **Q13** | 25 | 21 | 0 | 82 | 0 | 6 | 2 | 0 | 1 | 26 | 224542 | 6308239 | 56 |
| **Zone 5: CW263 - Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes (Moderate/Good_Easement)** | | | | | | | | | | | | | |
| **Q7** | 20 | 0.2 | 0.7 | 64 | 4 | 30 | 2 | 0 | 1 | 0 | 224350 | 6307968 | 56 |
| **Q9** | 22 | 0 | 0 | 30 | 22 | 40 | 2 | 0 | 1 | 3 | 224486 | 6308334 | 56 |



# APPENDIX C

**Fauna Species List**

## Appendix C - Fauna Species List

The following fauna list was developed from surveys of the Southern Extension Area undertaken by Umwelt over 14 days and five survey periods, being:

- 25 to 26 August 2015;
- 11 to 13 November 2015;
- 11 to 15 January 2016;
- 7 to 8 April 2016; and
- 18 to 19 April 2016.

The following abbreviations or symbols are used in the list:

| | |
|---|---|
| asterisk (*) | Denotes species not indigenous to the Southern Extension Area; |
| subsp. | Subspecies; |
| V | Vulnerable; and |
| E | Endangered. |

Birds recorded were identified using descriptions in Pizzey and Knight (2012) and the scientific and common name nomenclature of Birdlife Australia (Birdlife International 2013). Reptiles recorded were identified using keys and descriptions in Cogger (2014) and Wilson & Swan (2008) and the scientific and common name nomenclature of Cogger (2014).

Amphibians recorded were identified using keys and descriptions in Cogger (2014), Robinson (1998), Anstis (2013) and Barker *et al*. (1995) and the scientific and common name nomenclature of Cogger (2014). Mammals recorded were identified using keys and descriptions in Van Dyck & Strahan (2008), and Menkhorst & Knight (2010) and the scientific and common name nomenclature of Van Dyck & Strahan (2008).

| Scientific Name | Common Name | TSC Status | EPBC Status |
|---|---|---|---|
| **AMPHIBIANS** | | | |
| **Myobatrachidae** | | | |
| *Crinia signifera* | common froglet | | |
| *Limnodynastes dumerilii dumerilii* | eastern banjo frog (dumerilii) | | |
| **Hylidae** | | | |
| *Litoria dentata* | bleating tree frog | | |
| *Litoria peronii* | Peron's tree frog | | |
| **REPTILES** | | | |
| **Scincidae** | | | |
| *Lampropholis delicata* | dark-flecked garden sunskink | | |

| Scientific Name | Common Name | TSC Status | EPBC Status |
|---|---|---|---|
| *Lampropholis guichenoti* | pale-flecked garden sunskink | | |
| *Saiphos equalis* | three-toed skink | | |
| *Saproscincus mustelinus* | weasel skink | | |
| **Agamidae** | | | |
| *Amphibolurus muricatus* | jacky lizard | | |
| **BIRDS** | | | |
| **Podargidae** | | | |
| *Podargus strigoides* | tawny frogmouth | | |
| **Columbidae** | | | |
| *Phaps chalcoptera* | common bronzewing | | |
| **Alcedinidae** | | | |
| *Ceyx azureus* | azure kingfisher | | |
| *Dacelo novaeguineae* | laughing kookaburra | | |
| **Cuculidae** | | | |
| *Cacomantis variolosus* | brush cuckoo | | |
| **Cacatuidae** | | | |
| ***Callocephalon fimbriatum*** | **gang-gang cockatoo** | **V** | |
| *Calyptorhynchus funereus* | yellow-tailed black-cockatoo | | |
| **Psittacidae** | | | |
| *Platycercus elegans* | crimson rosella | | |
| *Platycercus eximius* | eastern rosella | | |
| **Strigidae** | | | |
| *Ninox novaeseelandiae* | southern boobook | | |
| **Accipitridae** | | | |
| *Accipiter fasciatus* | brown goshawk | | |
| *Aquila audax* | wedge-tailed eagle | | |
| **Climacteridae** | | | |
| ***Climacteris picumnus*** | **brown treecreeper** | **V** | |
| *Cormobates leucophaea* | white-throated treecreeper | | |
| **Pardalotidae** | | | |
| *Pardalotus punctatus* | spotted pardalote | | |
| **Meliphagidae** | | | |
| *Acanthagenys rufogularis* | spiny-cheeked honeyeater | | |
| *Anthochaera chrysoptera* | little wattlebird | | |
| *Anthochaera carunculata* | red wattlebird | | |

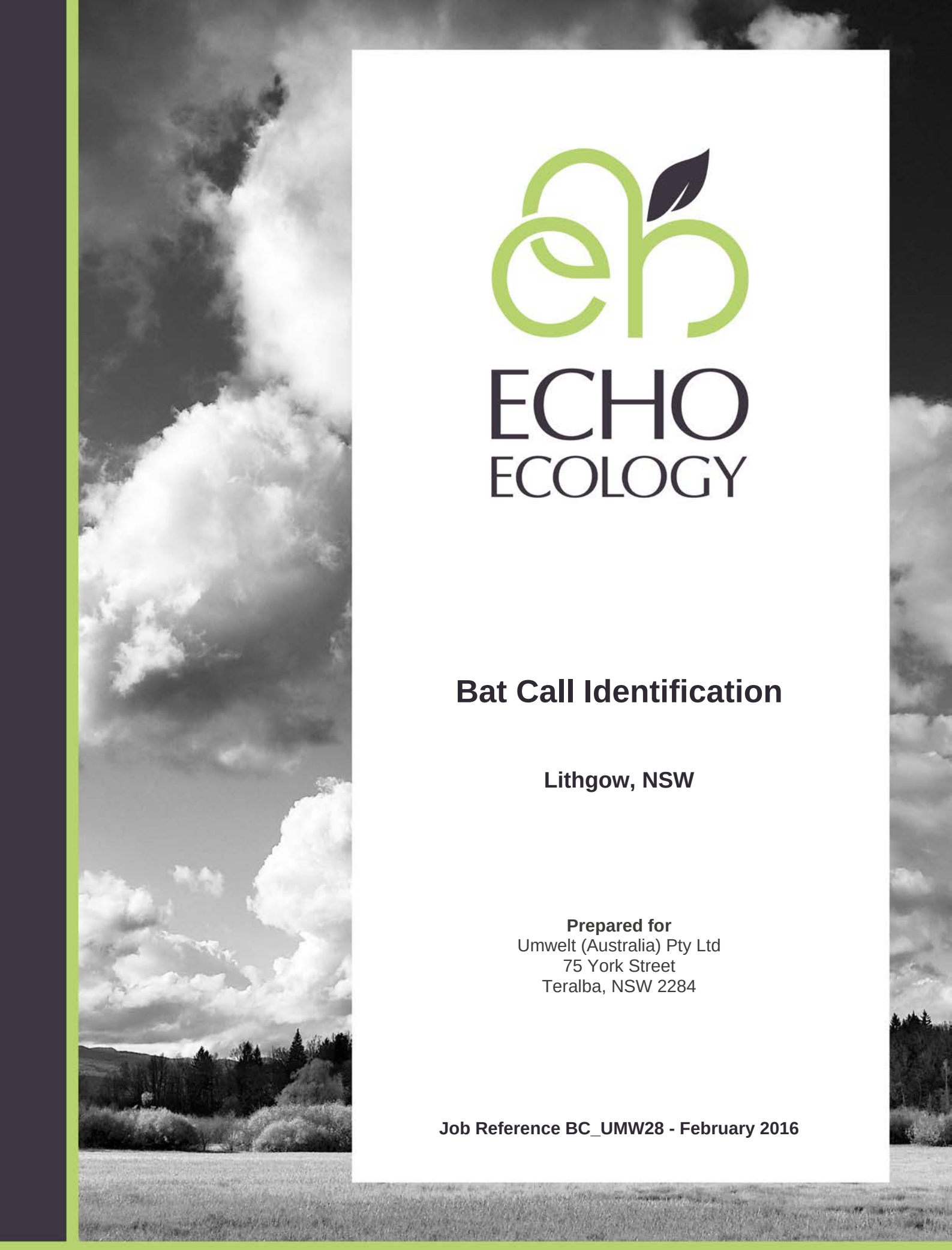
| Scientific Name | Common Name | TSC Status | EPBC Status |
|---|---|---|---|
| *Lichenostomus chrysops* | yellow-faced honeyeater | | |
| *Lichenostomus leucotis* | white-eared honeyeater | | |
| *Manorina melanocephala* | noisy miner | | |
| *Melithreptus brevirostris* | brown-headed honeyeater | | |
| *Melithreptus lunatus* | white-naped honeyeater | | |
| *Philemon corniculatus* | noisy friarbird | | |
| **Petroicidae** | | | |
| *Eopsaltria australis* | eastern yellow robin | | |
| ***Petroica boodang*** | **scarlet robin** | **V** | |
| **Acanthizidae** | | | |
| *Acanthiza pusilla* | brown thornbill | | |
| *Acanthiza chrysorrhoa* | yellow-rumped thornbill | | |
| *Acanthiza lineata* | striated thornbill | | |
| *Acanthiza nana* | yellow thornbill | | |
| *Sericornis frontalis* | white-browed scrubwren | | |
| **Pachycephalidae** | | | |
| *Pachycephala rufiventris* | rufous whistler | | |
| *Pachycephala pectoralis* | golden whistler | | |
| **Artamidae** | | | |
| *Cracticus tibicen* | Australian magpie | | |
| *Cracticus torquatus* | grey butcherbird | | |
| *Strepera graculina* | pied currawong | | |
| **Campephagidae** | | | |
| *Coracina novaehollandiae* | black-faced cuckoo-shrike | | |
| **Corcoracidae** | | | |
| *Corcorax melanorhamphos* | white-winged chough | | |
| **Corvidae** | | | |
| *Corvus coronoides* | Australian raven | | |
| **Rhipiduridae** | | | |
| *Rhipidura albiscapa* | grey fantail | | |
| *Rhipidura leucophrys* | willie wagtail | | |
| **Maluridae** | | | |
| *Malurus lamberti* | variegated fairy-wren | | |
| *Malurus cyaneus* | superb fairy-wren | | |

| Scientific Name | Common Name | TSC Status | EPBC Status |
|---|---|---|---|
| **Hirundinidae** | | | |
| *Hirundo neoxena* | welcome swallow | | |
| **Nectarinidae** | | | |
| *Dicaeum hirundinaceum* | mistletoebird | | |
| **MAMMALS** | | | |
| **Macropodidae** | | | |
| *Macropus giganteus* | eastern grey kangaroo | | |
| *Macropus rufogriseus* | red-necked wallaby | | |
| *Wallabia bicolor* | swamp wallaby | | |
| **Petauridae** | | | |
| ***Petaurus norfolcensis*** | **squirrel glider** | **V** | |
| **Phalangeridae** | | | |
| *Trichosurus vulpecula* | common brushtail possum | | |
| *Pseudocheirus peregrinus* | common ringtail possum | | |
| **Vombatidae** | | | |
| *Vombatus ursinus* | common wombat | | |
| **Emballonuridae** | | | |
| ***Saccolaimus flaviventris*** | **yellow-bellied sheathtail-bat** | **V** | |
| **Molossidae** | | | |
| *Tadarida australis* | white-striped freetail-bat | | |
| **Rhinolophidae** | | | |
| *Rhinolophus megaphyllus* | eastern horseshoe-bat | | |
| **Vespertilionidae** | | | |
| ***Chalinolobus dwyeri*** | **large-eared pied bat** | **V** | **V** |
| *Chalinolobus gouldii* | Goulds wattled bat | | |
| *Chalinolobus morio* | chocolate wattled bat | | |
| ***Miniopterus schreibersii oceanensis*** | **eastern bentwing-bat** | **V** | |
| *Scotorepens orion* | south -eastern broad-nosed bat | | |
| *Vespadelus darlingtoni* | large forest bat | | |
| *Vespadelus regulus* | southern forest bat | | |
| *Vespadelus vulturnus* | little forest bat | | |
| **Canidae** | | | |
| *Vulpes vulpes* | red fox | | |
| **Felidae** | | | |
| **Felis catus* | cat | | |

| Scientific Name | Common Name | TSC Status | EPBC Status |
|---|---|---|---|
| **Leporidae** | | | |
| **Lepus capensis* | brown hare | | |
| **Oryctolagus cuniculus* | rabbit | | |
| **Muridae** | | | |
| **Mus musculus* | house mouse | | |
| **Bovidae** | | | |
| **Ovis aries* | sheep | | |

# APPENDIX D

**Bat Analysis Report**



ECHO ECOLOGY

# Bat Call Identification

## Lithgow, NSW

**Prepared for**
Umwelt (Australia) Pty Ltd
75 York Street
Teralba, NSW 2284

**Job Reference BC_UMW28 - February 2016**

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This report has been prepared to document the analysis of digital ultrasonic bat echolocation calls received from a third party. The data was not collected by the author and as such no responsibility is taken for the quality of data collection or for the suitability of its subsequent use.

This report was authored by

**Dr Anna McConville**
PhD, B.Env.Sc.

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# 1.0 INTRODUCTION

This report has been commissioned by Umwelt (Australia) Pty Ltd to analyse bat echolocation call data (Anabat, Titley Electronics) collected from near Lithgow, NSW. Data was provided electronically to the author. This report documents the methods involved in analysing bat call data and the results obtained only.

# 2.0 METHODS

The identification of bat echolocation calls recorded during surveys was undertaken using AnalookW (Version 4.1z) software. The identification of calls was undertaken with reference to Pennay *et al*. (2004) and through the comparison of recorded reference calls from the Sydney Basin. Reference calls were obtained from the NSW database and from the authors personal collection.

Each call sequence ('pass') was assigned to one of five categories, according to the confidence with which an identification could be made, being:

- Definite - Pass identified to species level and could not be confused with another species
- Probable - Pass identified to species level and there is a low chance of confusion with another species
- Possible - Pass identified to species level but short duration or poor quality of the pass increases the chance of confusion with another species
- Species group - Pass could not be identified to species level and could belong to one of two or more species. Occurs more frequently when passes are short or of poor quality
- Unknown - Either background 'noise' files or passes by bats which are too short and/or of poor quality to confidently identify.

Call sequences that were less than three pulses in length were not analysed and were assigned to 'Unknown' and only search phase calls were analysed. Furthermore, some species are difficult to differentiate using bat call analysis due to overlapping call frequencies and similar shape of plotted calls and in these cases calls were assigned to species groups.

The total number of passes (call sequences) per unit per night was tallied to give an index of activity.

It should be noted that the activity levels recorded at different sites may not be readily able to be compared. Such comparisons are dependent on many variables which need to be carefully controlled during data collection and statistically analysed. Influential variables include wind, rain, temperature, duration of recording, season, detector and microphone sensitivity, detector placement, weather protection devices etc.

## 2.1 Characteristics Used to Differentiate Species

*Miniopterus schreibersii oceanensis* was differentiated by *Vespadelus* sp. by a combination of uneven consecutive pulses and the presence of a down-sweeping tail. Long, high quality call sequences with regularly-spaced consecutive pulses, few down-sweeping tails and higher or lower characteristic frequencies were assigned to *Vespadelus darlingtoni* or *Vespadelus regulus*.

*Chalinolobus gouldii* was differentiated from other species by the presence of curved, alternating call pulses.

*Scotorepens orion*, *Scoteanax rueppellii* and *Falsistrellus tasmaniensis* were unable to be differentiated from one another.

*Nyctophilus* sp. calls were identified from *Myotis macropus* by pulse intervals > 95 ms and an initial slope of < 300 OPS. *Nyctophilus geoffroyi* and *Nyctophilus gouldi* were unable to be differentiated.

*Chalinolobus morio* calls were differentiated from those of *Vespadelus* sp. by the presence of a down-sweeping tail on the majority of pulses.

*Chalinolobus dwyeri*, *Rhinolophus megaphyllus*, *Saccolaimus flaviventris*, *Tadarida australis* were differentiated from other bat species on the basis of characteristic frequency.

# 3.0 RESULTS

A total of 13,421 call sequences were recorded, of which 2,492 call sequences were able to be analysed (ie were not ‘noise’ files or bat calls of short length). Of the bat calls, 1,108 call sequences (46 %) were able to be confidently identified (those classified as either definite or probable identifications) to species level (Table 3-1). Species recorded confidently within the site include:

- *Chalinolobus dwyeri* (Large-eared pied bat)

- *Chalinolobus gouldii* (Gould's wattled bat)
- *Chalinolobus morio* (Chocolate wattled bat)
- *Miniopterus schreibersii oceanensis* (Eastern bentwing bat)
- *Nyctophilus* species (*Nyctophilus gouldi* or *Nyctophilus geoffroyi*)
- *Rhinolophus megaphyllus* (Eastern horseshoe bat)
- *Saccolaimus flaviventris* (Yellow-bellied sheathtail bat)
- *Scotorepens orion* (Eastern broad-nosed bat)
- *Tadarida australis* (White-striped free-tailed bat)
- *Vespadelus darlingtoni* (Large forest bat)
- *Vespadelus regulus* (Southern forest bat)
- *Vespadelus vulturnus* (Little forest bat)

Additionally, the following bat species potentially occurred within the site, but could not be confidently identified (those calls classified as possible or as a species group):

- *Falsistrellus tasmaniensis* (Eastern falsistrelle)
- *Myotis macropus* (Large-footed myotis)
- *Scoteanax rueppellii* (Greater broad-nosed bat)

It should be noted that additional bat species may be present within the site but were not recorded by the detectors and habitat assessment should be used in conjunction with these results to determine the likelihood of occurrence of other bat species.

Table 3-1 below summarises the results of the bat call analysis.

**Table 3-1: Results of bat call analysis (number of passes per site per night)**

| IDENTIFICATION | Anabat 7 Site 1 11/01/2016 | Anabat 7 Site 1 12/01/2016 | Anabat 7 Site 2 13/01/2016 | Anabat 7 Site 2 14/01/2016 | Anabat 8 Site 1 11/01/2016 | Anabat 8 Site 1 12/01/2016 | Anabat 8 Site 2 13/01/2016 | Anabat 8 Site 2 14/01/2016 |
|---|---|---|---|---|---|---|---|---|
| **DEFINITE** | | | | | | | | |
| *Chalinolobus dwyeri* | - | - | - | - | - | - | 1 | - |
| *Chalinolobus gouldii* | 98 | 150 | 81 | 19 | 12 | 4 | 61 | 40 |
| *Chalinolobus morio* | 24 | 22 | 6 | 1 | - | 5 | 1 | - |
| *Rhinolophus megaphyllus* | 1 | 3 | - | - | - | - | 1 | 1 |
| *Tadarida australis* | 37 | 11 | 14 | 8 | 53 | 7 | 27 | 13 |
| *Vespadelus darlingtoni* | 17 | 29 | - | - | 4 | 1 | - | - |
| *Vespadelus regulus* | - | - | - | - | 1 | - | - | - |
| *Vespadelus vulturnus* | - | - | - | - | - | - | 2 | - |
| **PROBABLE** | | | | | | | | |
| *Chalinolobus gouldii* | 26 | 18 | 24 | 10 | 10 | 3 | 21 | 4 |
| *Chalinolobus morio* | 11 | 7 | 20 | 1 | 2 | 4 | - | 2 |
| *Miniopterus schreibersii oceanensis* | 6 | 2 | - | - | - | - | 1 | - |

| IDENTIFICATION | Anabat 7 Site 1 11/01/2016 | Anabat 7 Site 1 12/01/2016 | Anabat 7 Site 2 13/01/2016 | Anabat 7 Site 2 14/01/2016 | Anabat 8 Site 1 11/01/2016 | Anabat 8 Site 1 12/01/2016 | Anabat 8 Site 2 13/01/2016 | Anabat 8 Site 2 14/01/2016 |
|---|---|---|---|---|---|---|---|---|
| *Rhinolophus megaphyllus* | - | 1 | - | - | - | - | - | - |
| *Saccolaimus flaviventris* | 2 | 1 | - | 2 | - | 4 | 1 | - |
| *Scotorepens orion* | 1 | - | - | - | - | - | - | - |
| *Tadarida australis* | 4 | 3 | 1 | - | 1 | 1 | 1 | - |
| *Vespadelus darlingtoni* | 85 | 36 | 1 | - | 2 | 3 | 1 | - |
| *Vespadelus regulus* | 7 | 5 | - | - | 4 | - | 1 | - |
| *Vespadelus vulturnus* | 3 | 6 | - | - | 1 | - | 1 | 2 |
| **POSSIBLE** | | | | | | | | |
| *Chalinolobus dwyeri* | - | - | - | - | - | 1 | - | - |
| *Chalinolobus gouldii* | 4 | 2 | 4 | - | - | - | 1 | - |
| *Chalinolobus morio* | 4 | 4 | - | - | - | - | - | - |
| *Miniopterus schreibersii oceanensis* | 1 | 1 | - | - | - | - | - | - |
| *Rhinolophus megaphyllus* | - | 1 | - | - | - | - | - | - |
| *Saccolaimus flaviventris* | 5 | - | - | - | - | 4 | 3 | 1 |

| IDENTIFICATION | Anabat 7 Site 1 11/01/2016 | Anabat 7 Site 1 12/01/2016 | Anabat 7 Site 2 13/01/2016 | Anabat 7 Site 2 14/01/2016 | Anabat 8 Site 1 11/01/2016 | Anabat 8 Site 1 12/01/2016 | Anabat 8 Site 2 13/01/2016 | Anabat 8 Site 2 14/01/2016 |
|---|---|---|---|---|---|---|---|---|
| *Vespadelus darlingtoni* | 5 | 4 | - | - | - | - | - | - |
| *Vespadelus regulus* | - | 2 | - | - | - | - | - | - |
| **SPECIES GROUPS** | | | | | | | | |
| *Chalinolobus gouldii / Mormopterus (Ozimops) ridei* | 5 | 8 | 19 | 7 | 11 | 2 | 13 | 6 |
| *Chalinolobus gouldii / Scoteanax rueppellii* | 5 | - | 1 | - | - | - | - | - |
| *Chalinolobus morio / Vespadelus vulturnus* | 42 | 42 | 24 | 6 | 16 | 24 | 9 | 9 |
| *Falsistrellus tasmaniensis / Scotorepens orion* | 6 | 6 | - | - | - | - | 1 | - |
| *Falsistrellus tasmaniensis / Scotorepens orion / Scoteanax rueppellii* | 19 | 17 | 1 | - | 1 | 1 | 7 | - |
| *Miniopterus schreibersii oceanensis / Vespadelus regulus* | 70 | 74 | 9 | 8 | 27 | 25 | 9 | 5 |
| *Myotis macropus / Nyctophilus geoffroyi / Nyctophilus gouldi* | 14 | 6 | - | 4 | 45 | 58 | 35 | 48 |
| *Nyctophilus geoffroyi / Nyctophilus gouldi* | 3 | 4 | - | 1 | 5 | 7 | 7 | 3 |
| *Vespadelus darlingtoni / Vespadelus regulus* | 253 | 169 | 41 | 14 | 11 | 24 | 20 | 30 |
| **UNKNOWN** | | | | | | | | |
| 'Noise' files | 41 | 288 | 1961 | 7509 | 58 | 84 | 54 | 391 |

| IDENTIFICATION | Anabat 7 Site 1 11/01/2016 | Anabat 7 Site 1 12/01/2016 | Anabat 7 Site 2 13/01/2016 | Anabat 7 Site 2 14/01/2016 | Anabat 8 Site 1 11/01/2016 | Anabat 8 Site 1 12/01/2016 | Anabat 8 Site 2 13/01/2016 | Anabat 8 Site 2 14/01/2016 |
|---|---|---|---|---|---|---|---|---|
| Unknown | 115 | 98 | 56 | 41 | 59 | 78 | 66 | 30 |
| **TOTAL** | **914** | **1020** | **2263** | **7631** | **323** | **340** | **345** | **585** |

# 4.0 SAMPLE CALLS

A sample of the calls actually identified from the site for each species is given below.

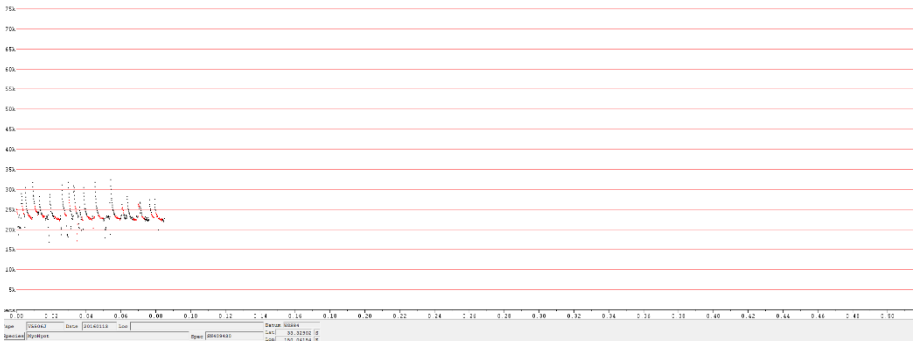


**Figure 4-1: *Chalinolobus dwyeri* definite call**

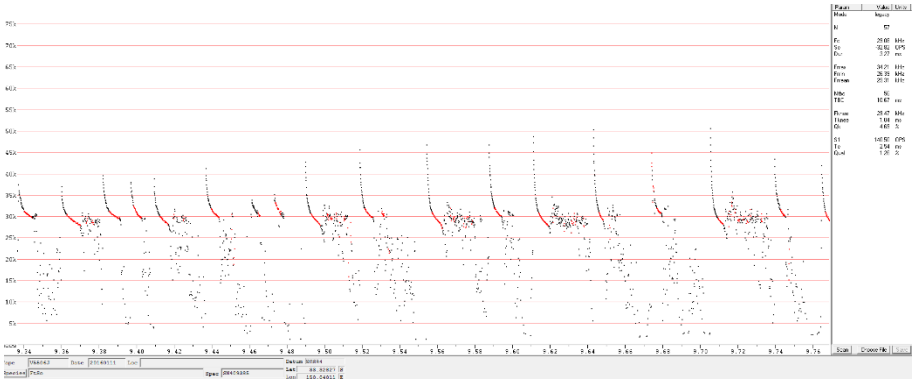


**Figure 4-2: *Chalinolobus gouldii* definite call**

**Figure 4-3: *Chalinolobus morio* definite call**

**Figure 4-4: *Miniopterus schreibersii oceanensis* probable call**

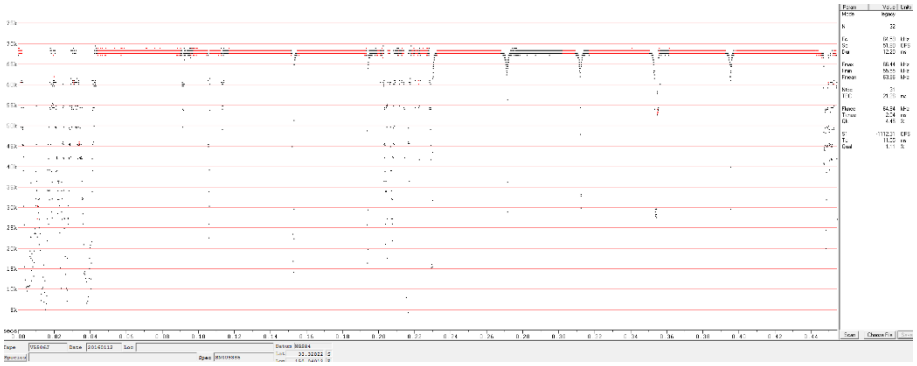


**Figure 4-5: *Rhinolophus megaphyllus* definite call**

**Figure 4-6: *Saccolaimus flaviventris* probable call**

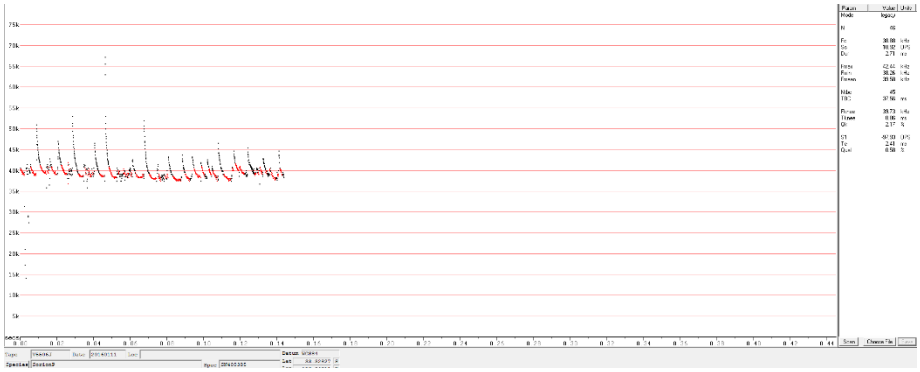


**Figure 4-7: *Scotorepens orion* probable call**

**Figure 4-8: *Tadarida australis* definite call**

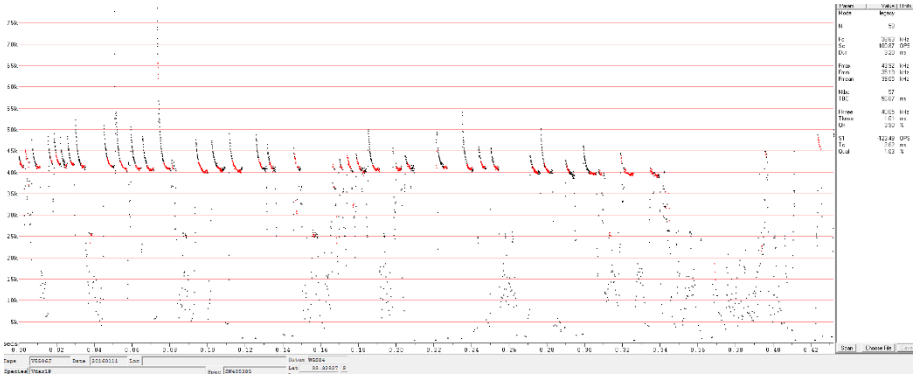


**Figure 4-9: *Vespadelus darlingtoni* definite call**

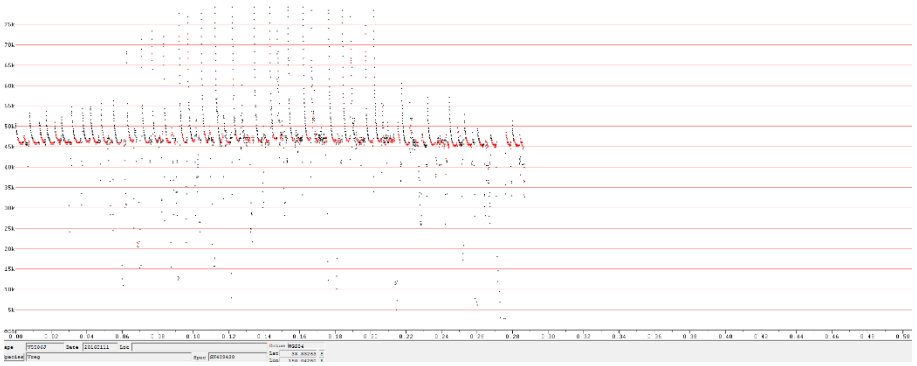


**Figure 4-10: *Vespadelus regulus* definite call**

**Figure 4-11: *Vespadelus vulturnus* definite call**

# 5.0 REFERENCES

Adams, M., Reardon, T.R., Baverstock, P.R. and Watts, C.H.S. (1988). Electrophoretic resolution of species boundaries in Australian Microchiroptera. IV. The Molossidae (Chiroptera). *Australian Journal of Biological Sciences* 41: 315-326.

Australasian Bat Society Incorporated (undated) *Standards for reporting bat detector surveys*, http://batcall.csu.edu.au/abs/issues/ABS_Anabat_survey_standards.pdf

Churchill, S. (2008). *Australian Bats.* Second Edition Allen & Unwin; Crows Nest, NSW.

Hoye, G.A, Law, B.S. and Lumsden, L.F. (2008). Eastern Free-tailed Bat Mormopterus sp. Pp. 493-495 in *The Mammals of Australia*: Third Edition (S. van Dyck and R. Strahan, Eds.); New Holland; Sydney.

Law, B.S., Turbill, C. and Parnaby, H. (2008). Eastern Forest Bat Vespadelus pumilus. Pp. 567-568 in *The Mammals of Australia*: Third Edition (S. van Dyck & R. Strahan; Eds.); New Holland; Sydney.

Law, B.S., Reinhold, L. and Pennay, M. (2002). Geographic variation in the echolocation calls of Vespadelus spp. (Vespertilionidae) from New South Wale and Queensland, Australia. *Acta Chiropterologica* 4: 201-215.

Pennay, M., Law, B. and Reinhold, L. (2004). *Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats*. NSW Department of Environment and Conservation, Hurstville.

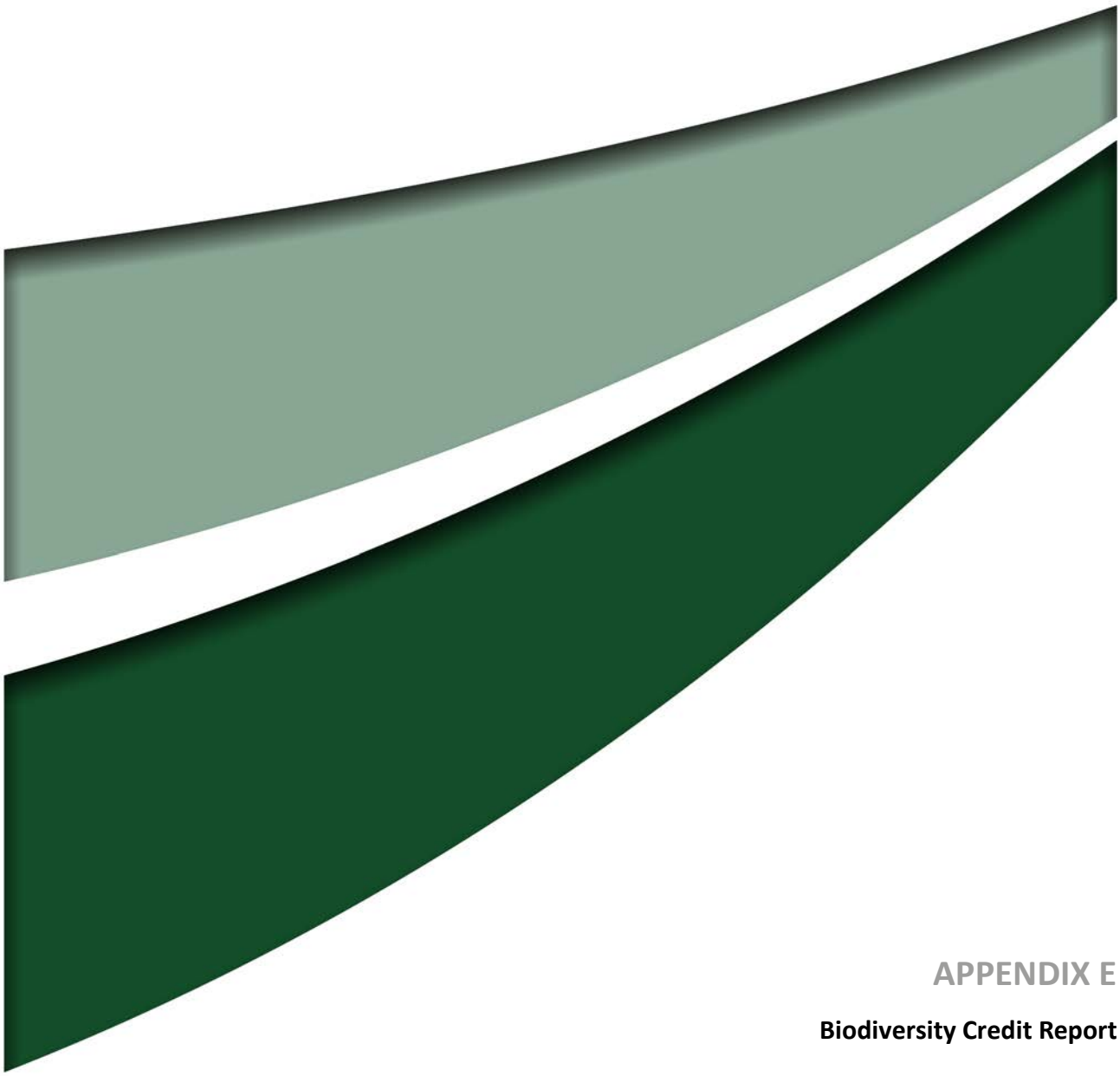
Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001a). *Key to the bat calls of south-east Queensland and north-east New South Wales*. Queensland Department of Natural Resources and Mines, State Forests of New South Wales, University of Southern Queensland, and New South Wales National Parks and Wildlife Service, Australia.

Reinhold, L., Herr, A., Lumsden, L., Reardon, T., Corben, C., Law, B., Prevett, P., Ford, G., Conole, L., Kutt, A., Milne, D. and Hoye, G. (2001b). Geographic variation in the echolocation calls of Gould's wattled bat *Chalinolobus gouldii*. *Australian Zoologist* 31: 618-624.

Richards, G.C., Ford, G.I. and Pennay, M. (2008). Inland Free-tailed Bat Mormopterus sp. Pp. 494-495 in *The Mammals of Australia*: Third Edition (S. van Dyck and R. Strahan, Eds.); New Holland; Sydney.

Thomas, D.W., Bell, G.P. and Fenton, M.B. (1987). Variation in echolocation call frequencies recorded from North American vespertilionid bats: a cautionary note. *Journal of Mammalogy* 68: 842-847.

Van Dyck, S. and Strahan, R. (Eds.) (2008). *The Mammals of Australia: Third Edition*. New Holland; Sydney.



# APPENDIX E

**Biodiversity Credit Report**

# *Biodiversity credit report*

**This report identifies the number and type of biodiversity credits required for a major project.**

Date of report: 4/08/2016 Time: 12:21:36PM Calculator version: v4.0

## Major Project details

| | |
|---|---|
| **Proposal ID:** | 0020/2016/2435MP |
| **Proposal name:** | Invincible Colliery Modification |
| **Proposal address:** | Cullen Bullen NSW 2790 |
| **Proponent name:** | Castlereagh Coal Pty Ltd |
| **Proponent address:** | Cullen Bullen NSW |
| **Proponent phone:** | 0409112771 |
| **Assessor name:** | Travis Peake |
| **Assessor address:** | 75 York St Teralba NSW 2284 |
| **Assessor phone:** | 02 4950 5322 |
| **Assessor accreditation:** | 0020 |

## Summary of ecosystem credits required

| Plant Community type | Area (ha) | Credits created |
|---|---|---|
| Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion | 8.24 | 542.00 |
| Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes | 41.02 | 2,893.00 |
| **Total** | 49.26 | 3,435 |

## Credit profiles

**1. Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion, (CW117)**

| | |
|---|---|
| Number of ecosystem credits created | 542 |
| IBRA sub-region | Capertee |

| Offset options - Plant Community types | Offset options - IBRA sub-regions |
|---|---|
| Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion, (CW117)<br><br>Apple Box - Broad-leaved Peppermint dry open forest of the South Eastern Highlands Bioregion, (CW101)<br><br>Broad-leaved Peppermint - Mountain Gum dry open forest of the Central Tablelands area of the South Eastern Highlands Bioregion, (CW118)<br><br>Slaty Gum woodland of the slopes of the southern Brigalow Belt South Bioregion, (CW191)<br><br>Red Box - Tumbledown Gum - Red Stringybark - Long-leaved Box dry woodland, upper NSW South Western Slopes Bioregion, (CW279) | Capertee<br>and any IBRA subregion that adjoins the IBRA subregion in which the development occurs |

**2. Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes, (CW263)**

| | |
|---|---|
| Number of ecosystem credits created | 2,893 |
| IBRA sub-region | Capertee |

| Offset options - Plant Community types | Offset options - IBRA sub-regions |
|---|---|
| | |

Inland Scribbly Gum grassy open forest on hills in the Mudgee Region, NSW central western slopes, (CW263)

Black Cypress Pine - Narrow-leaved Stringybark heathy woodland of the southern Brigalow Belt South Bioregion, (CW107)

Black Cypress Pine shrubby woodland of the Brigalow Belt South Bioregion, (CW108)

Blue-leaved Ironbark heathy woodland of the southern part of the Brigalow Belt South Bioregion, (CW114)

Blue-leaved Ironbark woodland on sandy uplands and slopes of the Darling Riverine Plains Bioregion, (CW115)

Brown Bloodwood - cypress - ironbark heathy woodland in the Pilliga region of the Brigalow Belt South Bioregion, (CW120)

Buloke - White Cypress Pine woodland in the NSW South Western Slopes Bioregion, (CW121)

Long-leaved Box - Red Box - Red Stringybark mixed open forest on hills and hillslopes in the NSW South Western Slopes Bioregion, (CW149)

Motherumbah (Acacia cheelii) woodlands on sandstones of the Brigalow Belt South Bioregion, (CW153)

Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion, (CW155)

Mugga Ironbark - Inland Grey Box shrubby woodland of the Brigalow Belt South Bioregion, (CW156)

Mugga Ironbark - Buloke - Pillga Box - White Cypress Pine shrubby woodland on sandstone in the Dubbo region, south-western Brigalow Belt South Bioregion, (CW157)

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion, (CW160)

Scribbly Gum - Brown Bloodwood woodland on volcanic slopes of the southern Brigalow Belt South Bioregion, (CW186)

Tumbledown Red Gum - Black Cypress Pine - Currawang woodland of ridges and rocky hills mainly of the Cobar Peneplain Bioregion, (CW201)

Tumbledown Red Gum - Black Cypress Pine - Red Box low woodland of hills of the NSW South Western Slopes Bioregion, (CW202)

White Box - Tumbledown Red Gum - Long-leaved Box shrub/grass woodland on fine-grained sediments of the upper Macquarie River gorge, NSW central western slopes, (CW212)

White Box shrubby open forest on fine grained sediments on steep slopes in the Mudgee region of the of central western slopes of NSW, (CW217)

Red Stringybark - Long-leaved Box - Black Cypress Pine shrub/grass woodland on siliceous sedimentary ranges in the upper NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion, (CW288)

Inland Scribbly Gum - Red Stringybark - Black Cypress Pine hillslope shrub-tussock grass open forest on mainly sandstone ranges in the NSW central western slopes, (CW261)

Red Stringybark - Inland Scribbly Gum open forest on steep hills in the Mudgee - northern section of the NSW South Western Slopes Bioregion, (CW291)

Capertee

and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Blue-leaved Stringybark open forest of the Mudgee region NSW central western slopes, (CW242)

Inland Scribbly Gum - Black Cypress Pine - Red Ironbark open forest of the NSW central western slopes, (CW259)

Mugga Ironbark - Black Cypress Pine - Red Stringybark - Blakely's Red Gum - Red Ironbark woodland on hillslopes and in valleys on ranges in the NSW central western slopes, (CW268)

Red Stringybark woodland on hillslopes, northern NSW South Western Slopes Bioregion, (CW292)

Bottlebrush riparian shrubland wetland of the northern NSW South Western Slopes Bioregion and southern Brigalow Belt South Bioregion, (CW243)

Red Stringybark - Long-leaved Box - Black Cypress Pine - grassy/shrubby low woodland on ranges, central NSW South Western Slopes Bioregion, (CW287)

Mugga Ironbark - Red Box - White Box - Black Cypress Pine tall woodland on rises and hills in the northern NSW South Western Slopes Bioregion, (CW270)

Inland Scribbly Gum - White Bloodwood - Red Stringybark - Black Cypress Pine shrubby sandstone woodland mainly of the Warrumbungle NP - Pilliga region in the Brigalow Belt South Bioregion, (CW262)

Narrow-leaved Ironbark - White Cypress Pine - Buloke tall open forest on lower slopes and flats in the Pilliga Scrub and surrounding forests in the central north Brigalow Belt South Bioregion, (CW273)

Red gum - Rough-barked Apple +/- tea tree sandy creek woodland (wetland) in the Pilliga - Goonoo sandstone forests, Brigalow Belt South Bioregion, (CW238)

Rough-barked Apple - Blakely's Red Gum - Black Cypress Pine woodland on sandy flats, mainly in the Pilliga Scrub region, (CW299)

Dapper Mugga Ironbark - Western Grey Box - Blakely's Red Gum - Black Cypress Pine grass shrub hill woodland (southern Brigalow Belt South Bioregion), (CW271)

White Bloodwood - Red Ironbark - Black Cypress Pine shrubby sandstone woodland of the Pilliga Scrub and surrounding regions, (CW318)

White Mallee - Dwyer's Red Gum mallee heath on sands in the Goonoo - Pilliga region, Brigalow Belt South Bioregion, (CW327)

Black Cypress Pine - Narrow-leaved Ironbark - red gum +/- White Bloodwood shrubby open forest on hills of the southern Pilliga, Coonabarabran and Garawilla regions, Brigalow Belt South Bioregion, (CW235)

Red Stringybark - Rough-barked Apple +/- Nortons Box open forest on hillslopes in the Warrumbungle NP - Coolah regions, (CW290)

Spur-wing Wattle heath on sandstone substrates in the Goonoo - Pilliga forests, Brigalow Belt South Bioregion, (CW307)

Red Stringybark - Narrow-leaved Ironbark - Black Cypress Pine - hill red gum sandstone woodland of southern NSW Brigalow Belt South Bioregion, (CW289)

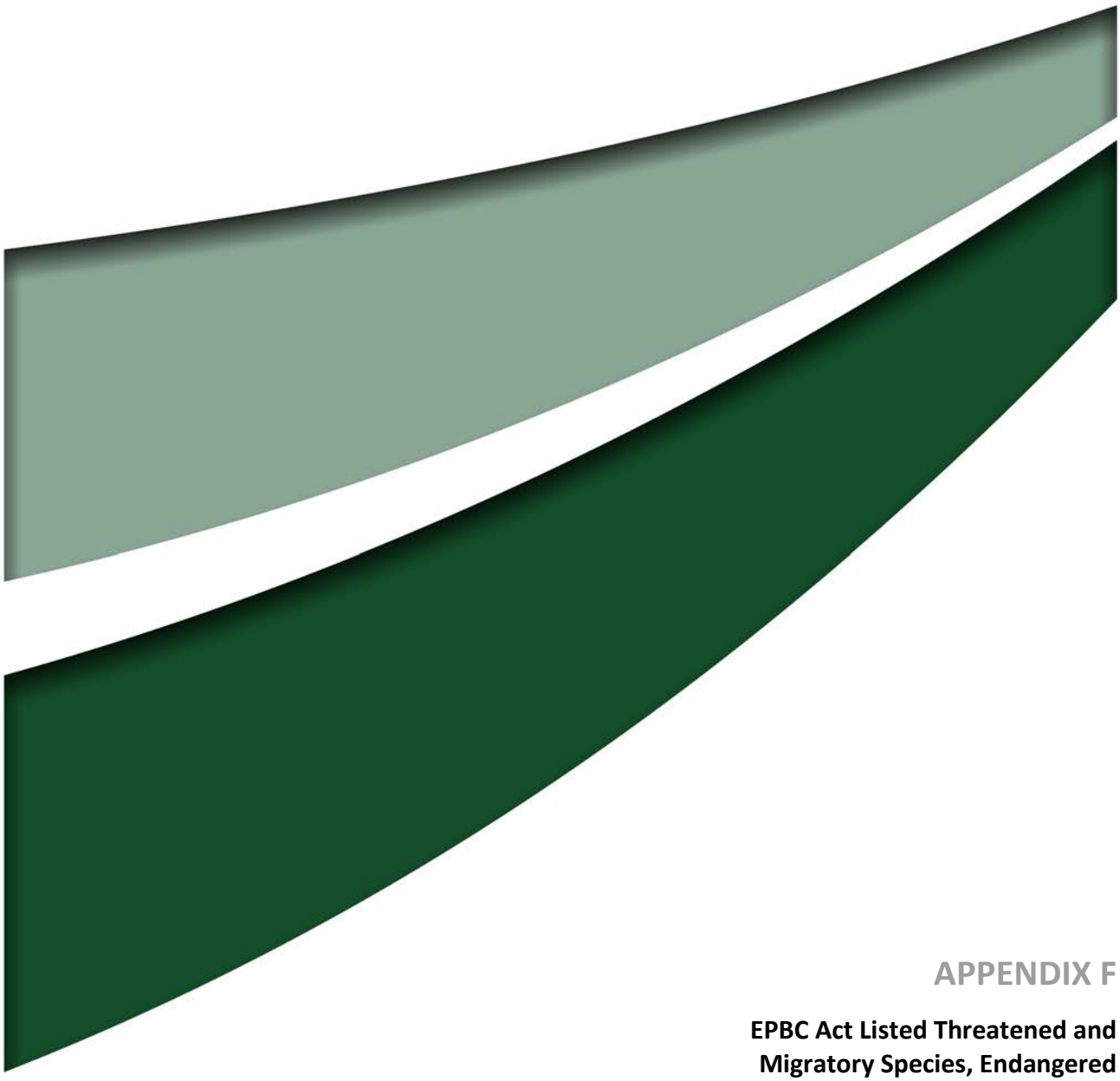
Blue-leaved Ironbark - Black Cypress Pine shrubby sandstone open forest in the southern Brigalow Belt South Bioregion (including Goonoo), (CW241)

Narrow-leaved Ironbark - Black Cypress Pine +/- Blakely's Red Gum

| | |
|---|---|
| shrubby open forest on sandstone low hills in the southern Brigalow Belt South Bioregion (including Goonoo), (CW272)<br><br>White Cypress Pine - Narrow-leaved Ironbark - Buloke grassy open forest of the Dubbo region, southern Brigalow Belt South Bioregion, (CW326)<br><br>Mugga Ironbark - Narrow-leaved Ironbark - Buloke - Black Cypress Pine shrub grass open forest in the Goonoo forests and surrounding region, southern Brigalow Belt South Bioregion, (CW269)<br><br>Dwyer's Red Gum - Black Cypress Pine - ironbark low woodland on sandstone hillcrests in the Dubbo - Gilgandra region, south-western Brigalow Belt South Bioregion, (CW255)<br><br>Thyme Honey-myrtle - red gum - Mugga Ironbark shrubland / woodland in impeded drainage flats or depressions in the southern Brigalow Belt South Bioregion, (CW308)<br><br>Red gum - Rough-barked Apple - Narrow-leaved Ironbark - cypress pine grassy open forest on flats and drainage lines in the Goonoo and surrounding forests, southern Brigalow Belt South Bioregion, (CW281)<br><br>Narrow-leaved Wattle low open forest / very tall shrubland on ridges in northern NSW South Western Slopes Bioregion and southern Brigalow Belt South Bioregion, (CW276)<br><br>Inland Scribbly Gum - Red Stringybark - Black Cypress Pine - Red Ironbark open forest on sandstone hills in the southern Brigalow Belt South Bioregion and northern NSW South Western Slopes Bioregion, (CW260)<br><br>Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion, (CW282)<br><br>Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/ - Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bio, (CW275) | |

## Summary of species credits required

| Common name | Scientific name | Extent of impact Ha or individuals | Number of species credits created |
|---|---|---|---|
| Squirrel Glider | Petaurus norfolcensis | 47.61 | 1,047 |
| Capertee Stringybark | Eucalyptus cannonii | 24.00 | 312 |
| Broad-headed Snake | Hoplocephalus bungaroides | 11.76 | 388 |



# APPENDIX F

**EPBC Act Listed Threatened and Migratory Species, Endangered Populations and Threatened Ecological Communities Assessment of Significance**

# Appendix F - EPBC Act Listed Threatened and Migratory Species, Endangered Populations and Threatened Ecological Communities Assessment of Significance

Under the Commonwealth EPBC Act, the approval of the Commonwealth Minister for the Environment is required for any action that may have a significant impact on matters of national environmental significance (MNES). The ecological MNES are:

- listed threatened species and communities
- migratory species protected under international agreements and
- Ramsar wetlands of international importance.

A small area of the proposed Southern Extension Area (approximately 1 hectare) lies outside the approved disturbance area of the existing Invincible Project Approval and the area that was referred in EPBC Act referral 2014/147. This area (EPBC Assessment Area) is shown on **Figure 1.2**and represents the area of impact relevant to the following assessment. **Table 1** below list the threatened and migratory species and TECs identified as having the potential to occur within the EPBC Assessment area based on the results of the searches of the OEH Atlas of NSW Wildlife Database and DoE Protected Matters Database and includes an assessment of the likelihood of occurrence and potential for impact. The likelihood of occurrence analysis is based on a comparison of the current documented distribution, the species habitat requirement/preferences and the known habitat characteristics of the EPBC Assessment Area. If a species or community listed is considered to have the potential to occur within the EPBC Assessment Area, an analysis of the potential impacts of the Southern Extension Project on that species or community was undertaken to determine if a significant impact was likely.

An assessment of the potential impacts of the Southern Extension Project is provided below for each listed MNES with potential to be impacted (refer to **Table 1**). Ecological MNES with potential to occur within the EPBC Assessment Area and be impacted by the proposed works comprise the regent honeyeater (*Anthochaera phrygia*) and large-eared pied bat (*Chalinolobus dwyeri*).

The following abbreviations or symbols are used in the list:

| | |
|---|---|
| V | Vulnerable |
| E | Endangered |
| CE | Critically Endangered |
| EEC | Endangered Ecological Community |
| CEEC | Critically Endangered Ecological Community |
| TEC | Threatened Ecological Community |
| B | Bonn Convention for Migratory Birds (Bonn) |
| C | China-Australia Migratory Bird Agreement (CAMBA) |
| J | Japan-Australia Migratory Bird Agreement (JAMBA) |
| R | Republic of Korea-Australia Bird Agreement (ROKAMBA) |

**Table 1 Threatened and Migratory Species and TECs Recorded or with Potential to Occur within the EPBC Assessment Area or Local Area**

| Scientific Name | Common Name | Status EPBC Act | Likelihood to Occur in the EPBC Assessment Area | Potential to be Significantly Impact? |
|---|---|---|---|---|
| **Threatened Ecological Communities** | | | | |
| Natural Temperate Grassland of the South Eastern Highlands | | CEEC | Not present | No |
| Upland Basalt Eucalypt Forest of the Sydney Basin Bioregion | | EEC | Not present | No |
| White Box Yellow Box Blakely's Red Gum Woodland(TSC Act) / White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act) | | CEEC | Not present | No |
| **Threatened Flora** | | | | |
| *Acacia bynoeana* | Bynoes wattle | V | Unlikely | No |
| *Asterolasia elegans* | | E | Unlikely | No |
| *Boronia deanei* | Deane's Boronia | V | Unlikely | No |
| *Cryptostylis hunteriana* | Leafless tongue orchid | V | Unlikely | No |
| *Eucalyptus aggregata* | Black gum | V | Unlikely | No |
| *Eucalyptus pulverulenta* | Silver-leaved mountain gum | V | Unlikely | No |
| *Eucalyptus robertsonii* subsp. *hemisphaerica* | Robertson's peppermint | E | Unlikely | No |
| *Euphrasia arguta* | | CE | Unlikely | No |
| *Grevillea obtusiflora* | Grey grevillea | E | Unlikely | No |
| *Leucochrysum albicans* var *tricolor* | Hoary sunray | E | Unlikely | No |
| *Microtis angusii* | Onion orchid | E | Unlikely | No |
| *Pelargonium* sp. *Striatellum* | Omeos storkbill | E | Unlikely | No |
| *Persoonia marginata* | | V | Unlikely | No |
| *Pomaderris brunnea* | Rufous pomaderris | V | Unlikely | No |
| *Prasophyllum petilum* | Tarengo leek orchid | E | Unlikely | No |
| *Prasophyllum* sp. Wybong | Leek orchid | CE | Unlikely | No |
| *Prostanthera cryptandroides* subsp. *cryptandroides* | Wollemi mint bush | V | Unlikely | No |
| *Pultenaea glabra* | Smooth bush-pea | V | Unlikely | No |

| Scientific Name | Common Name | Status EPBC Act | Likelihood to Occur in the EPBC Assessment Area | Potential to be Significantly Impact? |
|---|---|---|---|---|
| *Thesium australe* | Austral toadflax | V | Unlikely | No |
| **Threatened Insects** | | | | |
| *Paralucia spinifera* | Bathurst copper butterfly | V | Unlikely | No |
| **Threatened Frogs** | | | | |
| *Heleioporus australiacus* | Giant burrowing frog | V | Unlikely | No |
| *Litoria booroolongensis* | Booroolong frog | E | Unlikely | No |
| *Litoria littlejohni* | Littlejohn's tree frog | V | Unlikely | No |
| **Threatened Reptiles** | | | | |
| *Aprasia parapulchella* | Pink-tailed worm-lizard | V | Unlikely | No |
| *Eulamprus leuraensis* | Blue Mountains water skink | E | Unlikely | No |
| *Hoplocephalus bungaroides* | Broad-headed snake | V | Unlikely | No |
| **Threatened Birds** | | | | |
| *Anthochaera phrygia* | Regent honeyeater | CE | **Potential** | **Yes** |
| *Grantiella picta* | Painted honeyeater | V | Potential | No |
| *Lathamus discolor* | Swift parrot | CE | Potential | No |
| *Leipoa ocellata* | Malleefowl | V | Unlikely | No |
| *Rostratula australis* | Australian painted snipe | E, C | Unlikely | No |
| **Threatened Mammals** | | | | |
| *Chalinolobus dwyeri* | Large-eared pied bat | V | **Likely** | **Yes** |
| *Dasyurus maculatus maculatus* | Spotted-tailed quoll | E | Potential | No |
| *Nyctophilus corbeni* | South-eastern long-eared bat | V | Potential | No |
| *Petauroides volans* | Greater glider | V | Potential | No |
| *Petrogale penicillata* | Brush-tailed rock wallaby | V | Unlikely | No |
| *Phascolarctos cinereus* | Koala | V | Potential | No |

| Scientific Name | Common Name | Status EPBC Act | Likelihood to Occur in the EPBC Assessment Area | Potential to be Significantly Impact? |
|---|---|---|---|---|
| *Pseudomys novaehollandiae* | New Holland mouse | V | Unlikely | No |
| *Pteropus poliocephalus* | Grey-headed flying-fox | V | Potential | No |
| **MIGRATORY SPECIES UNDER INTERNATIONAL CONVENTIONS** | | | | |
| *Apus pacificus* | Fork-tailed Swift | C, J, R | Unlikely | No |
| *Gallinago hardwickii* | Lathams snipe | C, J, R | Unlikely | No |
| *Hirundapus caudacutus* | White-throated needletail | C, J, R | Potential | No |
| *Monarcha melanopsis* | Black-faced monarch | B | Potential | No |
| *Motacilla flava* | Yellow wagtail | C, J, R | Unlikely | No |
| *Myiagra cyanoleuca* | Satin flycatcher | B | Potential | No |
| *Rhipidura rufifrons* | Rufous fantail | B | Potential | No |

An assessment, in accordance with the DoE Significant Impact Guidelines 1.1, of the potential impact of the Southern Extension Project on the regent honeyeater (*Anthochaera phrygia*) and the large-eared pied-bat (*Chalinolobus dwyeri*) is presented below.

**Regent Honeyeater**

**In the case of an endangered or critically endangered species, a *population* means:**

- a geographically distinct regional population, or collection of local populations; or
- a regional population, or collection of local populations, that occurs within a particular bioregion.

Although there appears to be minor behavioural differences between regent honeyeaters in the three main areas inhabited by the species (the Bundarra-Barraba area in NSW, the Capertee Valley in NSW, and north-eastern Victoria), the direction and extent of movements, including evidence of movement between breeding sites, and a lack of discernible genetic differences between the sites suggest that the regent honeyeater occurs as a single, contiguous population (Garnett and Crowley 2000).

**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; or**

No populations of regent honeyeater have been recorded within the EPBC Assessment Area. The Southern Extension Project will result in the loss of approximately 1hectare of potential foraging habitat for this species. However, it is considered unlikely that the Southern Extension Project will lead to a decrease in the size of a *population* (as defined above) of regent honeyeater.

- **reduce the area of occupancy of the species; or**

The regent honeyeater has not been recorded within the EPBC Assessment Area; however, the Southern Extension Project will result in the loss of approximately 1hectare of potential foraging habitat for the species. While the Project will remove potential habitat for these species, it is not likely to lead to a significant reduction in known habitat in the region.

The loss of approximately 1 hectare of potential foraging habitat will result in a reduction of the potential area of occupancy for the regent honeyeater; however this is unlikely to substantially reduce the area of known occupancy.

- **fragment an existing population into two or more populations; or**

The regent honeyeater has not been recorded within the EPBC Assessment Area. This species is highly dispersive and it is unlikely that the Southern Extension Project will create a significant change to the species' dispersal capacity or create a significant barrier to the movement of the species.

It is unlikely that the Project will result in the fragmentation of an existing *population* into two or more *populations*.

- **adversely affect habitat critical to the survival of a species; or**

The EPBC Assessment Area is located in an area where regent honeyeaters are considered likely to occur (DoE 2016) and as such meets the definition of habitat critical to the survival of the species in the National Recovery Plan (DoE 2016). However, the habitat within the EPBC Assessment Area does not contain any of the key tree or mistletoe species documented in the recovery plan and is not considered to represent breeding habitat for the species. The Southern Extension Project will result in the loss of approximately 1hectare of potential foraging habitat for the species.

- **disrupt the breeding cycle of a population; or**

The regent honeyeater mainly breeds in three key sites from the Bundarra-Barraba area NSW, the Capertee Valley in NSW, and north-eastern Victoria. Breeding has also been recorded within the Hunter Valley. The regent honeyeater has not been previously recorded in the EPBC Assessment Area and the habitat within the EPBC Assessment Area is not commensurate with the breeding habitat types listed in the National Recovery Plan (DoE 2016).

The Project is not expected to disrupt the breeding cycle of the regent honeyeater.

- **modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline; or**

The Southern Extension Project will involve the removal of approximately 1hectares of potential foraging habitat for the regent honeyeater. It is considered unlikely that the Southern Extension Project will modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the regent honeyeater 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;**

The Southern Extension Project is not expected to result in invasive species that are harmful to the regent honeyeater becoming established in the species' habitat.

- **introduce disease that may cause the species to decline; or**

It is considered unlikely that the Southern Extension Project will introduce any disease that may cause the regent honeyeater to decline.

- **interfere with the recovery of the species.**

It is considered unlikely that the Southern Extension Project will interfere with the recovery of the regent honeyeater throughout Australia.

**Conclusion**

The Project is unlikely to result in a significant impact on the population of the regent honeyeater.

**Large-eared Pied Bat**

**In the case of a vulnerable species, an *important population* is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:**

- key source populations either for breeding or dispersal; or
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

The identification of potential foraging habitat for this vulnerable species within the EPBC Assessment Area does not constitute the presence of an 'important population' as defined by the criteria listed above, as any potentially occurring individuals within the EPBC Assessment Area do not represent a key source population either for breeding or dispersal; the EPBC Assessment Area is not important for the maintenance of genetic diversity of the species; and the species is not at the limits of its range in the EPBC Assessment Area. Therefore, the EPBC Assessment Area is not likely to contain an important population of the large-eared pied bat.

Further, the National Recovery Plan for the large-eared pied bat (DERM 2011) states that habitat critical for the survival of the species requires the presence of diurnal roosts and shelter habitat, usually in the form of sandstone cliffs and adjacent fertile woodland valley foraging habitat. The majority of records of the species occur within several kilometres of clifflines or caves. Due to the absence of suitable cliffline or cave roosting habitat within the EPBC Assessment Area, the EPBC Assessment Area is not considered to contain important habitat for the species.

***An action has, will have, or is likely to have a significant impact on threatened species if it does, will, or is likely to:***

- **lead to a long-term decrease in the size of an important population of a species;**

Given that there is not considered to be an *important population* of the large-eared pied bat within the EPBC Assessment Area, the Southern Extension Project will not lead to a long-term decrease in the size of an *important population* of this species.

- **reduce the area of occupancy of an important population, or;**

The EPBC Assessment Area does not contain an *important population* of the large-eared pied and therefore will not reduce the area of occupancy of an *important population* of this species.

- **fragment an existing important population into two or more populations, or;**

The EPBC Assessment Area does not contain an *important population* of the large-eared pied bat and therefore the Southern Extension Project will not result in the fragmentation of an *important population* of this species

- **adversely affect habitat critical to the survival of a species, or;**

The large-eared pied bat is distributed across the east coast of Australia. The habitat in the EPBC Assessment Area is not known to provide core habitat for this species and the Southern Extension Project is not expected to interfere with any dispersal pathways for this species. Given the above, the EPBC Assessment Area is not considered to be critical habitat for the large-eared pied bat and consequently the Southern Extension Project is not expected to adversely affect habitat critical to the survival of this species.

- **disrupt the breeding cycle of an important population, or;**

No important populations of the large-eared pied bat occur within the EPBC Assessment Area, nor has any breeding population or breeding habitat for this species been recorded. As such, the Southern Extension Project is not expected to disrupt the breeding cycle of an important population of this species.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or;**

The EPBC Assessment Area contains potential foraging habitat for the large-eared pied bat. The Southern Extension Project will not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that this species is likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

There are not any invasive species that are likely to become established as a result of the Southern Extension Project that may have be harmful to the large-eared pied bat in becoming established in its habitat.

- **introduce disease that may cause the species to decline; or**

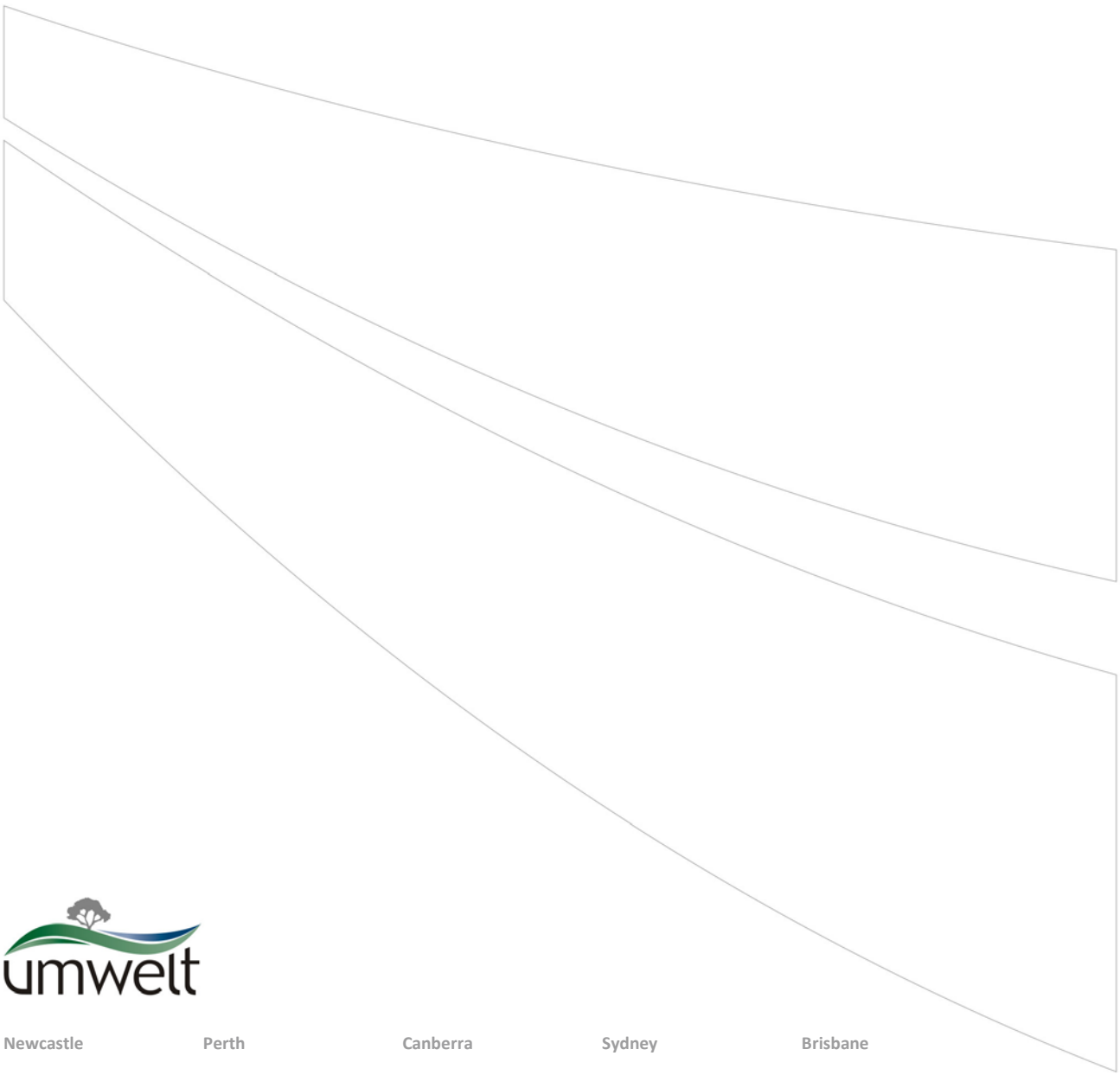
There are no diseases associated with the decline of the large-eared pied bat. The Southern Extension Project is not expected to introduce or exacerbate any diseases that may cause this species to decline.

- **interfere substantially with the recovery of the species.**

The Southern Extension Project will not substantially interfere with the recovery of the large-eared pied bat.

**Conclusion**

The Project is unlikely to result in a significant impact upon an *important population* of the large-eared pied bat as the EPBC Assessment Area is not considered to support an important population of this species.

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