umwelt

Inspired people | Dedicated team
Quality outcomes

Upper Hunter Holdings Pty Ltd

ECOLOGICAL ASSESSMENT

Dolwendee Quarry

FINAL

September 2015

ECOLOGICAL ASSESSMENT

Dolwendee Quarry

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Upper Hunter Holdings Pty Ltd

Project Director:	Steven Cox
Project Manager:	Shaun Corry
Report No.	3453/R01/V2
Date:	[Date]

Newcastle

75 York Street
Teralba NSW 2284

Ph. 02 4950 5322

www.umwelt.com.au

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

Table of Contents

Figures

Tables

Appendices

1.0 Introduction

This report provides a detailed ecological assessment of the Dolwendee Quarry Project. The Dolwendee Quarry Project (hereafter referred to as the Project) is a gravel quarry proposed by Upper Hunter Holdings Pty Ltd (UHH). This report provides a detailed account of the flora and fauna features present within the lands owned and managed by UHH (hereafter referred to as the wider study area) and a robust assessment of the ecological impacts of the proposed quarry location (hereafter referred to as the Project Disturbance Area). The ecological assessment will be included within the Supporting Documents being prepared by KMH Environmental Pty Ltd to accompany a State Significant Development (SSD) application to the NSW Department of Planning and Environment.

The wider study area is located within the Upper Hunter Valley of New South Wales (NSW), approximately 8 kilometres north-west of Denman and 24 kilometres south-west of Muswellbrook, NSW (refer to **Figure 1.1**).

The proposed Project intends to extract a resource of gravel from sandstone and conglomerate parent rock material from the footslopes below a prominent ridgeline. The ridgeline occurs just south of the Project Disturbance Area, lying in a south-east direction for approximately 400 metres before heading north-east for approximately 250 metres. The footslopes of the ridgeline range from 160 – 180 metres above sea level (ASL) and the ridge extends from 180 – 225 metres ASL.

The total resource proposed to be extracted from the quarry development is estimated at more than 5 million tonnes (KMH, 2014). Under these conditions the Project meets the definition of State Significant Development as identified under Schedule 1, Clause 7 of State Environmental Planning Policy (State and Regional Development) 2011.

1.1 Report Structure

This report provides an assessment of the potential ecological impacts of the Project. It begins with an introduction to the Project, including an overview of the Project and the assessment approach undertaken.

Section 2.0 explains the regional context of the Project, discussing regional considerations such as the history of land use, surrounding land uses and regional connectivity of habitats within the Project Disturbance Area.

Section 3.0 provides a detailed methodology of the surveys undertaken for the Project including detailed flora and fauna survey methods.

Section 4.0 provides the results of the surveys described in **Section 3.0** and lists the threatened species, threatened ecological communities (TECs), endangered populations (EPs) and migratory species identified during surveys or during the literature review.

Section 5.0 details the assessment of the level of impact the Project may have on the threatened species, TECs, EPs and migratory species that were identified in the Project Disturbance Area as described in **Section 4.0**.

Section 6.0 discusses the impact mitigation measures to reduce the likely level of impact on threatened species, TECs, EPs and migratory species.

Section 7.0 details the biodiversity offset strategy that has been developed to offset residual significant impacts of the Project that could not be avoided or fully mitigated.

Section 8.0 provides an overview of the proposed monitoring requirements that have been formulated to assess the success of proposed impact mitigation and biodiversity offset strategy in reducing the impacts of the Project on ecological values.

Section 9.0 provides references.

Image Source: Google Earth, Sinclair Knight Merz (2015), CNES/Astrium (2015)
Data Source: OEH (2013)

0 2.5 5.0 10.0km
1:200 000

Legend

- Project Area
- National Park
- Nature Reserve

FIGURE 1.1

Dolwendee Quarry
Locality Map

File Name (A4): R01/3453_012.dgn
20150811 10.32

1.2 Project Overview

As noted in **Section 1.0**, the Project aims to develop a new rock quarry alongside a prominent ridgeline on a private rural property approximately 8 kilometres north-west of Denman, NSW.

Geological testing has been undertaken within the Project Area to determine the suitability of the proposed Project. On-site testing has included back-hoe dug test pits, exposing surface materials, as well as four cored boreholes ranging in depth from 27.15 to 30.1 metres (KMH, 2014).

Preliminary testing of the surface materials and borehole cores indicated the following resource properties:

- Crushed conglomerate (blended with minor amounts of sandstone) expected to be used as pavement material on unsealed rural roads
- Crushed conglomerate/minor sandstone expected to produce a sub-base material for sealed rural roads
- Crushed conglomerate/sandstone expected to produce good unsealed hardstand pavement material
- It is likely that the finer material could be processed to meet pipeline trench back fill requirements.

The key features of the Project are outlined in **Table 1.1**. **Figure 1.2** shows the general layout of the Project.

Table 1.1 Resource Estimates for the Project

Key Feature	Proposed Operations
Stage 1 Quarry Footprint	• 10.7 hectares • Total depth of up to 35 metres • Benched batters comprising 4 metres wide benches at a maximum vertical interval of 10 metres.
Stage 1 Quarry Volumetric Calculations	• 2.8 Million cubic metres • Average core density of 2.318 Tonnes/m^3 • Estimated construction material resource of 6.5 million tonnes.
Stage 1 Quarry Extraction Rate and Quarry Life	• Average of 250,000 tonnes of extractive material per year • Expected life of approximately 26 years.
Operating Hours	• Monday to Friday 7am – 6 pm • Saturday 8am – 1 pm • No work on Sundays or public holidays.

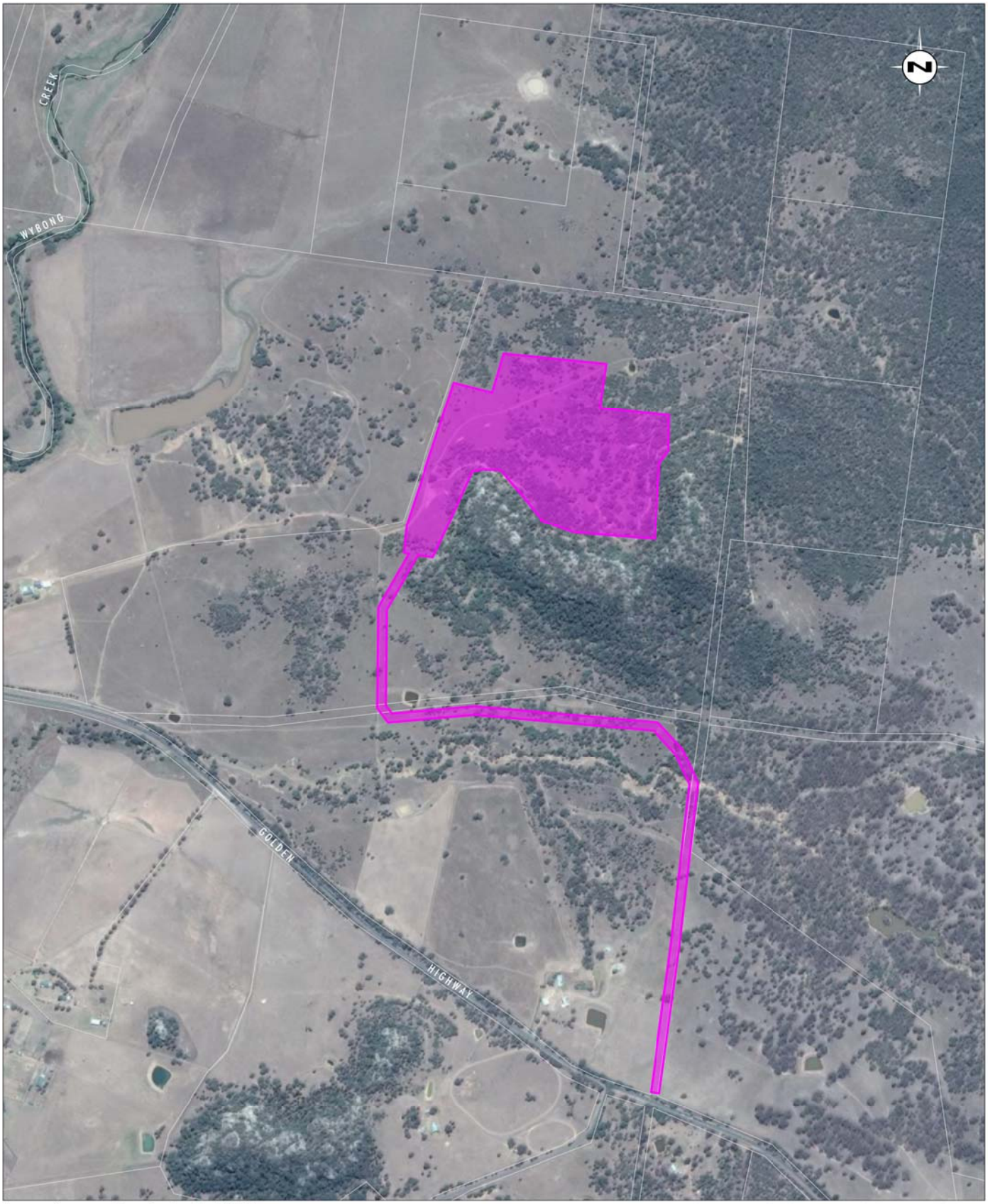


Image Source: Google Earth (2014)
Data Source: KMH (2014), Department of Lands (2009)

0 200 400 600m
1:12 500

Legend

Project Disturbance Area

FIGURE 1.2

Dolwendee Quarry
Project Disturbance Area

1.3 The Project Disturbance Area

The Project Disturbance Area (refer to **Figure 1.2**) is approximately 22.8 hectares and sits wholly within the wider study area that includes lands owned and managed by UHH. The Project Disturbance Area is the land that has been assessed by this ecological assessment. The Project Disturbance Area includes a proposed conventional open cut operation approximately 10.7 hectares, an active extraction area, raw material and product stockpiles, crushing and screening plant, internal haul road approximately 2.5 kilometres long, ancillary facilities including small office, amenities and car parking space.

1.4 Objectives of the Ecological Assessment

This Ecological Assessment has been prepared to assess the potential impact of the Project on native flora and fauna species, threatened and migratory species, EPs, TECs and their habitats occurring in the Project Disturbance Area and on adjoining lands as described in **Section 1.5**.

The objectives of the Ecological Assessment were to:

- identify the flora and fauna species recorded within the Project Disturbance Area from previous studies, local studies and/or ecological databases
- undertake targeted surveys to further identify any threatened flora or fauna species, migratory fauna species, EPs, TECs, or their habitats within the Project Disturbance Area, particularly those listed under the *NSW Threatened Species Conservation Act 1995* (TSC Act), *NSW Fisheries Management Act 1994* (FM Act), and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- assess the potential impact of the Project on any threatened flora and fauna species, migratory fauna species, EPs, TECs, or their habitats recorded (or with potential to occur) in the Project Disturbance Area
- assess the potential impact of the Project on any threatened flora and fauna species, migratory fauna species, EPs, TECs, or their habitats recorded (or with potential to occur) on lands adjoining the Project Disturbance Area or with potential to be affected by the Project
- develop appropriate impact mitigation and management options to minimise ecological impacts associated with the Project
- prepare a comprehensive biodiversity offset strategy to compensate for the residual impacts of the Project that cannot otherwise be satisfactorily avoided, minimised or mitigated.

1.5 Relevant Legislation and Guidelines

The ecological assessment completed as part of this Project was prepared in accordance with the relevant Department of Planning and Environment (DPE) Secretary's Environmental Assessment Requirements (SEARs) for the Project, dated 24 June 2014 as detailed in **Table 1.2**, with the Office of Environment and Heritage (OEH) submission to the SEARs dated 30 May 2014.

Table 1.2 Matters Specified in the Secretary's Environmental Assessment Requirements and Where They Are Addressed in this Report

SEARs for Ecological Studies	Where addressed in report
The ecological assessment must include:	
An assessment of the likely biodiversity impacts of the project	**Section 5.0** – Impact Assessment.
An offset strategy to ensure the development maintains or improves the biodiversity values of the region in the medium to long term	**Section 7.0** – Biodiversity Offset Strategy

In addition to the SEARs, submissions from other relevant government agencies, including OEH and NSW Department of Primary Industries (DPI), have been received. The OEH submission outlined the requirements of the Ecological Assessment with particular reference to the proximity of the Project Disturbance Area to a biodiversity offset area for Mangoola Coal (refer to **Section 3.1.3**) and assessing the Project using either the BioBanking Assessment Methodology (Scenario 1) or a detailed biodiversity assessment (Scenario 2) (refer to **Section 7.0**). The DPI submission, specifically the NSW Office of Water required the assessment of Groundwater Dependent Ecosystems (GDE) (refer to **Section 5.6**).

The ecological survey and assessment completed as part of the Project was undertaken in accordance with Part 4 of the EP&A Act and the following legislation and licences, where relevant:

- TSC Act
- FM Act
- EPBC Act
- National Parks and Wildlife Service (NPWS) Scientific Research Licence
- Animal Research Authority as provided by the NSW Department of Primary Industries.

The Project was referred to the Commonwealth Department of the Environment (DoE) to determine whether the Project constitutes a controlled action under the EPBC Act. It was determined on 25 March 2015 that the Project is '**not a controlled action**' under the EPBC Act and therefore further assessment and approval from the Commonwealth minister for the Department of Environment is not required.

1.5.1 Relevant Guidelines, Frameworks and Policies

The ecological survey and assessment completed as part of the Project took into account the following guidelines, frameworks and policies.

Table 1.3 Relevant Guidelines, Frameworks and Policies Considered in the Ecological Assessment

Specified in the Project SEARs
• Draft NSW Biodiversity Offsets Policy (OEH) • Guidelines for Threatened Species Assessment (DoP 2005) • BioBanking Assessment Methodology (DECC 2009) • NSW State Groundwater Dependent Ecosystem Policy (DLWC 2002) • Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW 2012) • State Environmental Planning Policy No. 44 (SEPP 44) – Koala Habitat Protection
Other Relevant Guidelines
• Threatened Species Assessment Guidelines: the Assessment of Significance (DECC 2007) • Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft (DEC 2004) • DECC (2008). Hygiene Protocol for the Control of Disease in Frogs • NSW Office of Environment and Heritage (OEH) Interim Policy on Assessing and offsetting Biodiversity Impacts of Part 3A, State Significant Development (SSD) and State Significant Infrastructure (SSI) Projects, June 2011 • Department of the Environment (2013). Significant Impact Guidelines 1.1 – Matters of National Environmental Significance • DPI (2008). Threatened Species Assessment Guidelines – The Assessment of Significance. February 2008 • OEH (2014). Assessors' Guide to Using the BioBanking Credit Calculator v2.0 • Environmental Offsets Policy (DSEWPC 2012)

1.6 Assessment Approach

This Ecological Assessment has been prepared to assess the potential impact of the Project on native flora and fauna species, threatened and migratory species, EPs, TECs and their habitats occurring in the Project Disturbance Area and on adjoining lands. The process of undertaking an ecological assessment requires particular steps to identify the ecological features that require specific assessment, and to determine the level at which they are likely to be impacted. This is initially undertaken without consideration of any mitigation or offsetting measures, however the preliminary impact assessment informs project design and, in this case, has led to the development of project avoidance measures undertaken specifically to protect, or reduce impact on, ecological matters (refer to **Section 5.1**). Through the use of impact assessments under the EP&A Act and the EPBC Act, a decision is made as to whether or not species, populations or communities will be significantly impacted by the Project. For those species and communities that were determined to be significantly impacted, or potentially significantly impacted and for which avoidance measures are not feasible, detailed mitigation and offsetting measures were developed.

During all steps the precautionary principle was applied to ensure that wherever there was uncertainty resulting from lack of data or knowledge, or uncertainty in the level or extent of impact, the worst case was assumed. The application of the precautionary principle in the project assessment is detailed in **Section 5.7**.

2.0 Regional Setting

The Project Disturbance Area is situated in the Upper Hunter Valley, NSW. It lies within the 22,000 km^2 Hunter River catchment which is drained by the Hunter and Goulburn Rivers and their tributaries. The Project Disturbance Area is situated approximately 125 kilometres from the coast.

The Project Disturbance Area occurs in the Hunter Catchment Management Authority (CMA) and specifically within the Hunter/Central Rivers Kerrabee Catchment sub-region. It is characterised by rolling hills with a mixture of remnant grassy woodlands and derived native grassland. However, steep hills with areas of escarpments occur in the central eastern portion of the wider study area.

As previously mentioned, Wybong Creek comprises the western boundary of the wider study area which also supports floodplains associated with the creek. These floodplains extend east from Wybong Creek towards the rolling hills and largely support grazing land. Two ephemeral drainage lines flow through the wider study area, one in the north east and one in the central east.

Elevations range between 120 metres ASL in the west and 225 metres ASL in the eastern extent of the wider study area.

2.1 Soil Landscapes

A total of two soil units have been identified within the Project Disturbance Area as described by Kovac and Lawrie (1991).

Table 2.1 Soil Landscapes of the Project Disturbance Area and Surrounds

Soil Landscape	Location within Project Disturbance Area and Wider Study Area	Associated Soil Units
Sandy Hollow (SCsy)	Dominant soil landscape associated with the gentle slopes throughout the Project Disturbance Area, except for the north-eastern and far south-eastern margins.	Yellow Solodics Brown Solodics Deep Sands Alluvial Soils
Lees Pinch (SLlp)	Minor soil landscape associated with steep outcropping sandstone hills adjacent to the Project Disturbance Area.	Shallow Sands (Siliceous)

Source: Kovac and Lawrie (1991)

The Yellow Solodics, associated with the Sandy Hollow soil landscape are the dominant soil unit of the Project Disturbance Area. The Sandy Hollow soil landscape covers the smooth and gentle rises and slopes in the central Goulburn Valley, the south-eastern part of Merriwa Plateau and the northern part of the southern mountains (Kovac and Lawrie, 1991). The main soils occurring within this landscape are red and yellow Solodic Soils on the upper and midslopes with yellow and brown Solodic Soils on the lower slopes. Red Earths occur midslope, directly adjacent to sandstone benches with Siliceous Sands (Kovac and Lawrie, 1991). Alluvial soils occur along major drainage lines. Moderate gully erosion (<1.5 metres) can occur within this landscape in drainage lines, with minor sheet and rill erosion potentially occurring on slopes (Kovac and Lawrie, 1991).

The Lees Pinch landscape includes the sandstone outcrops adjacent to the Project Disturbance Area.

2.2 Catchment Characteristics

The Project Disturbance Area is located in the catchment area of Wybong Creek which is a tributary of the Goulburn River. Wybong Creek flows through the wider study area, approximately 900 metres to the west of the Project Disturbance Area at its closest point.

On a broad scale, the Project Disturbance Area is located within the Hunter River Catchment. The Goulburn River confluence with the Hunter River is approximately 4.8 kilometres downstream from Denman, approximately 11 kilometres south of the Project Disturbance Area.

2.3 History of Land Use in the Project Disturbance Area and Region

A review of the publically available historical aerial photographs (Google Earth) was undertaken to ascertain the historical land use within the Project Disturbance Area and particularly the historical extent of native vegetation. The earliest photographs obtainable were from 2002 and revealed no discernible difference of land use types than that are currently being undertaken, being agricultural activities, primarily grazing. Parts of the wider study area have a history of cropping and viticulture.

2.4 Conservation Areas

Two large national parks are situated approximately 14 kilometres to the south of the Project Disturbance Area (Wollemi and Yengo National Parks) and Goulburn River National Park is situated approximately 15 kilometres to the west. These National Parks contain large areas of native vegetation and offer a wide range of good quality fauna habitats. A smaller, yet significant conservation area also exists approximately eight kilometres to the north-west of the Project Disturbance Area (Manobalai Nature Reserve). This conservation area also contains significant areas of remnant vegetation and important fauna habitats. These conservation areas will not be adversely affected by the Project.

Adjoining the wider study area to the east is a dedicated biodiversity offset site for the Mangoola Coal Mine (Umwelt 2006). The dedicated biodiversity offset area is approximately 1924 hectares in size and includes 1074 hectares of intact woodland or forest vegetation.

2.5 Connectivity

The Project Disturbance Area comprises a relatively small area of predominately native vegetation. The lowland surrounding the Project Disturbance Area has a history agricultural activity, including cultivation, grazing and viticulture. The steeper rocky slopes in the eastern portion of the Project Disturbance Area provides a direct vegetated link to larger areas of intact forest vegetation which is dedicated as conservation offsets for the Mangoola Coal Mine (Umwelt 2006).

3.0 Methods

3.1 Literature Review

A review of previous documents and reports relevant to the Project Disturbance Area was undertaken to inform the field survey methodology, results and impact assessment component of this report. This included regional and sub-regional vegetation mapping reports in the vicinity of the Project Disturbance 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 are discussed below; focusing on the key findings of each assessment.

3.1.1 Hunter Remnant Vegetation Project (Peake 2006)

The Hunter Remnant Vegetation Project (HRVP) (Peake 2006) documents the distribution, composition and conservation status of vegetation communities occurring in the central Hunter Valley of NSW. Five vegetation communities identified within the HRVP were mapped within the wider study area, comprising:

- Western Hunter Narrabeen Exposed Grey Gum – Stringybark Woodland
- Hunter Valley River Oak Forest
- Hunter Lowlands Red Gum Forest
- Narrabeen Footslopes Slaty Box Woodland
- Central Hunter Box – Ironbark Woodland.

Peake (2006) regarded two of these vegetation communities to be restricted in extent but not threatened and four vegetation communities to be of conservation significance and under threat. When the HRVP was published in 2006, the following vegetation communities identified within the wider study area were listed as Endangered Ecological Communities (EECs): Hunter Lowlands Red Gum Forest; and Central Hunter Box – Ironbark Woodland.

The HRVP (Peake 2006) has been used as a basis for the regional assessment of vegetation communities and as a comparison in an impact assessment context against which the loss of vegetation communities as a result of the Project was assessed. While the HRVP utilised imagery from 2000, the report provides a thorough analysis and mapping of remnant vegetation in the central Hunter Valley.

3.1.2 Greater Hunter Native Vegetation Mapping

As part of the Upper Hunter Strategic Assessment (UHSA), OEH released the Draft Greater Hunter Vegetation Map (Sivertsen et al. 2012) (GIS format) and associated Vegetation Classification Dataset (Excel spreadsheet), covering the entire UHSA area which includes the central Hunter Valley. The vegetation types of the Draft Greater Hunter Vegetation Map has replaced the Hunter Central Rivers vegetation types currently used in the BioBanking credit calculator. While the Draft Greater Hunter Vegetation Map was produced using a number of on-ground data collection points, many parts of the map are based on modelling results and may contain errors and therefore does not replace the need for on-ground vegetation community survey and mapping.

All of the vegetation communities recorded in the wider study area have been aligned with the vegetation community nomenclature of the Greater Hunter Native Vegetation Mapping, where appropriate, to inform an indicative FBA Assessment of the Project.

3.1.3 Relevant Ecological Reports

One ecological study has been undertaken within the Project Disturbance Area (The Envirofactor 2009) and a number of ecological studies have been completed on nearby areas for the Mangoola Coal project, including but not limited to:

- Ecological Assessment Anvil Hill Project (Umwelt 2006)
- Ecological Assessment – Proposed Modification for Mangoola Coal Pipeline (Umwelt 2008)
- Ecological Assessment for Proposed Mine Plan Modification – Mangoola Coal (Umwelt 2010)
- Ecological Assessment for Exploration Drilling Sites, Wybong NSW (Umwelt 2011)
- Draft Upper Hunter Strategic Assessment (UHSA) (Umwelt in preparation).

These existing reports provided background information and context for this report.

3.2 Database Searches

In order to identify threatened species, migratory species, EPs and TECs with the potential to occur in the Project Disturbance Area relevant ecological databases were searched.

The databases searched were:

- a 10 kilometre radius search from the centre of the Project Disturbance Area of the OEH Atlas of NSW Wildlife (July 2015)
- a 10 kilometre radius search from the centre of the Project Disturbance Area of the Department of Environment Protected Matters Database (July 2015).

Records from these database searches were combined with records derived through literature reviews and professional opinion to identify the range of potentially occurring threatened and migratory species. The identification of potentially occurring threatened and migratory species was then used to assist in the development of appropriate survey methods.

Current lists of threatened species and key threatening processes listed under the FM Act were sourced from the Department of Primary Industries (NSW Fisheries) and Department of Environment websites.

3.3 Flora Survey Methods

Vegetation survey and mapping was carried out across the wider study area to sample and describe flora and vegetation communities present in the Project Disturbance Area. In particular, literature review and vegetation survey aimed to identify threatened species, EPs, TECs and species of local or regional significance present or potentially occurring within the Project Disturbance Area. Key steps involved in the vegetation survey included:

- aerial photograph interpretation (API)
- field survey site selection using stratification
- field survey and associated plant identification
- vegetation community description and delineation.

3.3.1 Aerial Photograph Interpretation

Aerial photographs of the Project Disturbance Area were 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 Project Disturbance Area.

The Manifold System 8.0 Enterprise Edition geographical information system (GIS) was used to view these aerial photos on-screen, using a 32 bit mode. Use of GIS allowed zooming to a relatively large scale. Using this method, mapping was carried out at a scale of up to approximately 1:840, since at higher magnification than this the gain in scale was outweighed by the loss in resolution.

3.3.2 Field Survey Site Selection and Stratification of the Project Disturbance Area

Designing an appropriate flora survey requires consideration of both survey methods and effort. Meaning, surveys should be undertaken during periods of optimal climatic and seasonal conditions and the use of stratification should be employed to ensure that the full range of potential habitats present are assessed and adequately surveyed. Reference was made to the relevant OEH flora survey guidelines (DEC 2004 and DECC 2008) when designing the field survey, with appropriate survey methods selected that maximised the opportunities of identifying the full suite of flora species (and vegetation communities) that occur within the Project Disturbance Area.

Survey sites were selected by considering a range of attributes that were thought to influence or determine the type of vegetation communities present. The vegetation survey of the wider study area was stratified using the biophysical attributes shown in **Table 3.1**. This stratification was done intuitively, but based on existing topographic, soil, vegetation and geological mapping. Other factors considered included the spreading the survey sites across the wider study area, as well as topographic position and aspect.

Table 3.1 Biophysical Attributes Used for Stratification of the wider study area

Attribute	Attribute in Wider Study Area	Definition
Landform1	Ephemeral and permanent creeks	Wybong Creek flowing south along the western boundary of the wider study area An ephemeral creek in the north eastern portion of the wider study area that flows west to Wybong Creek Lynch's Gully to the south of the Project Disturbance Area
Vegetation Structure	Closed forest	Trees dominant strata with crowns touching to overlapping
	Open forest	Trees dominant strata with crowns touching or slightly separated
	Woodlands	Trees dominant strata with crowns rarely touching or overlapping. Wide gaps in the canopy are common. Grasses and forbs dominate the understorey
	Grassland	Open grasslands dominated by grasses and forbs. Trees and shrubs may be present, but at very low frequency

3.3.3 Flora Field Survey

The flora field survey was carried out in spring 2014, specifically 30 September – 3 October and 6 November. Field survey allowed sampling of vegetation and field reconnaissance to identify spatial vegetation patterns. Survey methods included:

- quadrat vegetation sampling: semi-quantitative sampling of 400 m^2 quadrats placed within distinctive vegetation units. These quadrats were extended to 20 x 50 metres in potential box gum woodlands to meet the EPBC Act assessment requirements (DEH 2006)
- BioBanking plots/transects: additional biometric data was collected at each standard flora quadrat, which also necessitated the establishment of 20 x 50 m^2 plots and 50 metre transects
- meandering transects: non-quantitative sampling along transects through vegetation units
- rapid vegetation assessments: non-quantitative point sampling within distinct vegetation units
- field reconnaissance: identifying spatial arrangement of vegetation across the wider study area.

These survey methods are described in the following sections. All of the information collected has informed the definition and delineation of vegetation communities and all sampling techniques targeted potentially occurring threatened species.

3.3.3.1 Quadrat Survey

Quadrat survey of flora was undertaken using methods that are relatively standard in most NSW government vegetation management agencies and elsewhere. This ensured that data collected by other relevant surveys could be compared to the current survey results, and that the data from the Project could be analysed in an equivalent way to that collected by other recognised studies.

Quadrat survey involved semi-quantitative sampling flora in systematic 400 m^2 areas. The typical dimensions of the quadrats were 20 metres by 20 metres, although in some places this was altered to 10 metres by 40 metres to allow sampling of linear vegetation communities, particularly along an ephemeral creek and narrow hilltop vegetation. These quadrats were extended to 20 x 50 metres in potential box gum woodlands to meet the EPBC Act assessment requirements (DEH 2006).

When undertaking systematic sampling to facilitate vegetation community mapping and description, quadrat surveys have several distinct advantages over non-quantitative transects, including:

- providing a quantitative examination of species distribution and abundance
- being likely to detect inconspicuous or rare species (especially forbs and grasses) within the given sampling area, as a smaller area is surveyed in a concentrated search
- providing a basis for any subsequent monitoring required.

Quadrat sampling was carried out systematically to provide representative sampling of a range of attributes that occur in the wider study area, that influence or determine the presence of different flora species and vegetation associations.

The location of each quadrat was recorded using aerial photography and/or a hand-held GPS with accuracy of ± 5 metres. The Map Grid of Australia (MGA) coordinate system was used. The location of the 13 vegetation quadrats completed within the wider study area is provided on **Figure 3.1**.

At each quadrat, about 45 to 60 minutes were spent searching for all vascular flora species present within the 400 m2 area. Additional time was spent in the larger 1000 m^2 area quadrats. These were recorded on a proforma with a cover-abundance value to reflect their percentage cover in the quadrat. A modified Braun-Blanquet 6-point scale was used to estimate cover-abundances of all plant species within each quadrat (Braun-Blanquet 1927), with selected modifications sourced from Poore (1955) and Austin et al. (2000). **Table 3.2** shows the cover-abundance categories used. Additional searches were carried out for extra species located outside of the quadrat and within the vegetation unit being sampled. These were recorded without a cover-abundance value. Voucher specimens were collected of cryptic and significant species as well as any species that could not be identified in the field for later identification.

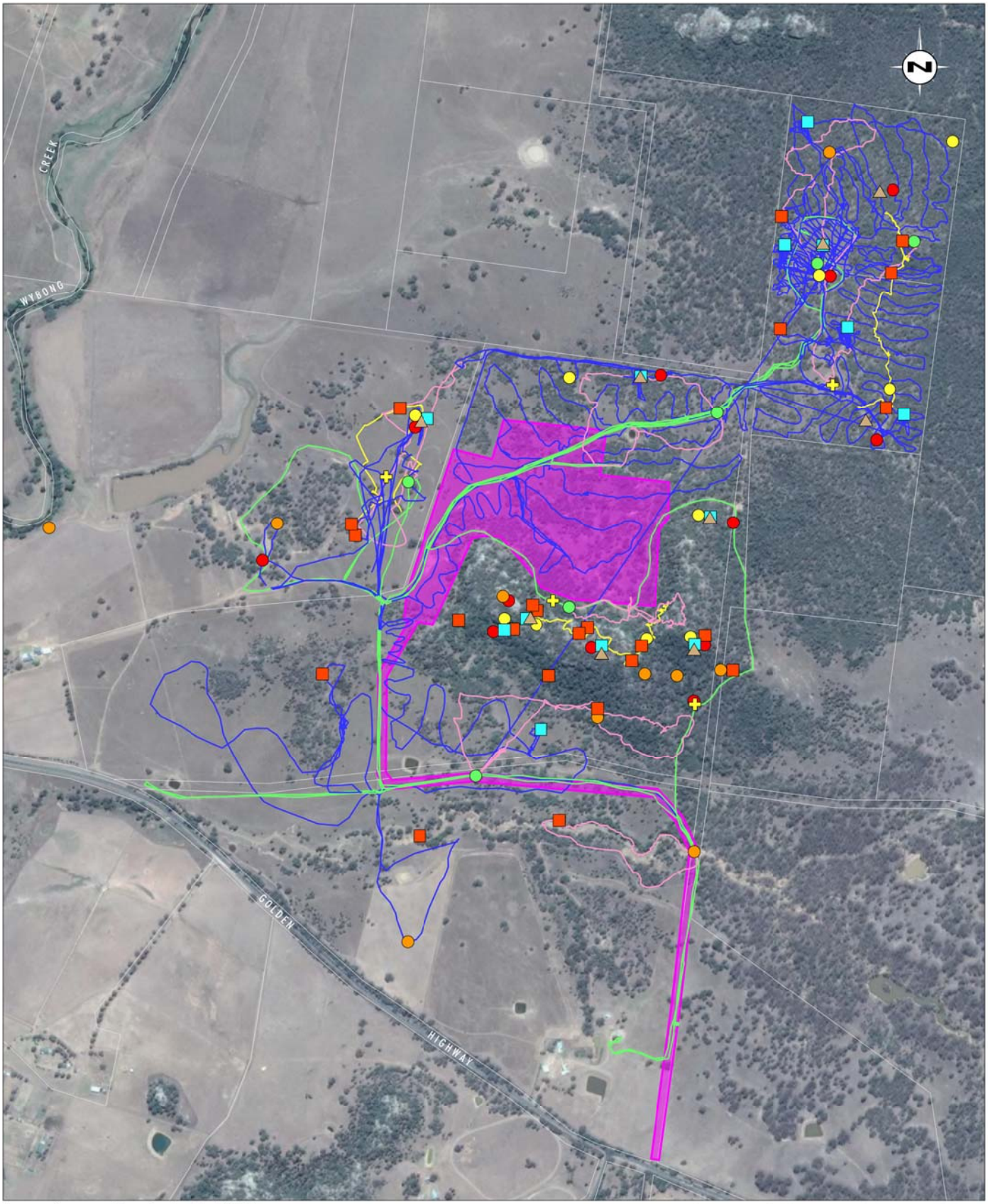


Image Source: Google Earth (2014)
Data Source: KMH (2014), Department of Lands (2009)

0 200 400 600m
1:12 500

Legend

- Project Disturbance Area
- Driving Spotlight Transect
- Hair Funnel Line
- Threatened Flora Transect
- Walking Spotlight Transect
- Flora Quadrat & SEPP 44
- Remote Camera
- Diurnal Bird Survey
- Diurnal Herpetological Survey
- Habitat Assessment
- Nocturnal Call-playback
- Rapid Vegetation Assessment
- Micro-bat Echolocation Recorder

FIGURE 3.1

Terrestrial Flora and Fauna Survey Effort

File Name (A4): R01/3453_014.dgn
20150910 11.04

Table 3.2 Modified Braun-Blanquet Crown Cover-abundance Scale

Class	Cover-abundance*	Notes
1	Few individuals (less than 5 per cent cover)	Herbs, sedges and grasses: <5 individuals Shrubs and small trees: <5 individuals
2	Many individuals (less than 5 per cent cover)	Herbs, sedges and grasses: 5 or more individuals Shrubs and small trees: 5 or more individuals Medium-large overhanging tree
3	5 – less than 20 per cent cover	-
4	20 – less than 50 per cent cover	-
5	50 – less than 75 per cent cover	-
6	75 – 100 per cent cover	-

Note: * Modified Braun-Blanquet scale (Poore 1955; Austin et al. 2000)

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.

3.3.3.2 Biometric Data Collection

In addition to the data collected at each standard flora quadrat, biometric site attribute data was also collected according to Appendix 2 of the BioBanking Assessment Methodology and Credit Calculator Operational Manual (DECC 2009). Biometric data was collected at each of the quadrat locations identified on **Figure 3.1**.

At each standard flora quadrat, 10 points along a 50 metre transect were assessed for:

- percentage native overstorey cover
- percentage native mid-storey cover.

In addition, 50 points along a 50 metre transect were assessed for:

- percentage native groundcover (grass)
- percentage native groundcover (shrubs)
- percentage native ground cover (other)
- percentage exotic plant cover.

The native plant species richness in a 20 metre x 20 metre quadrat was recorded as part of the standard flora quadrat surveys. The standard flora quadrat was also increased to a 20 metre x 50 metre plot in order to count the number of trees with hollows and total length of logs. Notes were also made on the regeneration of canopy species within each vegetation community.

3.3.3.3 Meandering Transects

Meandering transects were walked through vegetation units across much of the Project Disturbance Area (refer to **Figure 3.1**), particularly searching for threatened and otherwise significant species, EPs and TECs. Meandering transects enable floristic sampling across a much larger area than systematic quadrats. Records along transects supplemented floristic sampling carried out in quadrats, however, the data collected was in the form of presence records, rather than semi-quantitative cover abundance scores.

Meandering transects targeted specific vegetation units and provided invaluable information on spatial patterns of vegetation that informed vegetation community mapping of the Project Disturbance Area.

3.3.3.4 Rapid Vegetation Assessments

Rapid vegetation assessments were completed across the wider study area (refer to **Figure 3.1**). Ten rapid vegetation assessments are located within the wider study area. They were used in combination with meandering transects primarily to assist in the delineation and refinement of vegetation mapping. Rapid vegetation assessment points were located within distinct vegetation community units, rather than within ecotones, to allow data collection for each community without confounding effects from adjacent communities. Dominant, common and some uncommon (but notable) plant taxa were recorded within each vegetation community, but cover abundance scores were not. However, the vegetation structure at each rapid vegetation assessment point was documented, including the dominant species in each stratum.

3.3.3.5 Field Reconnaissance

Field reconnaissance was carried out during all field surveys and while travelling throughout the Project Disturbance Area. Field reconnaissance contributed to the ground-truthing of vegetation community boundaries, refinement of community descriptions, and providing a more comprehensive understanding of the floristic features across the Project Disturbance Area.

3.3.4 Targeted Threatened Flora Surveys

Throughout flora surveys of the wider study area, targeted searches were carried out for threatened flora species that are known to occur in or near to the Project Disturbance Area or were considered likely to occur in the Project Disturbance Area 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 quadrats (refer to **Figure 3.1**). The list of species that were specifically targeted during targeted threatened flora surveys was compiled through database searches and literature reviews (refer to **Section 3.1**) and is included in **Table 3.3**.

Table 3.3 Potential Seasonal Survey Requirements of Threatened Flora Species

Scientific Name	Common Name	TSC Act	EPBC Act	J	F	M	A	M	J	J	A	S	O	N	D
Acacia pendula	*Acacia pendula* population in the Hunter catchment	EP													
Cymbidium canaliculatum	*Cymbidium canaliculatum* population in the Hunter catchment	EP													
Eucalyptus camaldulensis	*Eucalyptus camaldulensis* population in the Hunter catchment	EP													
Eucalyptus glaucina	Slaty red gum	V	V												
Eucalyptus cannonii	Capertee stringybark	V													
Commersonia rosea		E	E												
Cynanchum elegans	white-flowered wax plant	E	E												
Homoranthus darwinioides		V	V												
Kennedia retrorsa		V	V												
Lasiopetalum longistamineum		V	V												
Ozothamnus tesselatus		V	V												
Pomaderris queenslandica	scant pomaderris	E													
Pomaderris sericea	silky pomaderris	E	V												
Pomaderris reperta	Denman pomaderris	CE	CE												
Prostanthera cryptandroides subsp. cryptandroides	Wollemi mint-bush	V	V												
Prostanthera stricta	Mount Vincent mint-bush	V	V												
Prostanthera discolor		V	V												

Scientific Name	Common Name	TSC Act	EPBC Act	J	F	M	A	M	J	J	A	S	O	N	D
Rulingia procumbens		V	V												
Monotaxis macrophylla	large-leafed monotaxis	E													
Thesium australe	Austral toadflax	V	V												
Philotheca ericifolia			V												
Swainsona recta	small purple pea	E	E												
Diuris tricolor	pine donkey orchid	EP, V													
Diuris pedunculata	small snake orchid	E	E												
Eucalyptus pumila	Pokolbin Mallee	V													
Prasophyllum petilum	Tarengo leek orchid	E	E												

Grey shaded cells = required survey times according to the Biodiversity Certification Credit Calculator or a BioBanking report exported for the Hunter-Central Rivers CMA from the online OEH Atlas of NSW Wildlife.
CE = Critically Endangered
E = Endangered
EP = Endangered Population
V = Vulnerable.

All threatened species known to occur in the local area or with suitable habitat within the Project Disturbance Area were specifically targeted during flora surveys. Known local populations of pine donkey orchid and *Prasophyllum petilum* were known to be in flower during the time the field surveys were undertaken within the Project Disturbance Area.

3.3.5 Threatened Ecological Community Delineation Techniques

Vegetation communities identified in the Project Disturbance Area were compared to TECs listed under the NSW TSC Act and the Commonwealth EPBC Act and an assessment of similarity with TECs was conducted. Published TEC listing advice documents were used in comparison with vegetation communities identified within the Project Disturbance Area in order to determine whether or not they conform with any listed communities. Specific criteria used in this assessment included, but was not limited to the Project Disturbance Area location including bioregion, subregion and local government area, published species lists including important species, location within the landscape, soil characteristics and characteristics of vegetation stratum.

3.3.6 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 and 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 2014), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name. Where the identity of a specimen was unknown or uncertain, it was lodged with the National Herbarium of New South Wales at the Royal Botanic Gardens Sydney for expert identification.

3.3.7 Summary and Adequacy of Flora Field Survey Effort

Table 3.4 summarises the suggested minimum effort required to undertake adequate surveys of flora species in accordance with DEC (2004), including threatened species and mapping and describing vegetation communities.

Table 3.4 Recommended Flora Survey Effort with Respect to OEH Draft Guidelines*

Survey Technique	Suggested Minimum Effort
Transects	• 1 x 100 m traverse per stratification unit <2 hectares • 2 x 100 m traverses per 2-50 hectares of stratification unit • 3 x 100 m traverses per 51-250 hectares of stratification unit • 5 x 100 m traverses per 251-500 hectares of stratification unit • 10 x 100 m traverses per 501-1,000 hectares of stratification unit, plus one additional 100 m traverse for each extra 100 hectares thereof
Quadrat	• At least: • 1 quadrat per stratification unit <2 hectares • 2 quadrats per 2-50 hectares of stratification unit • 3 quadrats per 51-250 hectares of stratification unit • 5 quadrats per 251-500 hectares of stratification unit • 10 quadrats per 501-1,000 hectares of stratification unit, plus one additional quadrat for each extra 100 hectares thereof.

* Number of quadrats recommended in accordance with Draft Threatened Species Survey and Assessment: Guidelines for Developments and Activities (DEC 2004)

The field survey undertaken within the wider study area was designed to be consistent with the survey techniques recommended in the OEH draft guidelines, but not to meet the adequacy in full. **Table 3.5** identifies the flora survey effort undertaken within the wider study area with respect to OEH draft guidelines for floristic quadrats and indicates that the level of field survey undertaken for the Project exceeds or greatly exceeds the suggested minimum sampling frequency for quadrats. Generally, the survey effort meets or exceeds the suggested minimum sampling frequency for quadrats within all stratification units with only 3 out of the 8 not meeting adequacy.

No floristic quadrats were completed within the HU712 – River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley – Moderate to Good Condition vegetation zone as it occurs along the far western boundary of the wider study area and will not be impacted on by the proposed Dolwendee Quarry. Even if the proposed development plan is revised, it is very unlikely to impact on this vegetation zone.

The results of the flora assessment and vegetation mapping can be viewed with a high degree of certainty.

Table 3.5 Adequacy of Vegetation Survey

Stratification Unit1	Area (ha) in Project Disturbance Area	Area (ha) in Wider Study Area	No. of Quadrats and Transects Sampled and No. of each required (x)2
HU702 – 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 Bioregion– Moderate to Good Condition	0	4.5	Quadrats: 2 (2)
HU712 – River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley – Moderate to Good Condition	0	2.8	Quadrats: 0 (2)
HU730 – White Box x Grey Box; Red Gum; Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley - Low Condition Derived Native Grassland	0	1.7	Quadrats: 1 (2)
HU730 – White Box x Grey Box; Red Gum; Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition	0	8.8	Quadrats: 2 (2)
HU826 – Narrow-leaved Ironbark - Grey Gum - Native Olive woodland of Central Hunter – Moderate to Good Condition	0	7.3	Quadrats: 2 (2)
HU869 – Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin – Moderate to Good Condition	0	1.3	Quadrats: 1 (2)
HU905 – Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter – Low Condition Derived Native Grassland	14.8	90.9	Quadrats: 2 (2)
HU905 – Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter – Moderate to Good Condition	7.4	107	Quadrats: 3 (2)

Notes:

1. See **Table 3.1** for details about biophysical attributes used in stratification units
2. Number of quadrats and transects (100 m traverses) recommended in accordance with Draft Threatened Species Survey and Assessment: Guidelines for Developments and Activities (DEC 2004) – see **Table 3.6**

Substantial transect survey was undertaken within the wider study area, as shown on **Figure 3.1**, to supplement the results of the quadrat survey which greatly exceeding the minimum survey requirement for this technique.

3.4 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the wider study area.

Vegetation mapping involved the following key steps:

- import of licensed regional vegetation community mapping for the Hunter Remnant Vegetation Project (HRVP) (Peake 2006) from the Hunter – Central Rivers Catchment Management Authority
- import of regional vegetation community mapping for the Greater Hunter Vegetation Map (GHVM) (Sivertsen et al. 2012)
- review of mapping undertaken by Umwelt (2014) as part of the UHSA Mangoola Coal project
- preparation of draft vegetation community map based on aerial photograph interpretation and preliminary delineation of vegetation community floristics
- ground-truthing of vegetation map based on survey effort documented in **Section 3.3**
- revision of vegetation community floristic delineations based on plot data
- revision of 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 then compared to those vegetation communities identified in the Vegetation of the Central Hunter Valley (Peake 2006), the Greater Hunter Native Vegetation Mapping – Geodatabase Guide (Version 4.0) (Sivertsen et al. 2012) and Biometric Vegetation Type (BVT) and Plant Community Type (PCT) descriptions from the Vegetation Information System (VIS) Classification exported from the online OEH website (OEH 2013e).

The vegetation community profiles provided in Peake (2006), Sivertsen et al. (2011) and OEH (2013e) were interrogated to identify communities that contained similar species and structural compositions to ensure that, where possible, the communities identified in the wider study area were aligned with similar communities/BVTs known to occur in the region.

3.5 Terrestrial Fauna Survey

Fauna surveys were carried out to identify the fauna species and their habitats occurring, or considered to have the potential to occur in the Project Disturbance Area, including threatened species, migratory species, EPs, and species of local or regional significance.

Fauna surveys were undertaken by Umwelt within the wider study area in spring 2014, specifically 30 September – 3 October and 6 November. **Figure 3.1** shows the location of all fauna survey methods undertaken for the Project. The results of the all fauna sampling conducted for the Project has been included in discussions below. All of the information collected as part of the Project has informed the definition and delineation of fauna habitat characteristics and all sampling techniques targeted potentially occurring threatened species.

During the fauna survey, a variety of survey techniques were employed. Each technique is described in detail in the following sections. Reference was made to the relevant OEH fauna survey guidelines (DEC 2004) when designing the field survey, with appropriate survey methods selected that maximised the

opportunities of identifying the full suite of fauna species that occur within the Project Disturbance Area. The survey undertaken within the Project Disturbance Area was not designed to meet the OEH fauna survey guidelines, however the survey techniques were consistent with those defined by the guidelines.

The field survey undertaken throughout the wider study area and described in detail below was stratified based on the following site attributes:

- biophysical attributes (e.g. landform, geology, elevation, slope, soil type, aspect); then
- vegetation structure (e.g. forest, woodland, shrubland etc); and
- floristics (e.g. species).

Stratification of the wider study area included an initial analysis of aerial photographs to delineate potential fauna habitats. The floristic attributes of the vegetation communities were considered to be similar in a fauna habitat context.

3.5.1 General Fauna Surveys

A variety of fauna survey methods, targeting the full suite of vertebrate fauna species, were employed throughout the wider study area and are identified on **Figure 3.1**, as detailed below.

3.5.1.1 Terrestrial Hair Funnels

A total of 50 terrestrial hair funnels were set across three trap lines within the wider study area (refer to **Figure 3.1**). Derived native grassland habitats were subject to less intensive sampling effort with a total of 10 funnels employed. A total of 1850 terrestrial hair funnel nights were completed across the wider study area by Umwelt.

Terrestrial Faunatech hair funnels were baited with rolled oats, peanut butter and honey mixture. All terrestrial hair funnels were positioned amongst habitat features such as logs, fallen bark, rocks and ground cover. The entrance to the hair funnel and the tree trunk were sprayed with a honey and water emulsion as an attractant. All hair funnels were left in position for 37 nights and all hair samples collected were identified by Barbara Triggs, (a recognised expert in the field of hair and scat identification) of 'Dead Finish', Victoria.

3.5.1.2 Arboreal Hair Funnels

A total of 30 arboreal hair funnels were set at the general fauna survey sites (refer to **Figure 3.1**). A total of 1110 arboreal hair funnel sampling nights were completed across the wider study area by Umwelt.

Hair funnels 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. All hair funnels were left in position for 37 nights and all hair samples collected were identified by Barbara Triggs.

3.5.1.3 Diurnal Bird Surveys

Twelve diurnal bird surveys, each of one person-hour, were undertaken within the wider study area, identified in **Figure 3.1**. Bird surveys were undertaken at various times of the day, primarily in early to mid morning and mid to late afternoon. Each survey consisted of a slow walking transect within approximately a 2 hectare area of the survey site. 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.

3.5.1.4 Diurnal Herpetological Surveys

Ten targeted diurnal herpetological (reptile and amphibian) surveys, each of one person-hour were undertaken within the wider study area. The location of the diurnal herpetological surveys are shown in **Figure 3.1**. Herpetological surveys were generally undertaken during the warmest parts of the day. Each survey consisted of a slow walking transect within approximately a 2 hectare area of the survey site. During the search likely micro-habitats were examined including around waterbodies, beneath rocks and logs, in tree bark and in ground litter.

Amphibians not identifiable from their calls and non-venomous reptiles were captured for visual identification. All amphibians were handled according to the hygiene protocol for the control of disease in frogs (DECC 2008).

3.5.1.5 Spotlighting Surveys

Spotlighting searches were undertaken both on foot and from a moving vehicle. Walking spotlighting searches were undertaken by two observers for a period of at least 30 minutes (total of one person hour) on each occasion. Vehicle spotlighting searches were undertaken by the passenger(s) from a slowly moving (first gear, low range) four wheel drive vehicle for a minimum of one kilometre. Opportunistic vehicle spotlighting was undertaken whenever driving through the wider study area at night. Walking and vehicle spotlighting searches were undertaken using 30 watt handheld spotlights and head torch.

Seven walking nocturnal spotlighting surveys and six driving spotlighting surveys were undertaken between fauna survey sites within the wider study area. The location of both types of nocturnal spotlighting survey is shown in **Figure 3.1**.

Spotlighting surveys targeted nocturnal birds, mammals and herpetofauna, undertaken generally between 7.30 pm and 12.00 am, commencing one hour after dusk.

3.5.1.6 Nocturnal Call-playback

Six nocturnal call-playback sessions were undertaken within the wider study area over consecutive nights using a 15 watt directional loud hailer. The location of nocturnal call-playback sessions is shown in **Figure 3.1**. Call-playback sessions commenced with a quiet listening period of approximately five minutes. Each species' call was played for a minimum of 4 minutes followed by a listening period of 2 minutes before the beginning of the next species' call. Call-playback sessions included the calls of:

- squirrel glider (*Petaurus norfolcensis*)
- koala (*Phascolarctos cinereus*)
- powerful owl (*Ninox strenua*)
- masked owl (*Tyto novaehollandiae*).

3.5.1.7 Micro-bat Echolocation Recording

Recordings of micro-bat echolocation calls were conducted over three nights within the wider study area. Calls were recorded using an Anabat SD1 device (hereafter referred to as an Anabat). A single Anabat was installed at each site, of which there were four sites as identified in **Figure 3.1**. The first two sites had each Anabat recording for two complete nights, while the last two sites only recorded a single complete night.

At each site, the Anabat was positioned at an approximate 30 degree angle 1 metre above the ground in waterproof housing. Each detector was positioned towards potential micro-bat flight paths or over waterbodies to increase the likelihood of detecting micro-bat species. 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 Anna McConville of Echo Ecology (a recognised expert in the identification of micro-bat calls with over 10 years experience). The echolocation calls of species were identified to one of three levels of confidence:

- definite
- probable
- possible
- species group.

All three levels of identification confidence were treated as positive identifications for the purposes of the ecological assessment.

3.5.1.8 Remote Camera Surveys

Bushnell Trophy Cam HD cameras were used for the remote camera survey which was predominately designed to target brush-tailed phascogale (*Phascogale tapoatafa*), brush-tailed rock-wallaby (*Petrogale penicillata*) and eastern pygmy-possum (*Cercartetus nanus*). A total of 24 remote cameras were installed across the wider study area. 19 of the cameras were mounted approximately one metre above the ground on a tree trunk and positioned toward a can of tuna as bait. Four cameras were installed high on a tree trunk, between 1 and 2 metres high, and positioned toward an arboreal hair funnel baited with a rolled oat, peanut butter and honey mixture. These four cameras were set up specifically targeting eastern pygmy-possum, a vulnerable species under the TSC Act. One additional camera was not baited, but was located along an animal track and positioned toward a bird nest built in to the hill. In potential brush-tailed rock-wallaby habitat areas cameras were positioned along potential tracks or facing rock platform areas where brush-tailed rock-wallabies may occur.

Cameras were set to take three photos in quick succession when movement was detected. Remote cameras were set at each site for 38 days, resulting in a total of 912 camera days/nights of survey. The locations of the remote cameras are shown on **Figure 3.1**.

3.5.1.9 Habitat Assessments

Habitat assessments were undertaken at a total of nine sites across the wider study area (**Figure 3.1**). The assessment targeted potential habitat and resources for fauna species, particularly for threatened fauna species. Records of a number of habitat features were made at each site, including:

- evidence of disturbance such as fire, weeds, feral animals, dumping, erosion and logging
- presence of stumps and stags
- presence of groundcover features such as rock, litter, grasses, logs, boulder, soil and lichen
- presence of dieback, insect attack or mistletoe
- presence of perch sites, fallen and loose bark
- vegetation strata and composition
- tree size class (trunk diameter), and age (old growth, mature, regenerating, saplings)
- presence of other species specific feed resources (such as for cockatoos and honeyeaters).

3.5.1.10 SEPP 44 (Koala Habitat) Assessment

An application for a proposed development approval which relates to a site occurring within an LGA specified under State Environmental Planning Policy 44 (SEPP 44) – Koala Habitat Protection, must be assessed under SEPP 44. Assessment under SEPP 44 is based on an initial determination of whether the land constitutes potential koala (*Phascolarctos cinereus*) habitat. This is determined by assessing whether the eucalypt species present in Schedule 2 of the policy (refer to **Table 3.6**) constitute 15 per cent or more of the total number of trees in the upper or lower strata of the tree component. If potential koala habitat is present, the area must be further assessed to determine if the land is core koala habitat.

Table 3.6 Eucalypt Species Listed Under Schedule 2 of SEPP 44

Scientific Name	Common Name
Eucalyptus tereticornis	forest red gum
Eucalyptus microcorys	tallowwood
Eucalyptus punctata	grey gum
Eucalyptus viminalis	ribbon or manna gum
Eucalyptus camaldulensis	river red gum
Eucalyptus haemastoma	broad-leaved scribbly gum
Eucalyptus signata	scribbly gum
Eucalyptus albens	white box
Eucalyptus populnea	bimble box or poplar box
Eucalyptus robusta	swamp mahogany

An assessment of the presence of trees listed on Schedule 2 of SEPP 44 was undertaken at each of the 13 floristic quadrats. The proportion of listed feed trees in comparison to non-feed trees was calculated.

3.5.1.11 Signs of Presence Searches

Searches for signs of animal presence were conducted opportunistically during all survey activities, particularly during habitat searches and reptile and amphibian searches. Due to the opportunistic nature of signs of presence surveys, the level of survey effort was not recorded. Evidence of presence included scats, feathers, nests, burrows, footprints, bones, tufts of hair and scratch marks on trees.

3.5.2 Terrestrial Fauna Survey Timing and Effort

Fauna surveys were undertaken across the wider study area in spring 2014 and focused on providing high levels of survey effort for a number of key species which were considered to be difficult to detect and this was carried out within predicted seasonal times of highest detectability. This effort was also matched to habitat areas considered likely to be of importance for target species.

Opportunistic fauna recording was completed during all other surveys completed within the wider study area, however the effort from such survey is not quantifiable.

Table 3.7 outlines the fauna survey effort completed within the wider study area. The locations of these survey methods are provided in **Figure 3.1**.

Table 3.7 Adequacy of Terrestrial Fauna Survey Effort

Survey Method	Total Effort
Terrestrial Hair Funnels	1850 terrestrial hair funnel nights
Arboreal Hair Funnels	1110 arboreal hair funnel nights
Diurnal Bird Surveys	12 person hours
Diurnal Herpetological Surveys	10 person hours
Walking Spotlighting Surveys	7 person hours
Driving Spotlighting Surveys	6 kilometres
Nocturnal Call-playback	6 sessions
Micro-bat Echolocation Recording	6 full nights
Remote Camera Surveys	912 camera days/nights
Habitat Assessments	9 locations
SEPP 44 Assessments	13 locations

4.0 Survey Results

4.1 Flora Survey Results

The results of the flora survey, including field survey, vegetation description and mapping and desktop components are detailed in the following sections. The results in this section include specific flora survey effort for the Project.

4.1.1 Database Searches

The threatened flora species recorded on the OEH Atlas of NSW Wildlife and Department of Environment Protected Matters Database are included in threatened species assessment table in **Appendix A**.

4.1.2 Flora Species

A total of 142 plant species were identified during the flora survey undertaken in 2014. Plants were recorded from two major vascular plant classes, being: ferns and flowering plants (**Table 4.1**) and included trees, shrubs, forbs, grasses, sedges, rushes, reeds, ferns, lithophytes, epiphytes, mistletoes, vines and twiners. The full list of flora species recorded during flora surveys is provided in **Appendix B**.

Table 4.1 Composition of Plant Classes and Families Recorded

Plant Classes	Sub-class	Number of Families	Number of Species
Filicopsida (ferns)	-	1	2
Magnoliopsida (flowering plants)	Magnoliidae (dicots)	40	100
Magnoliopsida (flowering plants)	Liliidae (monocots)	8	40
Totals (all plants)	-	49	142

A total of 49 plant families were recorded (refer to **Table 4.1**). Poaceae (grasses) was the most speciose family with 25 species recorded, followed by Asteraceae (daisies) with 18 species, Fabaceae (peas and acacias) with 14 species and Myrtaceae (eucalypts) with 10 species recorded.

Of the 142 species recorded, 27 (19 per cent) were introduced species. Introduced species recorded include paspalum (*Paspalum dilatatum*), kikuyu (*Pennisetum dilatatum*), catsear (*Hypochaeris radicata*), shivery grass (*Briza minor*), capeweed (*Arctotheca calendula*) and Patterson's curse (*Echium plantagineum*).

Two threatened flora species were recorded within the wider study area during the flora survey, being pine donkey orchid (*Diuris tricolor*) listed as Vulnerable under the TSC Act and *Prasophyllum petilum* listed as Endangered under the TSC Act and EPBC Act. Pine donkey orchid was recorded within the Project Disturbance Area.

4.1.3 Vegetation Communities in the Wider Study Area

Surveys of the wider study area identified eight native vegetation communities (refer to **Figure 4.1**). These vegetation communities were aligned with vegetation map units as described in the Hunter Remnant Vegetation Project (Peake 2006), where possible and were aligned with vegetation community classifications from the recently released Greater Hunter Native Vegetation Mapping (Sivertsen et al. 2011).

The following information is provided for each of the vegetation zones:

- equivalent Biometric Vegetation Type (BVT)
- broad condition class
- total area
- equivalent Greater Hunter Vegetation Map unit (Sivertsen et al. 2011)
- equivalent Hunter Remnant Vegetation Project unit (Peake 2006)
- the location of each community in the wider study area
- a floristic and structural description
- the conservation status of the community under both NSW and Commonwealth legislation.

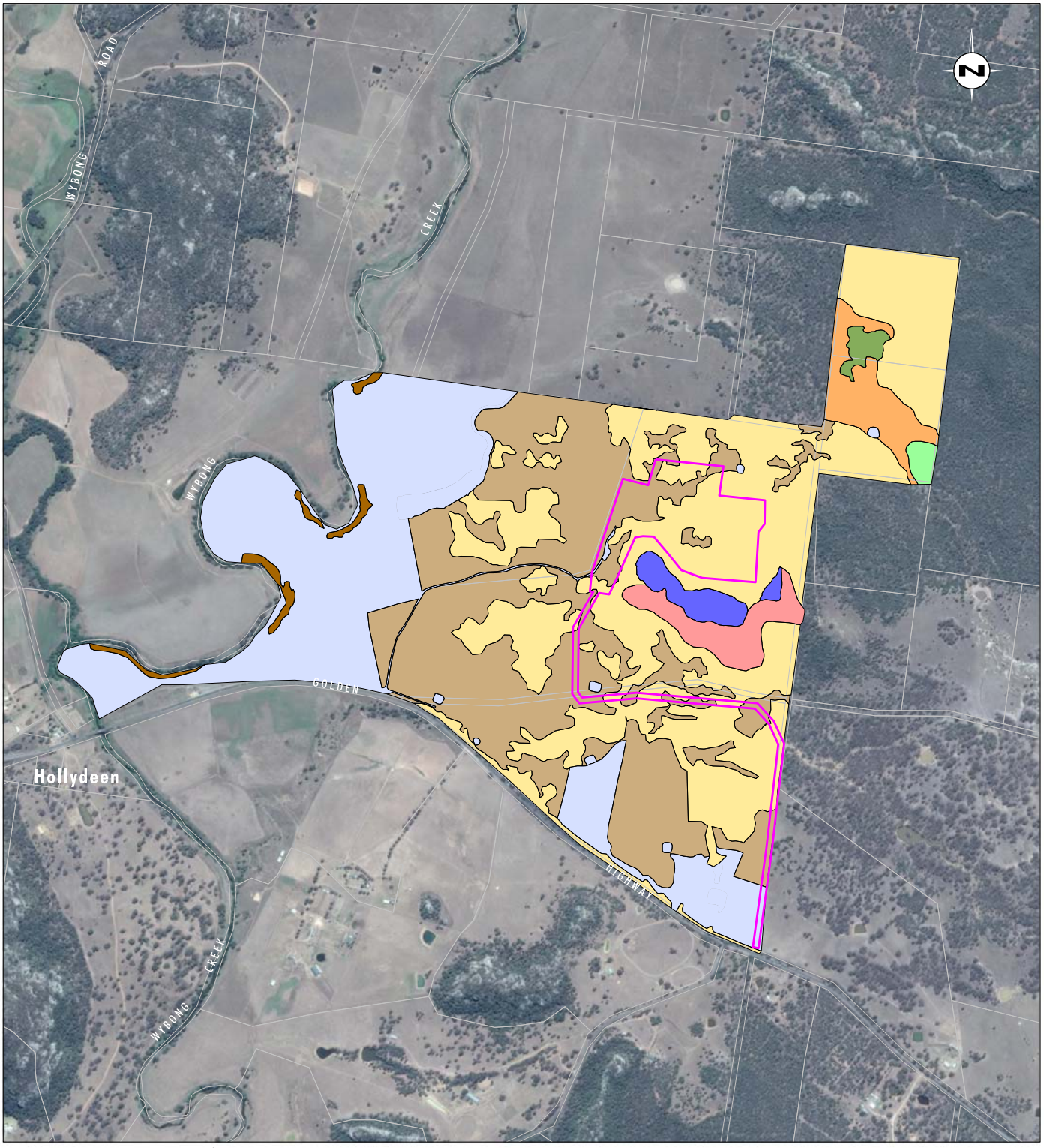


Image Source: Google Earth (2014)
Data Source: KHM (2014), Department of Lands (2009)

0 0.25 0.5 1.0km
1:20 000

Legend

- Project Disturbance Area
- 1- HU702 - 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 Bioregion - Moderate to Good Condition
- 2 - HU712 - River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley (Brigalow Belt South Bioregion And Sydney Basin Bioregion) - Moderate To Good Condition
- 3 - HU730 - White Box x Grey Box; Red Gum; Rough-Barked Apple Grassy Woodland on Rich Soils on Hills in the Upper Hunter Valley - Low Condition Derived Native Grassland
- 4 - HU730 - White Box x Grey Box; Red Gum; Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley - Moderate to Good Condition
- 5 - HU826 - Narrow-Leaved Ironbark - Grey Gum - Native Olive Woodland of Central Hunter - Moderate to Good Condition
- 6 - HU826 - Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin - Moderate to Good Condition
- 7 - HU905 - Narrow-Leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter - Low Condition Derived Native Grassland
- 8 - HU905 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter- Moderate to Good Condition
- N/A - Cleared Land (Including Disturbed Land, Exotic Rushland, Mixed Species Revegetation Plantation, Non-Native Vegetation and Water Bodies)

FIGURE 4.1

Vegetation Community Mapping

4.1.4 Zone 1 - HU702 – 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 Bioregion– Moderate to Good Condition

BVT Name	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 Bioregion
Condition	Moderate to Good
BVT Number	HU702
PCT Number	479
Area in Wider Study Area (ha)	4.5
Area in Project Disturbance Area (ha)	0
GHNVM Map Unit[1]	MU138 Narrow-leaved Ironbark – Black Pine – Narrow-leaved Wattle Shrub – Grass Open Forest on Sandstone Slopes of the Upper Hunter and Sydney Basin.
HRVP Map Unit[2]	MU15 – Western Hunter Narrabeen Exposed Grey Gum – Stringybark Woodland
General Description	This vegetation zone was confined to the exposed ridge tops in the centre of the wider study area (refer to **Figure 4.1**). Occurring throughout the proposed quarry location, this vegetation zone was restricted to between 190 – 225 metres ASL.
Canopy Description	This community supported a very-sparse to sparse canopy dominated by narrow-leaved ironbark (*Eucalyptus crebra*), grey gum (*Eucalyptus punctata*) and Dwyer's red gum (*Eucalyptus dwyeri*). Height of the canopy ranged from 13 to 15 metres.
Mid-storey Description	A sparse mid-storey of currawang (*Acacia doratoxylon*), drooping sheaok (*Allocasuarina verticillata*), native blackthorn (*Bursaria spinosa*), native olive (*Notelaea microcarpa* var. *microcarpa*) narrow-leaved geebung (*Persoonia linearis*) and red ash (*Alphitonia excelsa*) ranging from 3 – 8 metres in height.
Shrub Layer Description	The shrub layer was generally sparse. Shrubs included native blackthorn (*Bursaria spinosa*), *Prostanthera prunelloides*, dolly bush (*Cassinia aculeata*) and *Kunzea* sp. 'Mt Kaputar'. The shrub layer ranged from 1 to 2 metres in height.
Ground Cover Description	This vegetation zone was characterised by a sparse ground layer less than 1 metre in height. Native grasses were common included weeping grass (*Microlaena stipoides* var. *stipoides*), *Paspalidium distans*, rough spear-grass (*Austrostipa scabra* subsp. *falcata*) and slender rat's tail grass (*Sporobolos creber*). Herbs and sub-shrubs were less common, but included corrugated sida (*Sida corrugata*), rock fern (*Cheilanthes sieberi* subsp. *sieberi*), slender violet-bush (*Hybanthus monopetalus*), tall bluebell (*Wahlenbergia stricta*) and poverty raspwort (*Gonocarpus tetragynus*).
Introduced Species	Introduced species' were uncommon throughout this vegetation community but tiger pear (*Opuntia aurantiaca*) and catsear (*Hypochaeris radicata*) were recorded in low abundance.
TSC Act Status	This vegetation zone is not consistent with any TEC listed under the TSC Act.

4.1.5 Zone 2 - HU712 – River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley – Moderate to Good Condition

BVT Name	River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley
Condition	Moderate to Good
BVT Number	HU712
PCT Number	485
Area in Wider Study Area (ha)	2.8
Area in Project Disturbance Area (ha)	0
GHNVM Map Unit1	MU215 River Red Gum – River Oak Grassy Riparian Woodland of the Hunter Valley.
HRVP Map Unit2	MU30 – Hunter Valley River Oak Forest
General Description	Occurs on the banks of Wybong Creek along the western boundary of the wider study area (refer to **Figure 4.1**). The understorey contained a high weed content.
Canopy Description	This vegetation zone supported a mid-dense canopy dominated by river oak (*Casuarina cunninghamiana*).
Mid-storey Description	Not present.
Shrub Layer Description	No native shrub layer present, however a number of introduced shrubs were present, as detailed below.
Ground Cover Description	No native ground cover was present, however a number of introduced herbs were present, as detailed below.
Introduced Species	The understorey was characterised by a high proportion of exotic species, including African boxthorn (*Lycium ferocissimum*), fireweed (*Senecio madagascariensis*) and spear thistle (*Cirsium vulgare*).
TSC Act Status	Not consistent with any listed TEC under the TSC Act.

1 = Greater Hunter Native Vegetation Map (Sivertsen et al. 2011), 2 = Hunter Remnant Vegetation Project (Peake 2006), BVT = Biometric Vegetation Type, TSC Act = *Threatened Species Conservation Act 1995*

4.1.6 Zone 3 – HU730 – White Box x Grey Box; Red Gum; Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley – Low Condition Derived Native Grassland

BVT Name	White Box x Grey Box; Red Gum; Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley
Condition	Low Condition Derived Native Grassland
BVT Number	HU730
PCT Number	618
Area in Wider Study Area (ha)	1.7
Area in Project Disturbance Area (ha)	0
GHNVM Map Unit1	MU080 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter
HRVP Map Unit2	Derived from MU24 – Hunter Lowlands Red Gum Forest
General Description	This vegetation zone occurred in the north of the wider study area, just slightly upslope of a nearby ephemeral stream (refer to **Figure 4.1**). It was characterised by scattered young Blakely's <-> forest red gum (*Eucalyptus blakelyi <-> tereticornis*) intergrade trees above a relatively diverse native understorey.
Canopy Description	This vegetation zone comprised a very sparse emergent canopy, between 5 and 12 metres in height and dominated by Blakely's <-> forest red gum (*Eucalyptus blakelyi <-> tereticornis*) intergrades. Samples are currently being identified by RBGS.
Mid-storey Description	Not present.
Shrub Layer Description	Not present.
Ground Cover Description	This vegetation zone was characterised by a diverse, dense ground layer less than 1 metre in height. Common herbs included bristly rock fern (*Cheilanthes distans*), common everlasting (*Chrysocephalum apiculatum*), tall bluebell (*Wahlenbergia stricta*), Oxalis perennans, early nancy (*Wurmbea dioica*), variable glycine (*Glycine tabacina*), pine donkey orchid (*Diuris tricolor*), common onion orchid (*Microtis unifolia*) and black-tip greenhood (*Pterostylis bicolor*). Only a handful of native grass species were present within this community but occurred in high abundance. Species included barbed wire-grass (*Cymbopogon refractus*), purple wiregrass (*Aristida ramosa*) and *Austrostipa* sp.
Threatened Species	A moderate population of pine donkey orchid (*Diuris tricolor*) was recorded in this vegetation zone, which is listed as a vulnerable plant species under the TSC Act as well as an endangered population in the Muswellbrook local government area under the TSC Act.
Introduced Species	Introduced species were relatively common throughout this vegetation zone, including fireweed (*Senecio madagascariensis*), catsear (*Hypochaeris radicata*), scarlet pimpernel (*Anagallis arvensis*), tiger pear (*Opuntia aurantiaca*), proliferous pink (*Petrorhagia nanteuilii*) and white champion (*Silene latifolia*)>
TSC Act Status	The derived native grassland form of this BVT is not consistent with the White Box Yellow Box Blakely's Red Gum Woodland EEC listed under the TSC Act. For further information, refer to Section 4.2.3.3.

1 = Greater Hunter Native Vegetation Map (Sivertsen et al. 2011), 2 = Hunter Remnant Vegetation Project (Peake 2006), BVT = Biometric Vegetation Type, TSC Act = *Threatened Species Conservation Act 1995*

4.1.7 Zone 4 – HU730 – White Box x Grey Box; Red Gum; Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition

BVT Name	White Box x Grey Box; Red Gum; Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley
Condition	Moderate to Good Condition
BVT Number	HU730
PCT Number	618
Area in Wider Study Area (ha)	8.8
Area in Project Disturbance Area (ha)	0
GHNVM Map Unit1	MU080 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter
HRVP Map Unit2	MU24 – Hunter Lowlands Red Gum Forest
General Description	This vegetation zone occurred along an ephemeral stream in the north west section of the wider study area (refer to **Figure 4.1**). It was characterised by a multi species canopy above a grassy understorey.
Canopy Description	The sparse canopy was tall, between 15 and 20 metres in height, and dominated by Blakely's <-> forest red gum (*Eucalyptus blakelyi <-> tereticornis*) intergrades and grey box (*Eucalyptus moluccana*). Samples were confirmed by RBGS. Large, mature forest Blakely's <-> forest red gum (*Eucalyptus blakelyi <-> tereticornis*) intergrades and grey box (*Eucalyptus moluccana*) trees were relatively common as emergents above the canopy.
Mid-storey Description	The vegetation zone occasionally supported a sparse mid-storey between 3 and 8 metres in height, comprising younger Blakely's <-> forest red gum (*Eucalyptus blakelyi <-> tereticornis*) intergrades and grey box (*Eucalyptus moluccana*) as well as bulloak (*Allocasuarina luehmannii*).
Shrub Layer Description	A sparse shrub layer was common within the understory of this vegetation zone between 1 and 3 metres. Dominant species included Kunzea sp. 'Mt Kaputar', native olive (*Notelaea microcarpa var. microcarpa*), bulloak (*Allocasuarina luehmannii*) and narrow-leaved geebung (*Persoonia linearis*).
Ground Cover Description	This vegetation zone was characterised by a sparse to mid-dense ground layer less than 1 metre in height. Common herbs and sub-shrubs included bristly rock fern (*Cheilanthes distans*), sprawling bluebell (*Wahlenbergia gracilis*), tall bluebell (*Wahlenbergia stricta*), common everlasting (*Chrysocephalum apiculatum*), corrugated sida (*Sida corrugata*), pine donkey orchid (*Diuris tricolor*), blunt beard-heath (*Leucopogon muticus*), variable Glycine (*Glycine tabacina*), Oxalis perennans and Hypoxis sp. Native grasses included barbed wire-grass (*Cymbopogon refractus*), threeawn speargrass (*Aristida vagans*), Aristida personata, rough speargrass (*Austrostipa scabra* subsp. *falcata)*, *Bothriochloa* sp. and *Rytidosperma* sp.
Threatened Species	A moderate population of pine donkey orchid (Diuris tricolor) was recorded in this vegetation zone, which is listed as a vulnerable plant species under the TSC Act as well as an endangered population in the Muswellbrook local government area under the TSC Act.

Introduced Species	Common prickly pear (*Opuntia stricta var. stricta*), scarlet pimpernel (*Anagallis arvensis*), tiger pear (*Opuntia aurantiaca*), fireweed (*Senecio madagascariensis*), catsear (*Hypochaeris radicata*), proliferous pink (*Petrorhagia nanteuilii*) were frequently recorded in this vegetation zone.
TSC Act Status	This vegetation zone is consistent with the White Box Yellow Box Blakely's Red Gum Woodland EEC listed under the TSC Act. For further information, refer to **Section 4.2.3.3**.

1 = Greater Hunter Native Vegetation Map (Sivertsen et al. 2011), 2 = Hunter Remnant Vegetation Project (Peake 2006), BVT = Biometric Vegetation Type, TSC Act = *Threatened Species Conservation Act 1995*

4.1.8 Zone 5 - HU826 – Narrow-leaved Ironbark - Grey Gum - Native Olive Woodland of Central Hunter – Moderate to Good Condition

BVT Name	Narrow-leaved Ironbark - Grey Gum - Native Olive Woodland of Central Hunter
Condition	Moderate to Good
BVT Number	HU826
PCT Number	1612
Area in Wider Study Area (ha)	7.3
Area in Project Disturbance Area (ha)	0
GHNVM Map Unit1	MU094 *Eucalyptus crebra/Eucalyptus punctata/Notelaea microcarpa* Woodland of Central Hunter.
HRVP Map Unit2	MU15 – Western Hunter Narrabeen Exposed Grey Gum – Stringybark Woodland
General Description	A dominant vegetation zone along the steep protected south facing slopes of the ridgeline that runs approximately west – east through the wider study area (refer to **Figure 4.1**).
Canopy Description	The sparse to mid-dense canopy was tall, between 15 and 20 metres in height, with dominant species including narrow-leaved ironbark (*Eucalyptus crebra*) and grey gum (*Eucalyptus punctata*).
Mid-storey Description	This vegetation zone supported a sparse mid-storey comprising black cypress pine (*Callitris endlicheri*), drooping sheoak (*Allocasuarina verticillata*), currawang (*Acacia doratoxylon*), native olive (*Notelaea microcarpa var. microcarpa*), large mock-olive (*Notelaea longifolia*), native blackthorn (*Bursaria spinosa* subsp*. spinosa*) and red ash (*Alphitonia excelsa*). The mid-storey ranged from 3 to 10 metres in height.
Shrub Layer Description	The sparse shrub layer was relatively diverse, with common species including native blackthorn (*Bursaria spinosa* subsp. *spinosa*), narrow-leaved geebung (*Persoonia linearis*), dolly bush (*Cassinia aculeata*), sticky daisy-bush (*Olearia elliptica*), bead bush (*Spartothamnella juncea*), hop goodenia (*Goodenia ovata*), shiny-leaved Canthium (*Psydrax odorata*), *Kunzea* sp. 'Mt Kaputar' and *Prostanthera prunelloides*. The shrub layer was generally 1 to 3 metres in height.
Ground Cover Description	This vegetation zone was characterised by a sparse to mid-dense ground layer less than 1 metre in height. Common herbs included tufted bluebell (*Wahlenbergia communis*), bluebell (*Wahlenbergia luteola*), violet nightshade (*Solanum brownii*), berry saltbush (*Einadia hastata*), corrugated sida (*Sida corrugata*), *Dampiera lanceolata* var. *lanceolata,* poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), variable sword-sedge (*Lepidosperma laterale*), *Oxalis perennans*, common everlasting (*Chrysocephalum apiculatum*) and rock lily (*Dendrobium speciosum*). Native grasses were common but lacked diversity included just weeping grass (*Microlaena stipoides* var. *stipoides)* and rough speargrass (*Austrostipa scabra* subsp. *falcata*).
Introduced Species	The introduced catsear (*Hypochaeris radicata*) and common prickly pear (*Opuntia stricta* var. *stricta*) were relatively common in the understorey of this vegetation zone.
TSC Act Status	This vegetation community is not consistent with any listed TEC under the TSC Act.

1 = Greater Hunter Native Vegetation Map (Sivertsen et al. 2011), 2 = Hunter Remnant Vegetation Project (Peake 2006), BVT = Biometric Vegetation Type, TSC Act = *Threatened Species Conservation Act 1995*

4.1.9 Zone 6 - HU869 – Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin – Moderate to Good Condition

BVT Name	Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin
Condition	Moderate to Good
BVT Number	HU869
PCT Number	1655
Area in Wider Study Area (ha)	1.3
Area in Project Disturbance Area (ha)	0
GHNVM Map Unit1	MU137 Grey Box/ Slaty Box Shrub/ Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin
HRVP Map Unit2	MU7 – Narrabeen Footslopes Slaty Box Woodland.
General Description	Restricted to a small patch of vegetation along the eastern boundary of the wider study area (refer to **Figure 4.1**).
Canopy Description	This isolated vegetation zone supported a mid-dense canopy dominated by slaty box (*Eucalyptus dawsonii*). The canopy was approximately 20 metres tall.
Mid-storey Description	A sparse mid-storey was typical of this vegetation zone, comprising regenerating canopy trees, bulloak (*Allocasuarina luehmannii*) and native olive (*Notelaea microcarpa* var. *microcarpa*). The mid-storey ranged from 3 to 9 metres in height.
Shrub Layer Description	A shrub layer was commonly absent from this vegetation zone. When present it was very sparse and included bulloak (*Allocasuarina luehmannii*), *Kunzea* sp. 'Mt Kaputar', *Acacia falcata* and native olive (*Notelaea microcarpa* var. *microcarpa*). The shrub layer was approximately 1 metre in height.
Ground Cover Description	This vegetation zone was characterised by a sparse to mid-dense ground layer generally less than 1 metre in height. The ground cover was also species poor which is typical of this vegetation community within the Hunter Valley. Common herbs and sub-shrubs included purple wiregrass (*Aristida ramosa*), bluebell (*Wahlenbergia luteola*), common everlasting (*Chrysocephalum apiculatum*), corrugated sida (*Sida corrugata*), slender wire lily (*Laxmannia gracilis*), variable glycine (*Glycine tabacina*) and many-flowered mat-rush (*Lomandra multiflora* subsp. *multiflora*). Native grasses included rough speargrass (*Austrostipa scabra* subsp. *falcata*), barbed wire grass (*Cymbopogon refractus*), sickle lovegrass (*Eragrostis falcata*) and *Bothriochloa* sp.
Introduced Species	The introduced species tiger pear (*Opuntia aurantiaca*) and scarlet pimpernel (*Anagallis arvensis*) were recorded in low abundance in this vegetation zone.
TSC Act Status	This vegetation community is consistent with the VEC Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion listed under the TSC Act. For further information refer to **Section4.2.3.2**.

1 = Greater Hunter Native Vegetation Map (Sivertsen et al. 2011), 2 = Hunter Remnant Vegetation Project (Peake 2006), BVT = Biometric Vegetation Type, TSC Act = *Threatened Species Conservation Act 1995*

4.1.10 Zone 7 - HU905 – Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter – Low Condition Derived Native Grassland

BVT Name	Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter
Condition	Low
BVT Number	HU905
PCT Number	1691
Area in Wider Study Area (ha)	90.9
Area in Project Disturbance Area (ha)	14.8
GHNVM Map Unit1	Derived form of MU173 Eucalyptus crebra – *Eucalyptus moluccana* Grassy Woodland of the Central and Upper Hunter.
HRVP Map Unit2	Derived form of MU10 – Central Hunter Box – Ironbark Woodland.
General Description	This vegetation zone was the dominant grassland vegetation throughout the wider study area (refer **to Figure 4.1**). The mapping of this community was based on the location of remnant eucalypt trees, as well as taking into consideration landscape position.
Tree Canopy Description	Being a derived native grassland there was no true canopy recorded within this vegetation zone, however emergent narrow-leaved ironbark (*Eucalyptus crebra*), grey box (*Eucalyptus moluccana*), rough-barked apple (*Angophora floribunda*) and bulloak (*Allocasuarina luehmannii*) were either present or at least surrounded this community. Emergent trees were approximately 6 metres in height.
Mid-storey Description	Not present.
Shrub Layer Description	Not present.
Ground Cover Description	This community was characterised by a mid-dense to dense ground layer to 1 metre in height. Common herbs and sub-shrubs included bristly cloak fern (*Chielanthes distans*), common everlasting (*Chrysocephalum apiculatum*), early nancy (*Wurmbea dioica*), common onion orchid (*Microtis unifolia*), sundew (*Drosera peltata*), bulbine lily (*Bulbine bulbosa*), slender stackhousia (*Stackhousia viminea*), pine donkey orchid (*Diuris tricolor*), *Prasophylum petilum* and *Euchiton* sp. Native grasses included slender rats tail grass (*Sporobolus creber*), rough speargrass (*Austrostipa scabra* subsp. *falcata*), purple wiregrass (*Aristida ramosa*), *Bothriochloa* sp., *Austrostipa* sp.
Threatened Species	A moderate population of pine donkey orchid (*Diuris tricolor*) was recorded in this vegetation zone, which is listed as a vulnerable plant species under the TSC Act as well as an endangered population in the Muswellbrook local government area under the TSC Act. The majority of this species population were recorded in central to northern extent of the wider study area within this community. A single *Prasophylum petilum* plant was recorded in the centre of the wider study area. This species is listed as endangered under the TSC Act.

Introduced Species	The introduced species catsear (*Hypochaeris radicata*), proliferous pink (*Petrorhagia nanteuilii*), white champion (*Silene latifolia*), pelisser's toadflax (*Linaria pelisseriana*), shivery grass (*Briza minor*), capeweed (*Arctotheca calendula*), soursob (*Oxalis pes-caprae*), silvery hairgrass (*Aira cupaniana*), Patterson's curse (*Echium plantagineum*), subterranean clover (*Trifolium subterraneum*), lamb's tongues (*Plantago lanceolata*), perennial ryegrass (*Lolium perenne*), *Medicago* sp., fireweed (*Senecio madagascariensis*), scarlet pimpernel (*Anagallis arvensis*) were recorded in moderate abundance in this vegetation zone.
TSC Act Status	The derived native grassland form of this BVT is not consistent with the EEC *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions* listed under the TSC Act. For further information refer to **Section 4.2.3.1**.

1 = Greater Hunter Native Vegetation Map (Sivertsen et al. 2011), 2 = Hunter Remnant Vegetation Project (Peake 2006), BVT = Biometric Vegetation Type, TSC Act = *Threatened Species Conservation Act 1995*

4.1.11 Zone 8 - HU905 – Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter – Moderate to Good Condition

BVT Name	Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter
Condition	Moderate to Good
BVT Number	HU905
PCT Number	1691
Area in Wider Study Area (ha)	107
Area in Project Disturbance Area (ha)	7.4
GHNVM Map Unit1	MU173 *Eucalyptus crebra – Eucalyptus moluccana* Grassy Woodland of the Central and Upper Hunter.
HRVP Map Unit2	MU10 – Central Hunter Box – Ironbark Woodland.
General Description	This vegetation zone was the dominant remnant woodland in the wider study area occurring on the lower to mid slopes (refer to **Figure 4.1**). This vegetation zone was separated from other areas of this BVT (zone 7) based on its more natural woodland structure and generally intact tree canopy.
Canopy Description	This vegetation zone supported a sparse to mid-dense canopy between 5 to 17 metres in height. Narrow-leaved ironbark (*Eucalyptus crebra*) was typically the sole canopy species, while grey gum (*Eucalyptus punctata*), rough-barked apple (*Angophora floribunda*) and grey box (*Eucalyptus moluccana*) also occur scattered throughout, particularly in ecotones with bordering vegetation zones. Large, mature narrow-leaved ironbark trees were also common in this vegetation zones as emergent trees approximately 20 metres tall.
Mid-storey Description	When present, the mid-storey was sparse and dominated by bulloak (*Allocasuarina luehmannii*), Melaleuca decora, drooping sheoak (*Allocasuarina verticillata*), native olive (*Notelaea microcarpa* var. *microcarpa*), black cypress pine (*Callitris endlicheri*), red ash (*Alphitonia excelsa*) and currawang (*Acacia doratoxylon*). The mid-storey layer ranged from 2 to 10 metres in height.
Shrub Layer Description	The shrub layer varied from very-sparse to sparse, comprising saplings of several aforementioned canopy species plus *Kunzea* sp. 'Mt Kaputar', wedge-leaf hop-bush (*Dodonaea viscosa* subsp. *cuneata*), *Melaleuca decora*, bead bush (*Spartothamnella juncea*), shiny-leaved Canthium (*Psydrax odorata*), pink five-corners (*Styphelia triflora*), bulloak (*Allocasuarina luehmannii*) and native blackthorn (*Bursaria spinosa* subsp. *spinosa*). The shrub layer was between 1 and 3 metres in height.
Ground Cover Description	This community was characterised by a sparse to mid-dense ground layer dominated by a diverse number of native flora species, less than 1 metre in height. Common herbs and sub-shrubs included slender stackhousia (*Stackhousia viminea*), rock fern (*Cheilanthes sieberi* subsp. *sieberi*), wattle matt-rush (*Lomandra filiformis* subsp. *coriacea*), Brachycome *multifida* var. *multifida*), bristly cloak fern (*Cheilanthes distans*), yellow burr-daisy (*Calotis lappulacea*), Australian stonecrop (*Crassula sieberiana*), corrugated sida (*Sida corrugata*), tall bluebell (*Wahlenbergia stricta*), common everlasting (*Chrysocephalum apiculatum*), violet nightshade (*Solanum brownii*), narrawa burr (*Solanum cinereum*), bluebell (*Wahlenbergia luteola*), *Oxalis perennans*, variable glycine (*Glycine tabacina*) and pine donkey orchid (*Diuris tricolor*).

	Native grasses included barbed wire grass (*Cymbopogon refractus*), purple wiregrass (*Aristida ramosa*), threeawn speargrass (*Aristida vagans*), sickle lovegrass (*Eragrostis falcata*), slender rats tail grass (*Sporobolus creber*) and rough speargrass (*Austrostipa scabra* subsp. *falcata*).
Threatened Species	A population of pine donkey orchid (*Diuris tricolor*) was recorded in this vegetation zone, which is listed as a vulnerable plant species under the TSC Act as well as an endangered population in the Muswellbrook local government area under the TSC Act. The majority of this species population was recorded in the north eastern section of the wider study area.
Introduced Species	The introduced species scarlet pimpernel (*Anagallis arvensis*), common prickly pear (*Opuntia stricta* var. *stricta*), tiger pear (*Opuntia aurantiaca*), creeping pear (*Opuntia humifusa*), fireweed (*Senecio madagascariensis*) and narrow-leaved cotton bush (*Gomphocarpus fruticosus*) were recorded in low abundance in this vegetation zone.
TSC Act Status	This vegetation zone is consistent with the EEC *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions* listed under the TSC Act. For further information refer to **Section 3.2.2.1**.

1 = Greater Hunter Native Vegetation Map (Sivertsen et al. 2011), 2 = Hunter Remnant Vegetation Project (Peake 2006), BVT = Biometric Vegetation Type, TSC Act = *Threatened Species Conservation Act 1995*

4.1.12 Zone 9 - Cleared Land

All other areas not mapped as part of a vegetation zone satisfied the definition of 'cleared land' under the BioBanking Assessment Methodology. Cleared land is land on which the native overstorey has been completely removed and there is no native mid-storey, and less than 50 per cent of the ground cover vegetation is indigenous species, or less than 10 per cent of the ground cover is present (whether dead or alive). Areas mapped as cleared land comprised disturbed land, non-native vegetation, water bodies, dwellings and roads. Cleared land comprised 4 hectares of the wider study area.

4.2 Threatened Flora Species, Endangered Flora Populations and Threatened Ecological Communities

A detailed table of all recorded and potentially occurring threatened flora species, EP and TECs is provided in **Appendix A.** The extent of each of the occurring threatened flora species, EP and TECs described in **Sections 4.1.2** and **4.1.3** is shown on **Figures 4.1** and **4.2.**

Those threatened flora species, EPs and TECs that have been recorded or have been assessed (**Appendix A**) as having the potential to occur in the Project Disturbance Area are listed in **Table 4.4**.

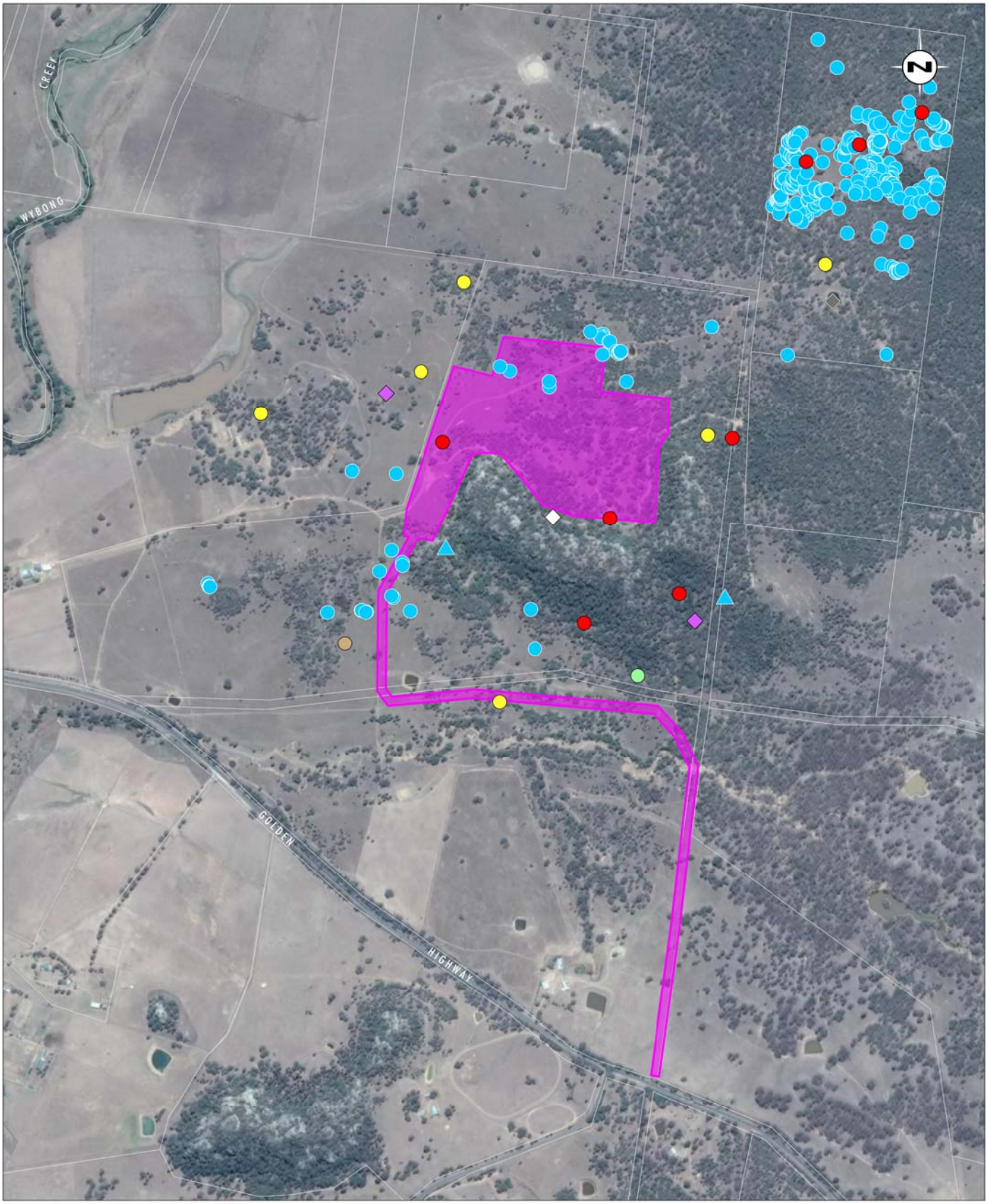


Image Source: Google Earth (2014)
Data Source: KMH (2014), Department of Lands (2009)

0 200 400 600m
1:12 500

Legend

- Project Disturbance Area
- Brown treecreeper (eastern subspecies)
- Eastern bentwing-bat
- Glossy black-cockatoo
- Grey-crowned babbler (eastern subspecies)
- Large-eared pied bat
- Little bentwing-bat
- Speckled warbler
- Yellow-bellied sheathtail-bat
- *Diuris tricolor*
- *Prasophyllum petilum*

FIGURE 4.2

Threatened Flora and Fauna Species, Endangered Populations and Migratory Species Records

File Name (A4): R01/3453_016.dgn
20150910 11.11

Table 4.2 Threatened Flora Species, Endangered Populations and Threatened Ecological Communities Recorded in the Wider Study Area and Project Disturbance Area

Species/Population/Community Name	Identified on OEH Atlas of NSW Wildlife within 10 Kilometres of Project Area	Recorded in Wider Study Area?	Recorded in Project Disturbance Area?	Status	
Common name Scientific name				TSC Act 1995	EPBC Act 1999
pine donkey orchid *Diuris tricolor*	✓	✓	✓	V	-
Tarengo leek orchid *Prasophyllum petilum*	✓	✓	×	E	E
Pine donkey orchid population in the Muswellbrook local government area	✓	✓	✓	EP	-
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions		✓	✓	EEC	CEEC
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion		✓	×	VEC	CEEC
White Box – Yellow Box – Blakely's Red Gum Woodland		✓	×	EEC	CEEC

Notes: CEEC = critically endangered ecological community
EEC = endangered ecological community
EP = endangered population
E = endangered
V = vulnerable

A description of the threatened flora species, EP and TECs listed under the TSC Act and/or EPBC Act that were recorded in the wider study area are provided below including their location within the wider study area, particularly in relation to the Project Disturbance Area.

4.2.1 Threatened Flora Species

Pine donkey orchid – Diuris tricolor

Pine donkey orchid (formerly known as Diuris sheaffiana) is listed as vulnerable under the TSC Act (OEH, 2014). The species is an annual terrestrial species that occurs in grassy eucalypt woodlands and associated derived native grasslands (OEH, 2014).

The pine donkey orchid was relatively common throughout the wider study area with 460 plants (stem counts) recorded during the field survey. The species occurred in four vegetation communities, specifically:

- Zone 3 – HU730 – White Box x Grey Box; Red Gum; Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley – Low Condition Derived Native Grassland
- Zone 4 – HU730 – White Box x Grey Box; Red Gum; Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition
- Zone 7 - HU905 – Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter – Low Condition Derived Native Grassland
- Zone 8 - HU905 – Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter – Moderate to Good Condition.

The locations of the 460 pine donkey orchids recorded within the wider study area are shown in **Figure 4.2**. Of these, a total of seven plants are located within the Project Disturbance Area.

Prasophyllum petilum

Prasophyllum petilum (Tarengo leek orchid) is listed as endangered under the TSC Act and EPBC Act. The species is a terrestrial perennial orchid endemic to NSW. *Prasophyllum* sp. Wybong (a previously undescribed species) has recently been grouped with *Prasophyllum petilum* by the taxonomists at the Royal Botanic Gardens Sydney. *Prasophyllum* sp. Wybong was not listed under the TSC Act but was listed as Critically Endangered under the EPBC Act. Now that it has been grouped with *Prasophyllum petilum*, it is listed as endangered under the TSC and EPBC Acts.

Prasophyllum petilum was previously only known at four sites in New South Wales: Captains Flat Cemetery, Ilford Cemetery, Steves Travelling Stock Route (TSR) at Delegate and the Tarengo TSR near Boorowa. Now that sp. Wybong has been grouped, it is known to occur at several locations around the Wybong area, near Muswellbrook in the Hunter Valley. It occurs in open grassy eucalypt woodlands and grassland.

This species is known to occur within the local area, furthermore is relatively common within the Wybong locality, approximately 6 kilometres north of the Project Area. The field survey only recorded a single **Prasophyllum petilum** plant within the central southern portion of the wider study area (refer to **Figure4.2**). This species does not occur in the Project Disturbance Area.

4.2.2 Endangered Flora Populations

One endangered flora population listed under the TSC Act was recorded in the wider study area, being the Pine Donkey Orchid population in the Muswellbrook local government area.

The population in the Muswellbrook local government area, comprises a number of occurrences that range from a few scattered individuals to a few thousand plants.

The population within the wider study area comprises 460 individuals, with a small portion of the population, seven individuals, occurring within the Project Disturbance Area.

4.2.3 Threatened Ecological Communities

Three TECs listed under the TSC Act were identified within the wider study area.

Justification summaries and equivalency analyses against Final Determinations, Listing Advice documents and identification guidelines are provided below for each of the TECs (listed under the TSC Act) mentioned above in **Table 4.4**.

As discussed in **Section 1.5**, the project was referred to the Commonwealth Department of the Environment and was deemed 'not a controlled action' under the provisions of the EPBC Act. Further assessment of communities listed under the EPBC Act is therefore not required.

4.2.3.1 Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC

HU905 – Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter – Moderate to Good (Zone 9) mapped in the wider study area and Project Disturbance Area is consistent with the EEC *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions* (TSC Act) (NSW Scientific Committee 2011b). This vegetation zone complies with the Final Determination of the EEC with regard to the following attributes:

- it occurs on Permian sediments within the NSW Sydney Basin Bioregion
- it occurs in the Muswellbrook Local Government Area (LGA) where the EEC has previously been recorded
- it supports a canopy dominated by the characteristic species narrow-leaved ironbark (*Eucalyptus crebra*) and/or grey box (*Eucalyptus moluccana*)
- it supports a reasonable proportion of species that are in the list of characteristic species for the EEC:
    - 16 out of 53 (30 per cent) native species recorded in this unit are characteristic species in the EEC listing
    - 16 out of 38 (42 per cent) species in the characteristic species list for the EEC were recorded in this unit.

It should also be noted that the derived native grassland form of this is community, mapped as HU905 – Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter – Low Condition – Derived Native Grassland (Zone 7), is not covered by the EEC *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions*.

4.2.3.2 Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC

HU869 – Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin – Moderate to Good Condition (Zone 6) mapped in the wider study area is consistent with the vulnerable ecological community (VEC) *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion* (TSC Act).

This vegetation zone complies with the Listing Advice of the VEC (NSW Scientific Committee 2011e) with regard to the following attributes:

- occurs within the NSW Sydney Basin Bioregion
- occurs in the Muswellbrook Local Government Area (LGA) where it has previously been recorded
- occurs on Permian sediments at the lower slopes of the Project Area
- it supports a reasonable proportion of species that are in the list of characteristic species for the VEC:
    - 7 out of 18 (39 per cent) native species recorded in this unit are characteristic species in the VEC listing
    - 7 out of 29 (24 per cent) species in the characteristic species list for the VEC were recorded in this unit.

4.2.3.3 White Box Yellow Box Blakely's Red Gum Woodland EEC

HU30– Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter – Moderate to Good Condition is consistent with the EEC *White Box Yellow Box Blakely's Red Gum Woodland* (TSC Act). This community corresponds with the Final Determination of White Box Yellow Box Blakely's Red Gum Woodland EEC (NSW Scientific Committee 2011a) with regard to the following attributes:

- occurs within the NSW Sydney Basin Bioregion
- the canopy of this vegetation zone is dominated by a mixture of red gum trees including forest red gum (*Eucalyptus tereticornis*), Blakelys red gum (*Eucalyptus blakelyi*) and or a combination of hybrids of the two red gum species (*Eucalyptus blakelyi × tereticornis*) as confirmed by the National Herbarium of NSW. The final determination for this EEC specifically identifies that intergrades between these two red gum species may occur in the Hunter Valley. Despite forest red gum not being identified as a characteristic canopy species in the Final Determination, the formal identification by the National Herbarium of NSW of the two red gum species hybridising is a key factor in identifying Zone 7 as conforming with this EEC
- supports a predominantly native understorey
- supports a reasonable proportion of species that are in the list of characteristic species for the EEC:
    - 21 out of 77 (27 per cent) native species recorded in this unit are characteristic species in the EEC listing
    - 21 out of 95 (22 per cent) species in the characteristic species list for the EEC were recorded in this unit.

4.2.3.4 Summary of TSC Act Listed Threatened Ecological Communities within the Project Disturbance Area

Table 4.3 below details the area of each of the TSC Act listed TECs within the Project Disturbance Area.

Table 4.3 TSC Act Listed TECs Identified in the Project Disturbance Area.

TSC Act Listed TEC	Area (ha)
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	7.4
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC	0
White Box Yellow Box Blakely's Red Gum Woodland EEC	0

EEC = Endangered Ecological Community
TEC = Threatened Ecological Community
VEC = Vulnerable Ecological Community

4.3 Fauna Survey Results

The results of the fauna field surveys are detailed in the following sections.

4.3.1 Database Searches

The threatened fauna species recorded on the OEH Atlas of NSW Wildlife and Department of Environment Protected Matters Database, from searches within 10 kilometres of the Project Disturbance Area, are included in Appendix A.

4.3.2 Fauna Habitat of the Project Area

The assessment of terrestrial fauna habitat identified a range of habitat characteristics which contribute to the distribution, abundance and diversity of terrestrial fauna within the Project Disturbance Area.

Two general fauna habitat types were identified during surveys within the Project Disturbance Area. Both of these broad habitat types has a range of characteristics which influence the habitat value, and the range of fauna species that are likely to be identified within each type. The broad habitat types recorded within the Project Disturbance Area consist of woodland and forest and grasslands.

4.3.2.1 Woodland and Forest Habitat

The vegetation of the woodland areas was generally composed of an open, low woodland overstorey and a scattered short understorey habitat area. Canopies were dominated by middle aged (200 – 400 millimetres DBH) trees reaching 5 to 22 metres in height. Mature (400 – 600 millimetres DBH) trees also occurred but at lower frequencies within the canopy. Old growth trees (600+ millimetres DBH) were scarce. Saplings (<100 millimetres diameter stems) were scarce to moderately common ranging between 1 and 10 metres in height. Stags (dead standing trees) were scarce. The dominant woodland canopy species were narrow-leaved ironbark (*Eucalyptus crebra*) and grey box (*Eucalyptus moluccana*).

Tree hollows were recorded in middle-aged, mature and old growth trees. Tiny (<25 millimetres), small (26 to 50 millimetres), medium (51 to 100 millimetres) and large (101 to 300 millimetres) tree hollows were scarce and no extra large (> 300 millimetres) tree hollows were recorded. Hollows were generally a mixture of alive and dead hollows.

An open shrub layer was common and ranged between 0.5 metres and 1.5 metres in height. The shrub layer often contained a poor to moderate level of species and structural diversity. The ground cover was predominately a mix of native and exotic grass species reaching an average height of 0.1 to 0.8 metres with areas of soil, litter and herb/forbs also occurring. Log cover (fallen trees and branches) was scattered to moderate and dominated by small (< 100 millimetres diameter), medium (101 to 300 millimetres diameter) and large (> 300 millimetres diameter) logs. Log cover was predominately comprised of solid (with and without bark) and hollow logs however some rotten logs were also recorded.

Species specific habitat areas of loose tree bark were recorded. No areas of rock on rock, rock overhangs, caves, litter at the base of trees, terrestrial termite mounds, or arboreal termite mounds were recorded.

4.3.2.2 Native Grassland Habitat

Canopy and shrub layers were generally absent from this community, although isolated paddock trees and areas of regenerating eucalypts and shrubs sometimes occurred. Most woody vegetation has been previously cleared for agricultural purposes. The ground layer was dominated by native and introduced grasses and forbs. The common grass species recorded included slender rats tail grass (*Sporobolus creber*), rough speargrass (*Austrostipa scabra* subsp. *falcata*), purple wiregrass (*Aristida ramosa*) and common herbs included bristly cloak fern (*Cheilanthes distans*), common everlasting (*Chrysocephalum apiculatum*), and early nancy (*Wurmbea dioica*).

Introduced grasses and herbs were common and included catsear (*Hypochaeris radicata*), shivery grass (*Briza minor*), capeweed (*Arctotheca calendula*) and Patterson's curse (*Echium plantagineum*) among others.

The grassland heights varied across the Project Area, ranging from 0.3 metres to one metre in height. Grazing pressure is currently low within the Project Disturbance Area.

4.3.3 Fauna Species Recorded

Targeted field surveys identified a total of 113 fauna species comprising 5 frog species, 8 reptiles, 76 birds and 24 mammals. A list of all fauna species recorded within the wider study area is presented in **Appendix C** of this report.

Records of fauna species should be interpreted carefully, since a record of a species within a particular area does not suggest it only occurs within that specific part of the wider study area and not within other parts. The high levels of mobility of many fauna species (particularly many birds and mammals) mean that those species could readily occur in areas other than where they were recorded.

The discussions below include the total numbers of each of the fauna groups. Descriptions of commonly recorded or notable species relates to observations within the wider study area, unless otherwise specified.

4.3.3.1 Amphibians

Five species of frog have been recorded in the wider study area comprising two species of Myobatrachidae (southern frogs) and three tree frogs from the family Hylidae. Frog species diversity is considered to be relatively high for the central Hunter Valley area.

The most commonly recorded frogs were the common eastern froglet (*Crinia signifera*) and broad-palmed frog (*Litoria latopalmata*).

4.3.3.2 Reptiles

Eight reptile species have been recorded within the wider study area with the skink family (*Scincidae*) being the most well represented.

The most commonly encountered reptile species in the wider study area were the rock skink (*Liopholis modesta*), garden skink (*Lampropholis delicata*) and barking gecko (*Underwoodisaurus millii*).

No threatened reptile species have been recorded or are expected to occur in the wider study area.

4.3.3.3 Birds

A total of 76 bird species were recorded in the wider study area. Fifty-four families are represented with Acanthizidae (warblers) recording nine species, Psittacidae (parrots and lorikeets) and Meliphagidae (honeyeaters) with five species each and Accipitridae (eagle, hawks and kites) and Artamidae (magpies and butcherbirds) recording four species each.

Some of the more frequently observed bird species recorded in woodland communities included the noisy miner (*Manorina melanocephala*), rufous whistler (*Pachycephala rufiventris*), grey fantail (*Rhipidura fuliginosa*) eastern rosella (*Platycercus eximius*), willie wagtail (*Rhipidura leucophrys*), yellow thornbill (*Acanthiza chrysorrhoa*), noisy friarbird (*Philemon corniculatus*), black-faced cuckoo-shrike (*Coracina novaehollandiae*), Australian magpie (*Gymnorhina tibicen*), pied butcherbird (*Cracticus nigrogularis*), Australian raven (*Corvus coronoides*) and white-winged chough (*Corcorax melanorhamphos*).

The galah (*Cacatua roseicapilla*) and Australian pipit (*Anthus novaeseelandiae*) were commonly recorded in grassland habitats.

One introduced species, the common starling (*Sturnus vulgaris*), was recorded within the wider study area.

Three threatened bird species, the speckled warbler (*Chthonicola saggitatus*), grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) and glossy black-cockatoo (*Calyptorhynchus lathami*), were recorded by Umwelt within the wider study area during field surveys and each of these species are considered likely to occur in the Project Disturbance Area. One additional threatened bird species, brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*), was recorded in the wider study area in 2008 (Envirofactor 2008). The location of threatened bird species are shown on **Figure 4.2**.

4.3.3.4 Mammals

Twenty-four mammal species were recorded during surveys with the most common family (*Vespertilionidae*) recording six species.

Three arboreal mammal species have been recorded in the wider, including the common brush-tailed possum (*Trichosurus vulpecula*) and the common ringtail possum (*Pseudocheirus peregrinus*) as well as a glider species (*Petaurus* sp).

Four species of macropod are known to occur in the Project Area comprising the eastern grey kangaroo (*Macropus giganteus*), common wallaroo (*Macropus robustus*), swamp wallaby (*Wallabia bicolor*) and red-necked wallaby (*Macropus rufogriseus*). Each of these species was principally observed in the open grassland areas and were also less frequently recorded in the woodland communities.

Five threatened mammal species are known to occur within the Project Area, including the squirrel glider (*Petaurus norfolcensis*) (precautionary identification), yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), little bentwing-bat (*Miniopterus australis*) and large-eared pied bat (*Chalinolobus dwyeri*). The location of the threatened mammal species recorded in the wider study area is shown on **Figure 4.2**.

Six introduced mammal species are known to occur within the wider study area including feral dogs (*Canis familiaris*), fox (*Vulpes vulpes*) and the European rabbit (*Oryctolagus cuniculus*).

4.3.4 Threatened Fauna Records

A total of eight threatened fauna species were recorded within the wider study area by Umwelt. One additional threatened fauna species was recorded in the wider study area by Envirofactor in 2008 (Envirofactor 2008). These species are listed in **Table 4.4** below.

Table 4.4 below lists the threatened fauna species recorded within the wider study area and/or the Project Disturbance Area. The Project Disturbance Area and wider study area is not considered to provide habitat for any listed endangered fauna populations.

Table 4.4 Threatened Fauna Species Recorded in the Wider Study Area and/or Project Disturbance Area

Species Name	Status		Recorded in Wider Study Area?	Recorded in Project Disturbance Area?
glossy black cockatoo *Calyptorhynchus lathami*	V	-	✓	×
brown treecreeper *Climacteris picumnus victoriae*	V	-	✓	×
speckled warbler *Chthonicola saggitata*	V	-	✓	✓
grey-crowned babbler *Pomatostomus temporalis temporalis*	V	-	✓	✓

Species Name	Status		Recorded in Wider Study Area?	Recorded in Project Disturbance Area?
squirrel glider *Petaurus norfolcensis*	V	-	✓	×
yellow-bellied sheathtail bat *Saccolaimus flaviventris*	V	-	✓	×
large-eared pied bat *Chalinolobus dwyeri*	V	V	✓	×
little bentwing-bat *Miniopterus australis*	V	-	✓	×
eastern bentwing-bat *Miniopterus schreibersii oceanensis*	V	-	✓	x

Notes: E = endangered
V = vulnerable

A table of all threatened fauna species and EPs known to occur in the local area from the literature review and database searches is provided in **Appendix A**.

4.3.4.1 Threatened Fauna Species Recorded in the Project Disturbance Area

The following threatened species (as listed under the TSC Act and EPBC Act) were recorded within the Project Disturbance Area or wider study area either as part of the current survey, database searches or literature reviews. The location of each of the threatened species is shown on **Figure 4.2**.

A précis of ecological requirements for each species is provided, sourced from the OEH Threatened Species website http://www.environment.nsw.gov.au/threatenedspecies and site specific information. Details of the number and location of records for each species are provided also, as well as any other relevant ecological information relating to these records.

Glossy Black-cockatoo – *Calyptorhynchus lathami*

The glossy black-cockatoo is listed as vulnerable under the TSC Act. The glossy black-cockatoo has a sparse distribution along the east coast and adjacent inland areas from western Victoria to Rockhampton in Queensland. In NSW, it has been recorded as far inland as Cobar and Griffith.

The glossy black-cockatoo was recorded at two locations within the wider study area, however it was not recorded in the Project Disturbance Area. This species forages on the fruits of *Allocasuarina* sp. which occurred in moderate abundance throughout the ridges and rocky slopes in the wider study area however was recorded in low abundances in the woodland occurring in the Project Disturbance Area.

A detailed assessment of significance for the Glossy Black-cockatoo (*Calyptorhynchus lathami*) is provided in **Appendix D**.

Brown Treecreeper (eastern subspecies) – *Climacteris picumnus 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 at one location within the wider study area by Envirofactor in 2008 (Envirofactor 2008). This species was not recorded in the Project Disturbance Area. Suitable habitat exists within the Project Disturbance Area for this species.

A detailed assessment of significance for the brown treecreeper (eastern subspecies) is provided in **Appendix D**.

Speckled Warbler – *Chthonicola sagittata*

The speckled warbler is listed as vulnerable under the TSC Act. In NSW, this species occupies eucalypt and cypress woodlands, generally on the western slopes of the Great Dividing Range.

The speckled warbler was recorded at seven locations across the wider study area with a total of 15 individual seen. This species was recorded foraging within the woodland habitats within the Project Disturbance Area with a group of three individuals observed in the south-eastern section of the Project Area and two individuals were observed in on the western boundary (refer to **Figure 4.2**).

A detailed assessment of significance for the speckled warbler is provided in **Appendix D**.

Grey-crowned Babbler (eastern subspecies) – *Pomatostomus temporalis temporalis*

The grey-crowned babbler (eastern subspecies) is listed as vulnerable under the TSC Act. In NSW, the eastern subspecies occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW.

The grey-crowned babbler was recorded at five locations across the wider study area with a total of nine individuals recorded. One record of this species (five individuals) was from within the Project Disturbance Area.

A detailed assessment of significance for the grey-crowned babbler is provided in **Appendix D**.

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.

This species was not observed during the field surveys however it was identified as possibly occurring in the wider study area during the analysis of hair samples by Barbarra Triggs. The squirrel glider and the closely related sugar glider (*Petaurus breviceps*) are unable to be distinguished from one another with hair samples analysis and as such, neither can be discounted from occurring. The wider study area is considered to comprise foraging and den habitat for this species and as such, in accordance with the precautionary principle, .its presence has been assumed.

A detailed assessment of significance for the squirrel glider is provided in **Appendix D.**

Yellow-bellied Sheathtail-bat – *Saccolaimus flaviventris*

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 species was recorded via echolocation recording at one location within the wider study area, to the north-east of the Project Disturbance Area. . The Project Disturbance Area is considered to comprise potential foraging habitat for this species as part of a wider foraging range in surrounding habitats.

A detailed assessment of significance for the yellow-bellied sheathtail-bat is provided in **Appendix D**.

Little Bentwing-bat – *Miniopterus australis*

The little bentwing-bat is listed as vulnerable under the TSC Act. The species is found along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW and roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and occasionally buildings.

This species was recorded via echolocation recording at one location within the wider study area, immediately south of the Project Disturbance Area. The Project Disturbance Area is considered to comprise potential foraging habitat for this species as part of a wider foraging range in surrounding habitats however potential roosting habitat for this cave-roosting species does not occur.

A detailed assessment of significance for the little bentwing-bat is provided in **Appendix D**.

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.

This species was recorded via echolocation recording at two locations within the wider study area, immediately south and to the north-east of the Project Disturbance Area. The Project Disturbance Area is considered to comprise potential foraging habitat for this species as part of a wider foraging range in surrounding habitats however potential roosting habitat for this cave-roosting species does not occur.

A detailed assessment of significance for the eastern bentwing-bat is provided in **Appendix D**.

Large-eared Pied Bat – *Chalinolobus dwyeri*

The large-eared pied bat is listed as vulnerable under the TSC and EPBC Acts. The species is mainly found in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. The species mainly roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the fairy martin (*Petrochelidon ariel*).

This species was recorded via echolocation recording at three locations within the wider study area, immediately south, west and to the south-east of the Project Disturbance Area. The Project Disturbance Area is considered to comprise potential foraging habitat for this species as part of a wider foraging range in surrounding habitats however potential roosting habitat for this species does not occur.

A detailed assessment of significance for the large-eared pied bat is provided in **Section 5.7.**

4.3.5 SEPP 44 (Koala Habitat) Assessment Results

Potential koala habitat was recorded in the HU 826 Narrow-leaved Ironbark - Grey Gum - Native Olive Woodland of Central Hunter and HU730 White Box x Grey Box; Red Gum; Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley vegetation communities within the wider study area as defined by SEPP 44.

No potential koala habitat as defined by SEPP 44 was recorded within the Project Disturbance Area as no Schedule 2 species listed under the policy were either recorded or recorded in densities greater than 15 per cent of all overstorey species within the woodland community.

Furthermore, no koalas were identified during extensive walking or driving spotlight searches (refer to **Section 3.5**) in the wider study area and the species has not been recorded during annual fauna monitoring surveys.

4.3.6 Groundwater Dependent Ecosystems

A review of the Bureau of Meteorology Atlas of Groundwater Dependent Ecosystems (BoM Atlas) was completed in July 2015. This review identified that Wybong Creek was the only GDE within the vicinity of the Project Area.

The vegetation community mapped along portions of Wybong Creek, HU712 River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley, is expected to be dependent on shallow groundwater resources during periods of reduced surface water flow.

5.0 Impact Assessment

The Project will result in the clearing of approximately 22.8 hectares of land which includes 22.1 hectares of native vegetation and 0.7 hectares of disturbed land. The following section summarises the results of the ecological impacts of the Project.

5.1 Project Changes to Avoid and Minimise Impacts

Key factors in Project design have been designed to ameliorate the impacts on significant ecological features, such as threatened species, EPs, TECs and/or their habitats. The approach to this has been to avoid ecological impact and maximise use of existing disturbed areas as much as possible. The two major considerations are detailed below.

5.1.1 Quarry location

The quarry location, size and layout was determined with consideration of numerous factors, including the site geology, landscape, vegetation and hydrology. Importantly, the quarry footprint has been located away from the prominent rocky ridgeline which contains the largest area of intact native vegetation on the property and is considered to contain the most important native fauna habitat. A significant proportion of the quarry footprint is cleared land and the quarry was located to minimise, as far as practicable, further clearing of woodland vegetation. These measures aim to minimise the ecological impacts of the proposal.

5.1.2 Haul Road location

The haul road location has been refined to reduce the need for further clearing of woodland vegetation and paddock trees. An example of this is the central section of the haul road that runs roughly east-west across Lots 3 and 4. An additional feature of the final haul road location is the protection afforded to it by an existing contour drain, again in the section where this crosses Lot 4 in an east-west direction. This existing contour drain will significantly reduce the potential for stormwater run-on to the haul road and as a result, minimise the need for additional drainage infrastructure (and associated vegetation clearing) and reduce the erosion and sedimentation risk both during construction and operation of the haul road.

5.2 Impact of the Project on Ecological Values

5.2.1 Summary of Ecological Values

The ecological values identified in the Project Disturbance Area that were considered in determining the impact of the Project and the development of impact mitigation and biodiversity offsetting requirements include:

- 7.4 hectares of woodland habitat for threatened woodland birds and micro-bats including known habitat for grey-crowned babbler (*Pomatostomus temporalis temporalis*) and speckled warbler (*Chthonicola sagittata*)
- Seven pine donkey orchids (*Diuris tricolor*)
- 22.2 hectares of known and potential habitat for the pine donkey orchid (*Diuris tricolor*)
- 7.4 hectares of Central Hunter Grey Box– Ironbark Woodland EEC (refer to **Figure 4.1**).

5.2.2 Summary of Ecological Impacts

Based on the ecological values of the Project Disturbance Area summarised in **Section 5.2.1**, the Project is unlikely to result in a substantial impact on ecological values. Despite this, a Biodiversity Offset Strategy will be required to address the residual impacts of the Project. The Project will result in the removal of approximately 22.2 hectares of native vegetation, including (approximately) 7.4 hectares of Central Hunter Grey Box– Ironbark Woodland EEC and 14.8 hectares of Derived Native Grassland.

A range of indirect impacts have also been considered in the ecological impact assessment, including (but not limited to) erosion and sedimentation impacts on aquatic and terrestrial ecosystems, impacts relating to the deposition of dust, increased noise, changes to weed and vertebrate pest species abundance and distribution and the impact of bushfire. The indirect impacts of the Project were considered in the preparation of assessments of significance for threatened species and ecological communities considered to be potentially impacted by the Project (refer to **Appendix D**).

5.3 Impact of the Project on Flora Species

A total of 142 flora taxa were recorded during field surveys for the Project, of which 115 (81 per cent) were native and 27 (19 per cent) were introduced taxa.

The Project is not likely to result in a substantial impact on species diversity in the wider study area as the higher quality, in-tact communities associated with the eastern escarpment areas and the lower slopes in the north will not be directly impacted as a result of the Project.

Two threatened flora species were recorded within the wider study area, being pine donkey orchid (Diuris tricolor) which is listed as Vulnerable under the TSC Act and the Tarengo leek orchid (*Prasophyllum petilum*) which is listed as Endangered under the TSC Act and EPBC Act.

A total of 460 pine donkey orchids were recorded within the wider study area during the surveys, with seven individuals occurring within the Project Disturbance Area that are likely to be impacted.

One individual leek orchid was identified within the wider study area and outside the Project Disturbance Area and will not be directly or indirectly impacted upon by the Project.

5.4 Impact of the Project on Vegetation Communities

A total of two native vegetation communities were mapped within the Project Disturbance Area (refer to **Figure 4.1**). These vegetation communities have been identified and mapped according to their respective NSW Biometric vegetation type. They are:

- HU905 – Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter
- HU905 – Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter Derived Native Grassland.

A further six communities were mapped within the wider study area including two communities that conform to the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands CEEC under the EPBC Act.

The Project will result in the removal of 7.4 hectares of Central Hunter Grey Box– Ironbark Woodland EEC and 14.8 hectares of Derived Native Grassland. The Project is not expected to result in the loss of

vegetation community diversity within the wider study area as a result of the direct or indirect impacts of the Project.

5.5 Impact of the Project on Fauna Habitat and Fauna Species

The Project will result in the loss of up to approximately 22.2 hectares of native habitat within the Project Disturbance Area. This comprises approximately 7.4 hectares of woodland habitat and 14.8 hectares of native grassland habitat.

5.5.1 Woodland Habitat

The removal of approximately 7.4 hectares of woodland and forest habitat within the Project Disturbance Area represents a small loss of fauna habitat and represents a decrease of the area of remnant vegetation in the wider study area. The majority of this habitat constitutes foraging habitat in the form of canopy vegetation, tree trunks and large branches and bark subsurfaces. This habitat type also contained low to moderate levels of leaf litter coverage, as well as fallen timber. Such features form foraging and shelter resources for fauna species. Other habitat features such as an open to moderately dense mid-understorey and shrub layer provide additional resources for foraging and nesting for the threatened woodland bird species known to occur.

Tree hollow abundance was relatively low within the Project Disturbance Area providing limited roosting and nesting habitat for hollow-dependent species.

The loss of 7.4 hectares of woodland habitat as a result of the Project is not expected to be significant from a fauna habitat perspective.

5.5.2 Derived Native Grassland Habitat

The removal of approximately 14.8 hectares of grassland habitat within the Project Disturbance Area represents a small loss of marginal fauna habitat. Grassland habitat is most likely to provide open foraging habitat for fauna species occurring in adjoining vegetated refuge areas. It is likely that these open areas provide foraging habitat for a number of threatened fauna species, however this would be as sub-optimal, modified habitat only. The loss of 14.8 hectares of grassland habitat as a result of the Project is not expected to be significant from a fauna habitat perspective.

5.6 Impact of the Project on Groundwater Dependent Ecosystems

As outlined in **Section 4.3.6**, there is one terrestrial vegetation community within the wider study area that is expected to be dependent on shallow groundwater resources during periods of reduced surface water flow. The proposed quarry is located further than 900 metres from this groundwater dependent terrestrial vegetation community.

The groundwater assessment conducted for the EIS confirmed that the Project would not intercept groundwater nor involve the extraction of groundwater. Consequently, the Project would not have a significant impact on the quantity or quality of groundwater available to surrounding users and ecosystems.

The surface water assessment completed for the Project (refer to the EIS) identified that the changes in annual flow volumes associated with proposed changes to catchment areas for Wybong Creek are considered to be negligible within the context of ephemeral streams. Thus, reductions in surface water flow to the terrestrial vegetation community identified in **Section 4.3.6** are expected to be negligible which

further reduces the potential for the community potentially dependent on shallow groundwater resources to be adversely impacted.

Based on the outcomes of the surface water and groundwater assessments, the Project is not expected to result in an adverse impact on the potential GDE identified in the wider study area.

5.7 Impact of the Project on Threatened Species, Populations and Ecological Communities

The basic principles of reducing impacts on threatened species are to:

1. avoid direct impacts and retain habitat
2. minimise impacts where ever possible
3. mitigate or ameliorate impacts and as a last resort
4. compensate or offset for any unavoidable impacts.

Section 5.1 describes the impact avoidance measures implemented during project planning. The following sections provide a detailed assessment of the significance of impacts related to the Project on threatened species, EPs and EECs using the relevant tests of significance under State (EP&A Act). In accordance with the relevant legislation and guidelines, the following assessments do not take into account the mitigation measures documented in **Section 6.0** or the Biodiversity Offset Strategy described in **Section 7.0**.

The precautionary principle has been consistently applied when assessing the potential impacts of the Project on threatened and migratory species and communities. The Environmental Planning and Assessment Regulation defines the precautionary principle as:

> Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
>
> In the application of the precautionary principle, public and private decisions should be guided by:
>
> (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
>
> (ii) an assessment of the risk-weighted consequences of various options.

Further, the EPBC Act Significant Impact Guidelines 1.1 states the following:

> When deciding whether or not a proposed action is likely to have a significant impact on a matter of national environmental significance, the precautionary principle is relevant. Accordingly, where there is a risk of serious or irreversible damage, a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on a matter of national environmental significance.

In light of the above, where there was lack of scientific certainty, the maximum potential impact was assumed. The development of mitigation and offset strategies were based on the outcomes of the impact assessment. The precautionary principle was also applied in the development of the mitigation and offset strategies to ensure that uncertainties were compensated for with more robust mitigation or more substantial offset outcomes.

The application of the precautionary principle described above is illustrated in **Figure 5.1** below.

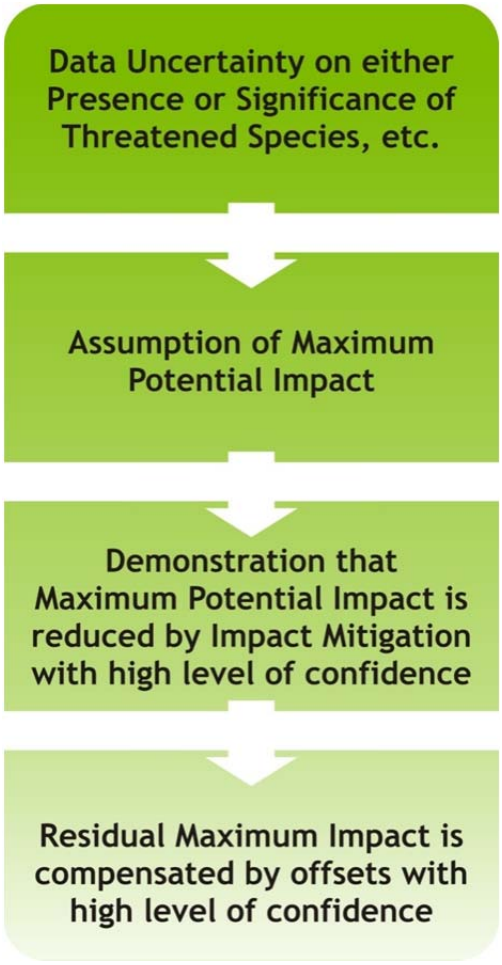


Figure 5.1

Application of the Precautionary Principle to the Impact Assessment and Development of Mitigation and Offset Strategies

The potential level of impact on threatened species and TECs was assessed using the 'seven part test' as detailed in Section 5A of the EP&A Act (including terrestrial species listed under the TSC Act and aquatic species listed under the FM Act). The assessment of significance was undertaken following an initial screening process to identify species that may be potentially affected by the Project (refer to **Appendix A**), with a consequential full assessment of the likely significance of impacts being completed for these species (refer to **Appendix D**).

The assessments of significance do not take into account the range of impact mitigation strategies and biodiversity offsets proposed for the Project, rather they consider the impacts of the Project without any mitigation or offsetting, consistent with the requirements of both State and Commonwealth significant impact assessment guidelines (DECC 2007; Department of the Environment 2013). The Assessment of Significance was completed for the threatened species and TECs listed in **Table 5.1**, either due to their recorded presence or the presence of potential habitat in the Project Disturbance Area, and the potential for the species or TECs to be affected. Further detail regarding the assessments of significance is provided below in the remaining subsections of **Section 5.7**and in **Appendix D**.

5.7.1 Threatened Species Assessed Under the Environmental Planning and Assessment Act 1979

An Assessment of Significance was completed for the TSC Act threatened species and TECs listed in **Table 5.1**, either due to their recorded presence or the presence of potential habitat in the Project Area, and the potential for the species or TECs to be affected. Further detail regarding the assessments of significance is provided below in the remaining subsections of **Section 5.7**and in **Appendix D**.

Table 5.1 Threatened Species and EECs for which an Assessment of Significance was undertaken under the EP&A Act

Species/Community Name	Species Listed under the TSC Act	
	Assessed Under the EP&A Act (7 Part Test)	Significant Impact?
Threatened Ecological Communities		
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	✓	×
Endangered Populations		
pine donkey orchid *Diuris tricolor* population in the Muswellbrook LGA	✓	×
Threatened Flora Species		
pine donkey orchid *Diuris tricolor*	✓	×
Tarengo leek orchid *Prasophyllum petilum*	✓	×
austral toadflax *Thesium australe*	✓	×
Threatened Fauna Species		
glossy black-cockatoo *Calyptorhynchus lathami*	✓	×
brown treecreeper *Climacteris picumnus victoriae*	✓	×
speckled warbler *Chthonicola sagittata*	✓	×

Species/Community Name	Species Listed under the TSC Act	
	Assessed Under the EP&A Act (7 Part Test)	Significant Impact?
grey-crowned babbler *Pomatostomus temporalis temporalis*	✓	×
spotted-tailed quoll *Dasyurus maculatus*	✓	×
koala *Phascolarctos cinereus*	✓	×
squirrel glider *Petaurus norfolcensis*	✓	×
yellow-bellied sheathtail bat *Saccolaimus flaviventris*	✓	×
east coast freetail-bat *Mormopterus norfolkensis*	✓	×
little bentwing-bat *Miniopterus australis*	✓	×
eastern bentwing-bat *Miniopterus schreibersii oceanensis*	✓	×
eastern false pipistrelle *Falsistrellus tasmaniensis*	✓	×
greater broad-nosed bat *Scoteanax rueppellii*	✓	×
south-eastern long-eared bat *Nyctophilus corbeni*	✓	×
large-eared pied bat *Chalinolobus dwyeri*	✓	×

Based on the threatened species assessment detailed in **Appendix D**, the Project is considered unlikely to result in significant impact on any species listed under the TSC Act.

5.7.2 Threatened Species Assessed Under the Fisheries Management (FM) Act 1994

No FM Act listed threatened aquatic flora or fauna species were recorded or considered to have the potential to occur within the Project Area. The Project will not have an impact on any FM Act listed species or communities.

5.7.3 SEPP 44 Assessment

The Project Area is not considered to be core koala habitat as defined under SEPP 44, and the preparation of a Koala Plan of Management is not required. Obligations under SEPP 44 are not required for the Project.

5.7.4 Threatened Species Assessed under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999

The Project, as described in **Section 1.2**, was referred to the Commonwealth Minister for the Environment in March 2015. The referral included an assessment of significance in accordance with the EPBC Act Significant Impact Guidelines 1.1 for all MNES occurring or considered to have the potential to occur in the Project Area. It was considered that the Project was unlikely to significantly impact any MNES. Based on the assessment submitted and the supporting documentation, the Minister for the Environment concluded that the Project is considered "not a controlled action". As such, no assessment of MNES is required by or presented in this report.

5.8 Cumulative Impact Considerations

The cumulative impact of the Project and surrounding developments is taken into consideration in the assessment of significance documented in **Appendix D**. Threats to species listed under the TSC Act, FM Act and EPBC Act include those that are cumulative in nature, and the assessments undertaken implicitly consider the contribution of cumulative impacts on these species.

6.0 Impact Mitigation Strategy

Upper Hunter Holdings has sought to avoid and minimise potential impacts on the ecological values of the Project Area throughout the project planning process. This has included avoidance and minimisation of disturbance of key vegetation communities and fauna habitats. These avoidance measures are described in detail in **Section 5.1**.

The ecological impact assessment documented in **Section 5.0** concluded that, without appropriate mitigation and offsetting, the Project is unlikely to have a significant impact on any threatened species, EP or TEC listed under the TSC Act (refer to **Table 5.2**). Despite this, Upper Hunter Holding has committed to the design and implementation of a strategy to mitigate the unavoidable impacts of the Project. Further to this, a comprehensive biodiversity offset strategy has been developed, which includes the protection and enhancement of native vegetation and threatened species habitat, to develop a positive long-term outcome for the threatened species and key ecological features affected by the Project. The proposed biodiversity offset strategy is documented in **Section 7.0**.

This section details the mitigation strategies that are designed to minimise impacts on significant ecological features in the areas to be disturbed as part of the Project.

6.1.1 General Ecological Management Strategies

A range of general management strategies will be used to limit impacts on native flora and fauna in the Project Area. The strategies will include:

- feral animal and weed control
- management of erosion and sedimentation to ensure that adjoining vegetation communities and aquatic systems are not adversely impacted
- adaptive management, as required, if a previously unrecorded or assessed threatened species is identified in the Project Area during operations.

6.1.1.1 Weed Control

Weed species could be inadvertently brought into the Project Area with imported materials, or could invade naturally through removal of native vegetation. A weed management strategy will be developed prior to the construction of the quarry to ensure any potential impacts from weeds are mitigated.

6.1.1.2 Feral Animal Control

Introduced fauna species such as foxes, rabbits, pigs, dogs and feral cats could increase within the Project Area due to increased disturbance. Clearing, thinning of vegetation and the creation of tracks through existing dense vegetation might assist the penetration of introduced fauna species such as pigs, cats and foxes, and allow them to establish in new areas. An increase in feral species has the potential to increase impacts on existing native species, particularly via predation and habitat destruction.

An appropriate feral animal control strategy will be developed prior to the commencement of the construction of the quarry.

6.2 Protection and Management of Arboreal Species and Habitat

A robust tree felling procedure will be implemented to minimise the potential for impacts on native fauna species (including threatened species) as a result of the clearing of hollow-bearing trees.

This procedure includes:

- comprehensive pre-clearing surveys, no more than two weeks prior to felling. This will include marking of hollow-bearing trees, as well as any other notable features such as fallen timber, hollow logs or boulders suitable for salvage; active nests, dreys or dens requiring consideration; and seed-bearing trees for salvage. Surveys will include detailed searches for threatened flora and fauna species, including micro-bats

- removal of non hollow-bearing trees/vegetation as close to the hollow-bearing tree felling date as possible (in order to discourage fauna usage of the area). It is not considered necessary for a suitably experienced and licensed person to be present to supervise such works, providing pre-clearing surveys have been completed within the designated timeframe

- detailed hollow-bearing tree felling procedures, including (but not limited to):

    - supervision of all hollow-bearing tree felling works by an appropriately qualified licensed person. If an ecological issue is encountered, this person is to advise on the most appropriate measures to ensure minimal impact on fauna species, particularly threatened species

    - visual canopy inspection on the day of the felling of hollow-bearing trees for fauna species and active nests

    - shaking of hollow-bearing tree (with heavy machinery) for at least 30 seconds to encourage resident fauna to abandon tree, prior to felling

    - lowering of hollow-bearing trees as gently as possible with heavy machinery

    - inspection of all hollows in felled trees

    - capture of any displaced/injured fauna

    - release of unharmed fauna into nearby secure habitats

    - injured fauna to be assessed and taken to wildlife carer, if necessary

    - felled trees to be rolled so that the number of hollows blocked against the ground are minimised

    - all felled trees to remain in place overnight to allow any unidentified fauna to escape

    - salvage of suitable hollows for treatment and installation within rehabilitation and revegetation areas as compensatory habitat, where practicable.

All personnel who will capture/handle/house and/or transport native fauna species (injured or uninjured) will be appropriately licensed under the requirements of the NSW Animal Ethics Committee.

Site personnel (particularly vehicle operators) will be briefed on fauna awareness issues and will be required to report incidents involving injury to native wildlife. Assistance from a wildlife carer or veterinarian will be sought if injured native wildlife are encountered.

7.0 Biodiversity Offset Strategy

A Biodiversity Offset Strategy is proposed to compensate for residual impacts on those species, vegetation communities and ecological features that are likely to be, or could potentially be, significantly impacted by the Project. The Biodiversity Offset Strategy has been developed in accordance with the SEARs (refer to **Section 1.5**) as follows:

A comprehensive offset strategy for the development including a justification of how the strategy would maintain or improve the terrestrial and aquatic biodiversity values of the region in the medium to long term, and how the strategy would be integrated with the Upper Hunter Strategic Assessment process.

The Biodiversity Offset Strategy has also been prepared in accordance with the *Principles for the Use of Biodiversity Offsets in NSW*, in accordance with the Project SEARs. This Project is not part of the Upper Hunter Strategic Assessment process which is restricted to coal mining projects.

The OEH submission to the SEARs for the Project, dated 24 June 2014, states that the biodiversity impacts of the Project can be assessed using either the BioBanking Assessment Methodology (Scenario 1) or a detailed biodiversity assessment (Scenario 2). Following consultation with OEH, this Biodiversity Offset Strategy has been prepared in accordance with Scenario 2.

7.1 Preliminary Assessment of Ecological Values to be Addressed

The Project will result in the loss of approximately 22.2 hectares of native vegetation comprising 7.4 hectares of TSC Act listed Central Hunter Grey Box – Ironbark Woodland EEC and 14.8 hectares of non-threatened derived native grassland community (refer to **Section 5.4**). The Project will result in the removal of seven pine donkey orchids (Diuris tricolor), 7.4 hectares of woodland habitat and 14.8 hectares of derived native grassland (DNG) habitat. Many of these matters are synonymous, e.g. the loss of Central Hunter Grey Box – Ironbark Woodland EEC also represents the loss of habitat for the woodland-dependent birds and micro-bats. Accordingly, the Biodiversity Offset Strategy (BOS) has been developed to compensate for residual impacts of the Project on these species, habitats or features. The key features to be addressed are outlined in **Table 7.1** below:

Table 7.1 Significant Ecological Features Addressed in the Biodiversity Offset Strategy

Ecological Feature	Area of Impact/ Number of Individuals
Central Hunter Grey Box - Ironbark Woodland EEC	7.2 hectares
Pine donkey orchid (Diuris tricolor)	7 individuals
Woodland habitat	7.2 hectares
Speckled warbler	5 individuals

7.2 Land-based Biodiversity Offset Site

The Biodiversity Offset Area (refer to **Figure 7.1**) is 16 hectares in area. It is located to the north of the Project Disturbance Area in Lot 1 which is currently owned and managed by UHH. The Biodiversity Offset Area adjoins a dedicated conservation offset for the Mangoola Coal project (Umwelt 2006) to the east.

7.2.1 Threatened Flora Species

One threatened flora species, pine donkey orchid (Diuris tricolor) was recorded within the Biodiversity Offset Area (refer to **Figure 7.2**). A total of 247 individuals were recorded. No other threatened flora species were recorded or considered likely to occur within the Biodiversity Offset Area.

7.2.2 Endangered Populations

The pine donkey orchid species recorded in the Biodiversity Offset Area constitute part of the endangered population "Pine Donkey Orchid (Diuris tricolor) Endangered Population in the Muswellbrook Local Government Area" listed under the TSC Act.

7.2.3 Threatened Ecological Communities

Two vegetation communities recorded within the Biodiversity Offset Area are consistent with the final determinations of threatened ecological communities (TECs) listed under the TSC Act (refer to **Figure 7.2**).

HU905 - Moderate to Good Condition - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter conforms to the final determination of the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community. A total of 13 hectares of this community has been mapped within the Biodiversity Offset Area.

HU730 – White Box x Grey Box; Red Gum; Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition conforms to the final determination of the White Box Yellow Box Blakely's Red Gum Endangered Ecological Community. The grassland form of this vegetation community does not comprise the EEC as listed under the TSC Act. A total of 1.6 hectares of this community has been mapped within the Biodiversity Offset Area.

7.2.4 Fauna Habitat

Fauna habitat within the Biodiversity Offset Area is consistent with that recorded within the Project Disturbance Area and wider study area (refer to **Section 4.3.2**). Both woodland and derived native grassland habitats were present within the Biodiversity Offset Area.

The woodland habitat was generally composed of an open, low woodland overstorey and a scattered short understorey. The dominant woodland canopy species were narrow-leaved ironbark (Eucalyptus crebra) and grey box (Eucalyptus moluccana). Tree hollows were recorded in middle-aged, mature and old growth trees throughout the proposed offset area. The shrub layer often contained a poor to moderate level of species and structural diversity. The ground cover was predominately a mix of native and exotic grass species reaching an average height of 0.1 to 0.8 metres.

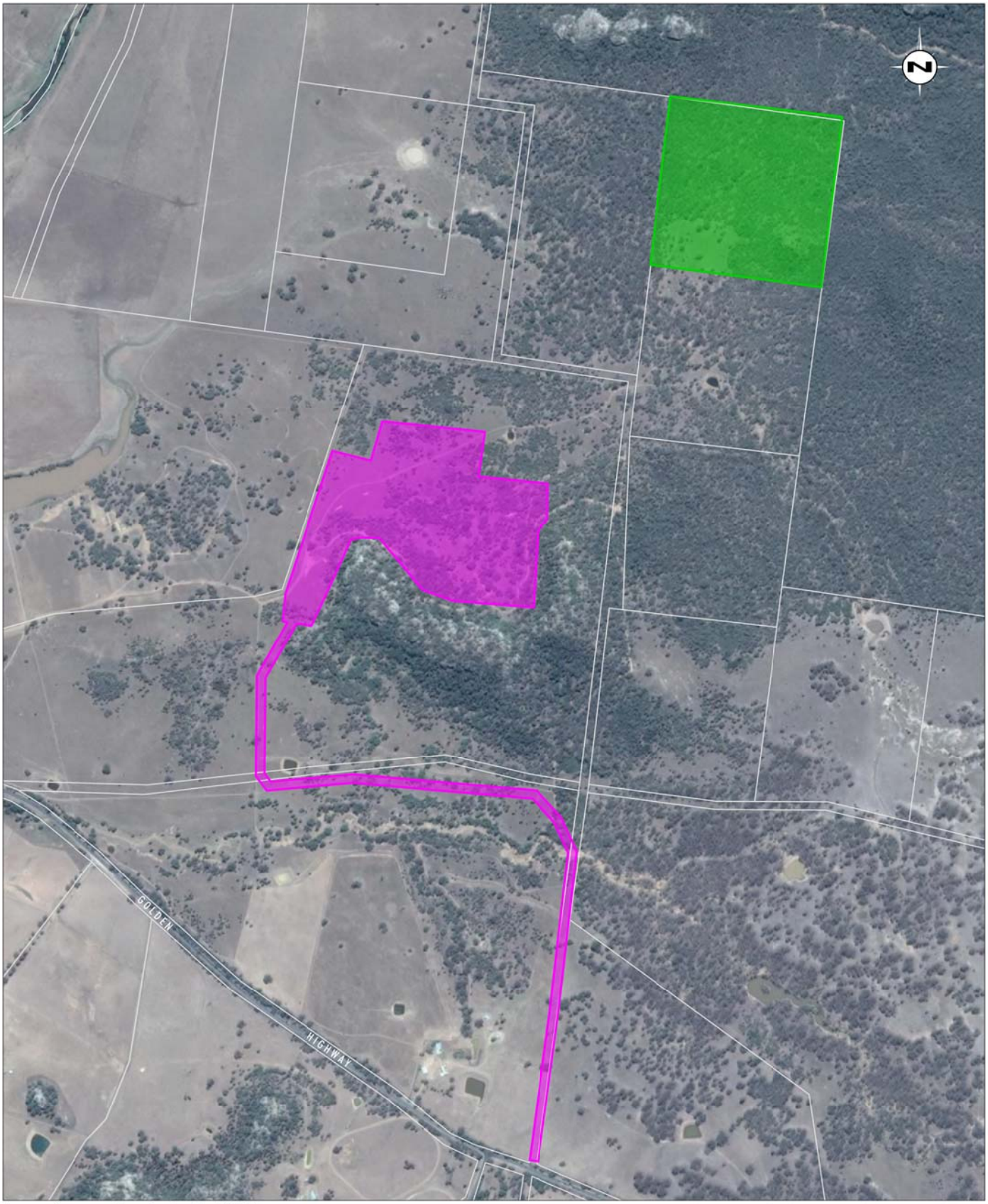


Image Source: Google Earth (2014)
Data Source: KMH (2014), Department of Lands (2009)

0 200 400 600m
1:12 500

Legend

- Project Disturbance Area
- Biodiversity Offset Area

FIGURE 7.1

Project Disturbance Area and Biodiversity Offset Area

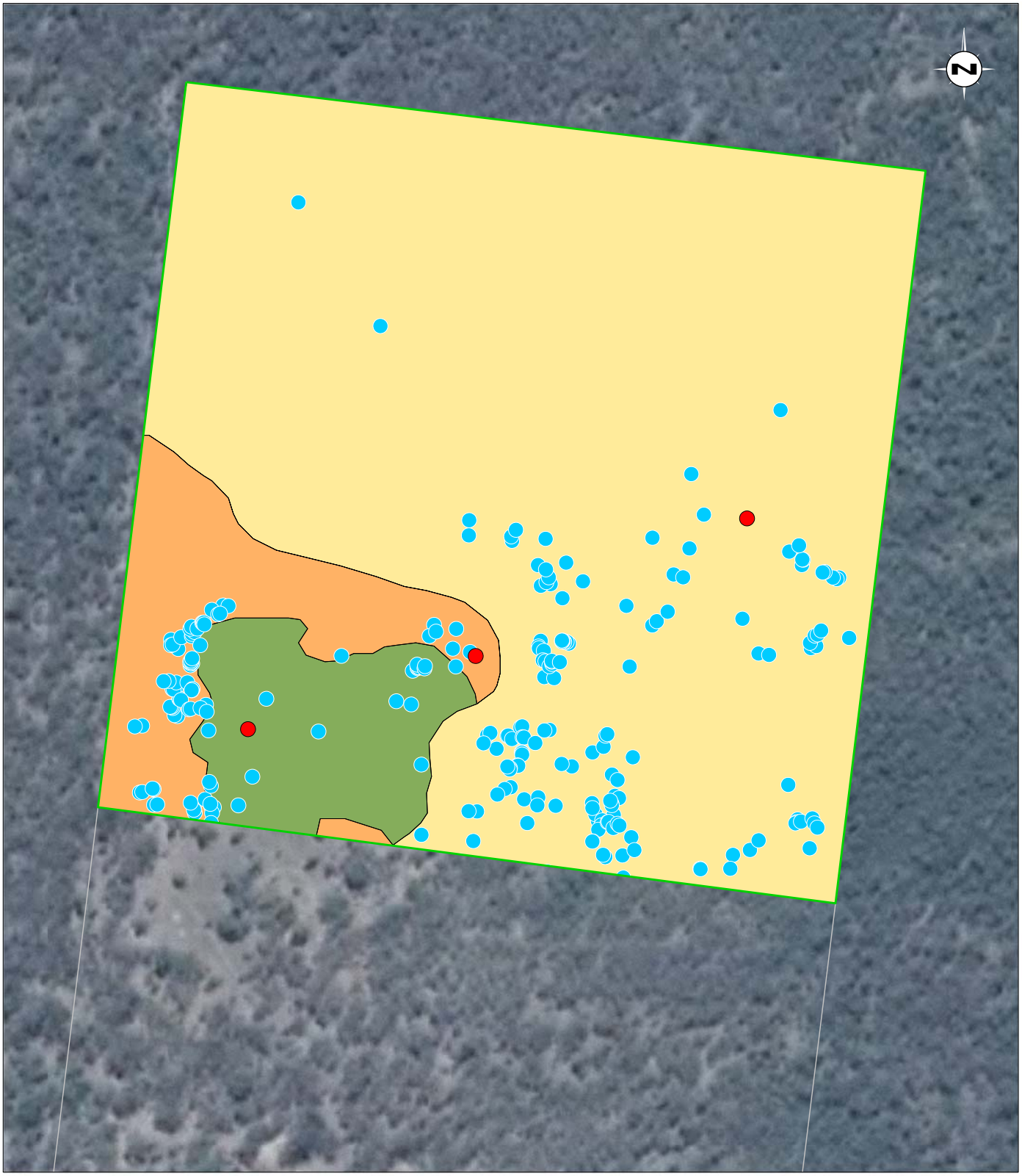


Image Source: Google Earth (2014)
Data Source: KHM (2014), Department of Lands (2009)

0 50 100 150m
1:3 000

Legend

- Biodiversity Offset Area
- Central Hunter Valley Eucalypt Forest and Woodland Complex (EPBC ACT) / Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions (TSC ACT)
- White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC ACT)
- White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC ACT) / White Box Yellow Box Blakely's Red Gum Woodland (TSC ACT)
- Speckled warbler
- *Diuris tricolor*

FIGURE 7.2

Threatened Species and TEC's in Biodiversity Offset Area

File Name (A4): R01/3453_018.dgn
20150907 15.42

The derived native grassland habitat consist of generally native grasses and is likely to be derived from HU730 – White Box x Grey Box; Red Gum; Rough-barked Apple grassy woodland. Canopy and shrub layers were generally absent from this community, although isolated paddock trees and areas of regenerating eucalypts and shrubs sometimes occurred. Most woody vegetation has been previously cleared for agricultural purposes. The ground layer was dominated by native and introduced grasses and forbs. This habitat type is susceptible to grazing however grazing pressure was considered to be low in the proposed offset area

7.2.5 Threatened Fauna Recorded

One threatened fauna species was recorded within the Biodiversity Offset Area, being the speckled warbler (Chthonicola sagittata). This species was recorded at three locations and a total of five individuals were observed (refer to **Figure 7.2**).

The Biodiversity Offset Area is considered to provide potential habitat for at least a further thirteen threatened fauna species, being;

- glossy black-cockatoo (*Calyptorhynchus lathami*)
- brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)
- grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)
- spotted-tailed quoll (*Dasyurus maculatus*)
- koala (*Phascolarctos cinereus*)
- squirrel glider (*Petaurus norfolcensis*)
- yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)
- east coast freetail-bat (*Mormopterus norfolkensis*)
- little bentwing-bat (*Miniopterus australis*)
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)
- eastern false pipistrelle (*Falsistrellus tasmaniensis*)
- greater broad-nosed bat (*Scoteanax rueppellii*)
- large-eared pied bat (*Chalinolobus dwyeri*).

7.2.6 Offset Management and Improvements

This section describes the improvements and management actions to be undertaken across the Biodiversity Offset Area.

A Biodiversity Offset Management Plan (BOMP) for the proposed biodiversity offset area will be prepared following approval of the Project to detail the planned improvements and its ongoing management for biodiversity conservation and enhancement purposes.

The Biodiversity Offset Area will be managed to conserve and enhance ecological values with a focus on weed and pest control, fencing and regeneration of DNG areas. A monitoring program will be developed as part of the BOMP assess the progress and determine the success of ongoing management actions.

Preliminary on-ground works will likely involve:

- weed and pest control programs
- fencing of the southern boundary of the biodiversity offset area to exclude stock access (refer to **Figure 7.2**)
- undertaking ecological monitoring across the Biodiversity Offset Area to monitor the success of the recovery of DNG areas.

Following the completion of the BOMP it will be submitted to DP&I for approval. The BOMP will include a concise and auditable strategy for the implementation of the offsets.

7.2.7 Summary of the Ecological Values

The ecological features of the Biodiversity Offset Area include:

- 13 hectares of Central Hunter Grey Box – Ironbark Woodland EEC listed under the TSC Act
- 1.6 hectares of White Box-Yellow Box-Blakely's Red Gum Woodland EEC listed under the TSC Act
- 1.3 hectares of DNG, which is likely to have once supported White Box-Yellow Box-Blakely's Red Gum Woodland. All of the DNG areas are likely to naturally regenerate into a functional woodland ecosystem (EEC) over time following the removal of grazing pressure
- 15 hectares of native vegetation
- 247 pine donkey orchids (Diuris tricolor), and 247 individuals of the Pine Donkey Orchid (Diuris tricolor) Endangered Population in the Muswellbrook Local Government Area, both listed under the TSC Act
- known speckled warbler habitat
- 14.63 hectares of woodland habitat and 1.33 hectares of DNG providing potential habitat for at least 13 threatened fauna species.

7.3 Assessment of the Biodiversity Offset Strategy Against Principles for Biodiversity Offsetting (OEH 2014)

The following provides an assessment of the Project Biodiversity Offset Strategy against these principles.

1. Before offsets are considered, impacts must first be avoided and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts.

Offsets sit within a hierarchy of 'avoid, minimise, offset'. The first priority in a development proposal is always to avoid any unnecessary impact to biodiversity. Where impacts cannot be avoided, a reasonable attempt should be made to minimise the impact as much as possible. After all feasible measures have been taken to avoid or minimise impacts to biodiversity, offsets should be used to compensate for any remaining impacts (OEH 2013).

The Project has been designed to avoid disturbance to the ecological features of the Project wider study area where possible, whilst maintaining the economic feasibility and practicality of all components of the Project. **Section 5.1** documents the key project avoidance measures undertaken as part of the Project. Where impact on ecological features has been unavoidable, a robust impact mitigation strategy has been provided that addresses the mitigation of these impacts in the long term (refer to **Section 6.0**).

Other key impact mitigation strategies include sediment and erosion control, weed and feral animal control and a comprehensive tree felling procedure to limit impacts on hollow-dependent threatened fauna species (refer to **Section 6.2**).

2. Offset requirements should be based on a reliable and transparent assessment of losses and gains.

Offsetting decisions should be based on a reliable and transparent assessment of the loss in biodiversity due to the development proposal and the likely gain in biodiversity through the offset. For terrestrial biodiversity, established assessment tools, such as the BioBanking Assessment Methodology, are considered best practice. This methodology is currently being reviewed and refined to ensure it is as robust as possible (OEH 2013).

The BOS has been developed through detailed consideration of potential impacts on threatened species and TECs (including their habitats), which have been identified and discussed in detailed in **Sections 4.0** and **5.0**. The selection of the Biodiversity Offset Area took into account such identified impacts, and identified preferences based on the ability of such available areas to appropriately address such impacts.

The area of impact has been derived from detailed GIS mapping of project boundaries and impact areas, and the ecological survey, mapping and impact assessments have been completed by qualified ecologists with considerable experience in the region. Extensive surveying has been undertaken at appropriate seasonal times to adequately determine the potential presence of seasonal threatened species.

All relevant ecological features of the Biodiversity Offset Area are quantifiable and, where the information is available, are presented in such a manner in this report. The quantification is documented in **Section 7.2** of this report.

3. Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.

> Offsets should reflect the biodiversity values, including threatened species and their habitat, that are being lost. This should be on a like-for-like basis for NSW-listed species and ecological communities that are also nationally listed. Like-for-like is preferable for ecological communities, threatened species and their habitat that are only listed in NSW. However, where offset sites that are exactly like-for-like are not reasonably available, offsets may include vegetation communities of a similar type or a type of a higher conservation priority, or threatened species of a higher conservation priority (OEH 2013).

The development of the BOS has been based on addressing the identified ecological impacts of the Project (refer to **Section 5.0**). These impacts have been identified via a thorough survey and assessment process, which has been described in detail within this document. Following the identification of impact, the BOS has been designed to provide mitigation actions targeted at each of the residual impacts. **Table 7.1** clearly documents the key ecological species, communities and features that would be impacted by the Project and are hence targeted for offsetting.

The BOS for the Project includes 13 hectares of like-for-like Central Hunter Grey Box - Ironbark Woodland EEC and 1.6 hectares of high conservation value vegetation communities, namely White Box-Yellow Box-Blakely's Red Gum Woodland.

The BOS provides a direct, 'like-for-like' offset for all key threatened flora and fauna species that are likely to be adversely impacted by the Project.

4. Offsets must be additional to other legal requirements.

> The biodiversity protection and management requirements of an offset must be in addition to any legal requirements already in place for biodiversity on that land. This includes, for example, any existing legal restrictions on clearing under the *Native Vegetation Act 2003*. Improvements in the condition of native vegetation not currently required by other legislation would count as an offset (OEH 2013).

The land-based Biodiversity Offset Area proposed as part of the BOS does not overlap with any other legal requirements or government funded protection or habitat restoration program on the site. The Biodiversity Offset Area is located on currently non-reserved land.

5. Offsets must be enduring, enforceable and auditable.

> Offset sites must be subject to good governance arrangements to ensure they are not inadvertently developed in the future. This includes having an appropriate plan of management, resourcing for management, legal security and accountability mechanisms. For terrestrial offsets, a BioBanking Agreement or addition to the NSW national parks system are the preferred mechanisms for securing an offset site. The purchase and retirement of biodiversity credits under the BioBanking Scheme, where appropriate credits are available, also meets the requirement for good governance arrangements.

Suitable offsets must be determined prior to approval. However the offset does not need to be finalised (e.g. be purchased or have relevant protection over it) prior to approval, providing it is subject to a suitable mechanism that will remain enforceable after the project has been completed (OEH 2013).

The Biodiversity Offset site will be secured for long-term conservation. The mechanism for securing this conservation will be determined in consultation with the relevant government agencies.

6. Supplementary measures can be used in lieu of offsets.

For terrestrial offsets, supplementary measures can be used in lieu of offsets in situations where land based offsetting is not feasible or practical. The supplementary measure must be relevant to the biodiversity value being impacted. The monetary value of a supplementary measure is to be determined by an appropriate method that is repeatable and transparent. Examples of supplementary measures include the provision of funds for:

- Biodiversity research or surveys
- Recovery of threatened species
- Community education and awareness programs
- Supplementary measures may also be used to compensate for impacts on aquatic biodiversity (OEH 2013).

The BOS does not propose any supplementary measures.

7. Offsets can be discounted where significant social and economic benefits accrue to NSW as a consequence of the proposal.

While an outcome in which biodiversity values are improved or maintained is preferred, it is acknowledged that in some circumstances flexibility may be required, especially in the context of a project providing significant social or economic benefits to NSW (OEH 2013).

The BOS has not been discounted.

The proposed quarry will result in generation of employment and demand for products and services, and would contribute to economic activity in the local area. It would provide a source of aggregates not currently available in the local area, reducing the need to transport materials long distances by road into the subject area. The quarry will benefit the many construction and mining projects currently under way or in planning by providing a local source of in-demand materials, keeping transport costs down. Such projects include the proposed Golden Highway Upgrade and upgrade to local roads, various coal mine expansions, agribusiness proposals and local residential subdivisions, all of which are close to the proposed quarry.

7.4 Summary of Biodiversity Offset Strategy

The Project identified the need for a comprehensive BOS to compensate for the residual significant impacts that could not be avoided or mitigated. The BOS described in this document has outlined the proposed offsetting components that have demonstrated an appropriate and valuable offsetting outcome in achieving the goals to:

- avoid and minimise potential impacts on ecological values as a result of the Project
- mitigate potential impacts within the Project Disturbance Area
- maintain or improve the biodiversity values of the surrounding region in the medium to long term
- maintain or improve the viability of threatened species that could be affected by the Project through the securing and/or restoration of habitat in the Hunter Valley
- ensure that there are no residual impacts on key threatened species and ecological communities in the long term as a result of the construction and operation of the Project.

The positive ecological outcomes associated with this BOS include:

- 13 hectares of direct “like for like” offset of Central Hunter Grey Box - Ironbark Woodland EEC to compensate for the impact on 7.4 hectares
- 1.6 hectares of high conservation value White Box Yellow Box Blakely’s Red Gum Woodland, none of which will be impacted upon
- 1.3 hectares of DNG, which is likely to have once supported White Box Yellow Box Blakely’s Red Gum Woodland. All of the DNG areas are likely to naturally regenerate into a functional woodland ecosystem (EEC) over time following the removal of grazing pressure
- 247 pine donkey orchids (*Diuris tricolor*) to offset an impact on seven individuals
- Protection of 15.96 hectares of native vegetation that provides known habitat for one threatened fauna species (speckled warbler) and potential habitat for at least another 13 threatened fauna species
- Consolidation of conservation lands in the local area. The Biodiversity Offset Area adjoins a dedicated conservation offset for the Mangoola Coal project (Umwelt 2006) to the east.

The BOS will be implemented only if the Project is approved and construction begins.

8.0 Monitoring Commitments

The aim of the ecological monitoring program will be to assess the adequacy of the Impact Mitigation Strategy (refer to **Section 6.0**) and the Biodiversity Offset Strategy (refer to **Section 7.0**). This will require the design and implementation of a rigorous and systematic monitoring program that includes a positive feedback loop, to allow for the adaptive management of all aspects of the monitoring program.

Details on the monitoring program will be documented in the BOMP to be prepared post-approval, and prior to the commencement of construction works in the Project Area. This document will contain the specific requirements of the monitoring program, including methods to be used, monitoring frequencies and locations.

9.0 References

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

Austin, M, P, Cawsey, E, M, Baker, B, L, Yialeloglou, M, M, Grice, D, J, and Briggs, S, V, (2000) *Predicted Vegetation Cover in the Central Lachlan Region*. Final report of the Natural Heritage Trust Project AA 1368.97. CSIRO Wildlife and Ecology, Canberra.

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 May 2015.

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

Bureau of Meteorology. (2015). Climate Data Online. Accessed July 2015 from http://www.bom.gov.au/climate/data/index.shtml

Bureau of Meteorology Altas of Groundwater Dependant Ecosystems (http://www.bom.gov.au/water/groundwater/gde/index.shtml)

Churchill, S. (2008) Australian Bats. Second Edition, Allen & Unwin, Sydney.

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

Cronquist, A, 1981. *An Integrated System of Classification of Flowering Plants*. Columbia University Press, New York.

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

(DECC) Department of Environment and Climate Change and (DPI) Department of Primary Industries (2005) Draft guidelines for Threatened species assessment. .

(DECC) Department of Environment and Climate Change NSW (2007) Threatened Species Assessment Guidelines: the Assessment of Significance, August 2007.

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

(DECC) Department of Environment and Climate Change NSW (2008) *Hygiene protocol for the control of disease in frogs* Information Circular Number 6.

(DECC) Department of Environment and Climate Change NSW, (2008) Principles for the Use of Biodiversity Offsets in New South Wales http://www.environment.nsw.gov.au/biocertification/offsets.htm

(DECC) Department of Environment, Climate Change NSW (2009) BioBanking Assessment Methodology and Credit Calculator Operation Manual, March 2009.

(DECCW) Department of Environment, Climate Change and Water NSW (2009) Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians, April 2009.

(DLWC) Department of Land and Water Conservation (2002) The NSW State Groundwater Dependent Ecosystems Policy.

(DPI) Department of Primary Industries NSW (2008) Threatened Species Assessment Guidelines - The Assessment of Significance.

(DSEWPC) Department of Sustainability, Environment, Water, Population and Communities (2012a) *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy, October 2012.

Department of the Environment (2014) Protected Matters Search Tool http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf accessed May 2015.

Echo Ecology (2015) Bat Call Analysis for Dolwendee Quarry Project.

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.

KMH (2014) Dolwendee Quarry: SSD Application Supporting Document. Prepared by KHM Environmental for the Upper Hunter Holdings Pty Ltd, Newcastle, NSW.

Kovac, M. and Lawrie J.W., (1991) *Soil Landscapes of the Singleton 1:250,000 Sheet*. Soil Conservation Service of New South Wales, Sydney.

Long, K.I. & J.L. Nelson (2004) (*Draft) Recovery Plan for Dasyurus maculatus (Spotted-tailed Quoll*) 2005-2009. Canberra: Department of the Environment and Heritage.

NSW Scientific Committee (2012) *Guidelines for Interpreting Listing Criteria for Species, Populations and Ecological Communities under the NSW Threatened Species Conservation Act*. NSW Scientific Committee, Sydney.

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

(OEH) Office of Environment and Heritage (2014) NSW Biodiversity Offsets Policy for Major Projects (State Significant Development and State Significant Infrastructure) http://www.environment.nsw.gov.au/biocertification/offsets.htm

(OEH) Office of Environment and Heritage NSW, (2014) NSW Threatened Species Profiles (accessed January 2014) www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx

(OEH) Office of Environment and Heritage (2014). *Pine Donkey Orchid – Threatened Species Profile*. Office of Environment and Heritage, Sydney. Conservation Act. Listing guidelines version 1.4, November 2014.

Office of Environment and Heritage (OEH) (2015) BioNet Atlas of NSW Wildlife, accessed February 2015.

Peake, T, C, (2006) *The Vegetation of the Central Hunter Valley, New South Wales. A Report on the Findings of the Hunter Remnant Vegetation Project*. Hunter – Central Rivers Catchment Management Authority, Paterson.

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

TSSC, 2009. *Prasophyllum sp. Wybong (C. Phelps ORG 5269*) Listing Advice. Threatened Species Scientific Committee, Canberra.

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

Sivertsen, D., Roff, A., Somerville, M., Thonell, J., & Denholme, B. (2011) *Hunter Native Vegetation Mapping. Geodatabase Guide (Version 4).* Internal Report for the Office of Environment and Heritage, Department of Premier and Cabinet, Sydney, Australia.

The EnviiroFactor Pty Ltd (2008). Flora and Fauna Assessment for Proposed Gravel Quarry at Hollydeen, NSW. Prepared for Upper Hunter Holdings Pty Ltd

Umwelt (Australia) Pty Limited (2006). 2006 Ecological Assessment Anvil Hill Project – Centennial Hunter Pty Limited – June 2006.

Umwelt (Australia) Pty Limited (2008). Ecological Assessment for the Proposed Modification for Mangoola Coal Pipeline.

Umwelt (Australia) Pty Limited (2010). Ecological Assessment for Proposed Mine Plan Modification – Mangoola Coal

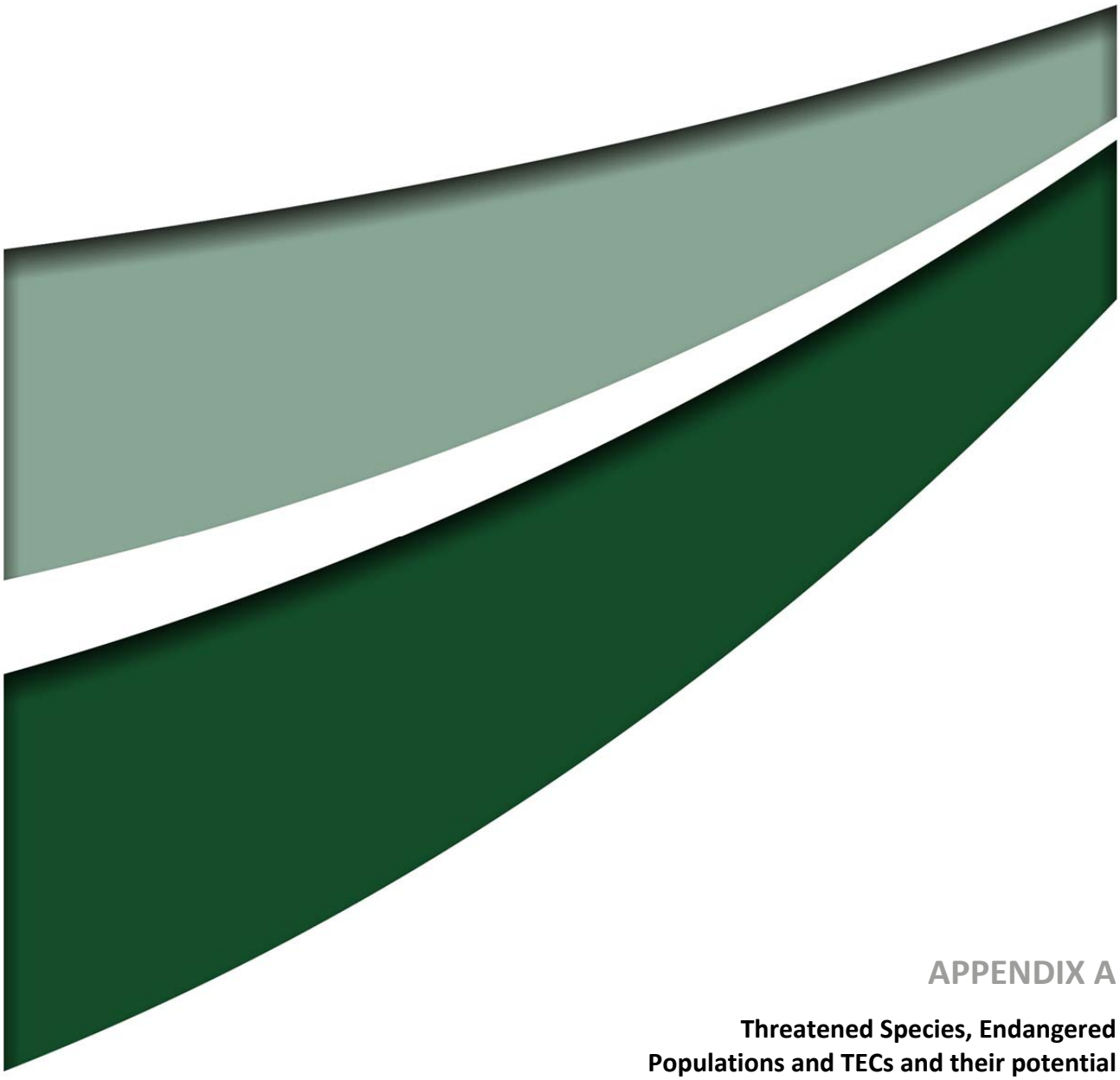
Umwelt (Australia) Pty Limited (2011). Ecological Assessment for Exploration Drilling Sites, Wybong NSW.

Umwelt (Australia) Pty Limited (in prep). Draft Upper Hunter Strategic Assessment for Mangoola Coal Mine.

Van Dyck, S and Strahan, R (2008). *The Mammals of Australia: Third Edition*. Australian Museum – Reed New Holland, Sydney.

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

Threatened Species, Endangered Populations and TECs and their potential to occur within the Project Disturbance Area

Appendix A – Threatened Species, Endangered Populations and TECs and their Potential to Occur Within the Project Disturbance Area

Tables 1 and **2** identify the threatened flora and fauna species, threatened ecological communities (TECs) and migratory species that have potential to occur within a 10 kilometre radius of the boundary of the Project Disturbance Area. This information was obtained from searches undertaken of the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife (2015). Note: No species, TECs or migratory species listed only under the EPBC Act have been included in the tables below. All Matters of National Environmental Significance (MNES) have been assessed during the referral process documented in Section **1.5** of the main text.

Tables 1 and **2** identify the status, specific habitat requirements, distribution, source of information, reservation within the region, potential for occurrence in the Project Disturbance Area and any requirement for an assessment of significance under the EP&A Act. Where species were identified as requiring an assessment of significance under the EP&A Act, the assessment has been undertaken in **Appendix D**.

Table 1 Likelihood of Occurrence Assessment of Threatened Flora Species, Endangered Populations and Threatened Ecological Communities Known or Predicted to Occur Within the Project Disturbance Area

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
THREATENED FLORA SPECIES						
Acacia pendula population in the Hunter catchment	EP (TSC)	Grows on major river floodplains on heavy clay soils, sometimes as the dominant species and forming low open woodlands. Within the Hunter catchment it typically occurs on heavy soils, sometimes at the margins of small floodplains, but also in more undulating locations remote from floodplains, such as at Jerrys Plains.	There are in the order of 40 to 50 naturally occurring remnants of the A. pendula population in the Hunter catchment. These range as far east as Warkworth, and as far west as Kerrabee, west of Sandy Hollow.	This population is not known to occur in any reserves in the region.	This endangered population does not occur in the Project Disturbance Area.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Androcalva procumbens	V (TSC) V (EPBC)	Grows in sandy sites, often along roadsides.	Endemic to NSW mainly confined to the Dubbo-Mendooran-Gilgandra region, but also in the Pilliga and Nymagee areas. Recent collections made from the upper Hunter region.	This species is not known to occur in any reserves in the region.	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No
Sandy Hollow commersonia *Androcalva rosea*	E (TSC E (EPBC)	Occurs on skeletal sandy soils in scrub or heath vegetation with occasional emergent narrow-leaved ironbark (*Eucalyptus crebra*), black cypress pine (*Callitris endlicheri*) or Caleys ironbark (*Eucalyptus caleyi* subsp. *caleyi*).	Only known from five localities in the Sandy Hollow district of the upper Hunter Valley, New South Wales, all within an 8 km radius of Sandy Hollow.	This species is not known to occur in any reserves in the region.	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Cymbidium canaliculatum population in the Hunter Catchment	EP (TSC)	This species occurs within dry sclerophyll forests and woodlands of tablelands and western slopes, growing in hollows of trees. It is usually found occurring singly or as a single clump, typically between 2 and 6 metres above the ground.	The population of *Cymbidium canaliculatum* in the Hunter Catchment is at the south-eastern limit of the geographic range for this species.	This population is not known to occur in any reserves in the region.	This endangered population does not occur in the Project Disturbance Area.	No
White-flowered wax plant *Cynanchum elegans*	E (TSC) E (EPBC)	The species has been recorded from rainforest gullies and scree slopes, but is thought to mainly occur at the ecotone between dry rainforest and sclerophyll forest or woodland (OEH 2015). The species has been recorded in dry subtropical rainforest, littoral rainforest, coastal scrub, open forest and woodland and open scrub.	*Cynanchum elegans* is restricted to eastern NSW from Yabbra State Forest in the north to Gerroa in the south and Merriwa in the west (OEH 2015).	Wollemi NP	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Leafless tongue-orchid *Cryptostylis hunteriana*	V (TSC) V (EPBC)	This species appears to favour moist soils on the flat coastal plains. Occupies swamp heath, but also in sclerophyll forest and woodland, often on sandy soils. Typically found in communities containing Eucalyptus haemastoma, E. capitellata and Corymbia gummifera.	This species is known to occur in the Karuah Manning and Wyong CMA sub-regions in the Hunter Central Rivers region.	This species is not known to occur in any conservation reserves in the region.	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No
Pine donkey orchid *Diuris tricolor*	V (TSC) EP (TSC) V (EPBC)	Sclerophyll forest among grass, often with *Callitris*. Sandy soils, either on flats or small rises.	Muswellbrook LGA is the eastern limit of the known range and the only recorded occurrence in the Sydney Basin Bioregion.	This species and population is not known to occur in any reserves in the region.	This species was recorded within the Project Disturbance Area.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Eucalyptus camaldulensis population in the Hunter catchment	EP (TSC)	River red gums are located on the banks and floodplains of watercourses on alluvial soils. This endangered population may occur with *Eucalyptus tereticornis, Eucalyptus melliodora, Casuarina cunninghamiana* subsp. *cunninghamiana* and *Angophora floribunda.*	The Hunter population occurs as far east as Hinton, east of Maitland, west to Bylong, and north to near Scone. Currently only 28 populations are known in the Hunter Valley, covering an area of only 83 hectares and constituting about 1,840 trees, and occurring over a range of at least 2000 km^2.		This endangered population does not occur in the Project Disturbance Area.	No
Pokolbin mallee *Eucalyptus pumila*	V (TSC) V (EPBC)	The single known population occupies north-west-facing slopes derived from sandstone.	Currently known only from a few small populations west of Pokolbin in the Hunter Valley. Historical records also exist for Wyong and Sandy Hollow, however, has not been recorded recently in these areas.	Singleton Military Area	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Euphrasia arguta	CE (TSC) CE (EPBC)	This species grows in grassy areas near rivers (Botanic Gardens Trust 2015).	*Euphrasia arguta* was rediscovered in the Nundle area of the NSW north western slopes and tablelands in 2008. Prior to this, it had not been collected for 100 years. Historically, *Euphrasia arguta* has only been recorded from relatively few places within an area extending from Sydney to Bathurst and north to Walcha.	This species is not known to occur in any reserves in the region.	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No
Kennedia retrorsa	V (TSC) V (EPBC)	Found in a variety of habitats from mountainsides to riparian zones, from sheltered forest to steep, exposed rocky ridgelines.	Believed to be restricted to the Mount Dangar area and the adjacent Goulburn River catchment, as well as in the Putty and Howes Valley district south of Bulga.	Goulburn River NP Wollemi NP	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Lasiopetalum longistamineum	V (TSC) V (EPBC)	The species typically grows in rich alluvial deposits and flowers in spring. Little is known about this species' ecology or biology.	This species occurs in the Mt Dangar – Gungal area within Merriwa and Muswellbrook LGAs. Three sites are known within Goulburn River NP. It is also known to occur at Wybong and the Singleton Military Training Area.	Goulburn River NP	The Project Disturbance Area provides suitable habitat for this species however it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No
Ozothamnus tesselatus	V (TSC) V (EPBC)	Dry sclerophyll forest and woodlands.	Restricted to a few locations north of Rylstone. Unconfirmed recording exists near Mt Owen.	Goulburn River NP Wollemi NP	The Project Disturbance Area provides suitable habitat for this species however it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Omeo storks bill *Pelargonium* sp. Striatellum	E (TSC) E (EPBC)	Typically occurs just above the high water level of irregularly inundated or ephemeral lakes. During dry periods it is known to colonise dry lake beds.	This species is known to occur in both Victoria and NSW. It occurs within the south-eastern highlands and South East Corner IBRA Bioregions and the Hawkesbury-Nepean, Murrumbidgee, Southern Rivers and North East Natural Resource Management Regions.	This species is not known to occur in conservation reserves in the region.	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No
Scant pomaderris *Pomaderris queenslandica*	E (TSC)	This species is found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.	This species is widely scattered but not common in north-east NSW and in Queensland. It is only known from a few locations on the New England Tablelands and North-west Slopes, including near Torrington and Coolatai, and also from several locations on the NSW North Coast.	Manobalai NR	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Denman pomaderris *Pomaderris reperta*	E (TSC) CE (EPBC)	This species occupies woodland in association with narrow-leaved ironbark (*Eucalyptus crebra*), Blakelys red gum (*E. blakelyi*), mock olive (*Notelaea microcarpa*), and black she-oak (*Allocasuarina littoralis*). This species grows on a sandy loam on sandstone or conglomerate.	This species has been recorded from a small number of sites near Denman in the upper Hunter Valley (Muswellbrook LGA). This species is also known from the Wybong area.	This species is not known to occur in any reserves in the region.	The Project Disturbance Area provides suitable habitat for this species however it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No
Tarengo leek orchidf *Prasophyllum petilum*	E (TSC) E (EPBC)	This species occurs on relatively fertile soils in grassy woodland or natural grassland.	This species is found at four sites in New South Wales: Captains Flat Cemetery, Ilford Cemetery, Steves Travelling Stock Route (TSR) at Delegate and the Tarengo TSR near Boorowa.	This species is not known to occur in any reserves in the region.	The Project Disturbance Area provides suitable habitat for this species and it has been recorded in proximity to the Project Disturbance Area.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Wollemi Mint-bush *Prostanthera cryptandroides subsp. cryptandroides*	V (TSC) V (EPBC)	Occurs on rocky ridgelines on Narrabeen Group Sandstones in association with a range of communities.	Occurs in restricted areas but over a fairly broad range from the Lithgow and Sandy Hollow Districts into the Border Rivers/Gwydir Catchment and up into Queensland.	Wollemi NP	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No
Illawarra greenhood *Pterostylis gibbosa*	E (TSC) E (EPBC)	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. At Milbrodale, the only known population in the Hunter, it occurs on soils derived from Triassic sandstone. It is found in association with narrow-leaved ironbark (*Eucalyptus crebra*), grey box (*E. moluccana*), black cypress pine (*Callitris endlicheri*) and a dense shrub layer.	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra).	This species is not known to occur in any reserves in the region.	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Austral toadflax Thesium australe	V (TSC) V (EPBC)	This species occurs in grassland or grassy woodland and is often found in damp sites in association with kangaroo grass (Themeda australis). This species is a root parasite that takes water and some nutrients from other plants, especially kangaroo grass.	This species is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania, Queensland and in eastern Asia. Occurs also at Mangoola, west of Muswellbrook, NSW.	This species is not known to occur in any reserves in the region.	The Project Disturbance Area provides suitable habitat for this species, although it has not been recorded there. This species is potentially sensitive to the proposed development.	Yes
THREATENED ECOLOGICAL COMMUNITIES						
Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion	EEC (TSC)	Weeping Myall Woodlands occur in a range from open woodlands to woodlands, generally 4-12 m high, in which weeping myall (*Acacia pendula*) trees are the sole or dominant overstorey species.	The EEC occurs in a small stand on heavy, brown clay soil at Jerrys Plains in the Hunter Valley, in the South Hunter Province of the Sydney Basin Bioregion.	This EEC is not known from any conservation reserves in the region.	The Project Disturbance Area does not provide suitable habitat for this community and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions	EEC (TSC)	Occurs on gentle slopes arising from depressions and drainage flats on Permian sediments of the Hunter Valley floor.	Recorded from Maitland, Cessnock and Port Stephens LGAs (in the Sydney Basin Bioregion) and Muswellbrook and Singleton LGAs (in the NSW North Coast Bioregion) but may occur elsewhere in these bioregions. The Mount Owen Complex is within the known distribution of this EEC.	Ravensworth SF	This community does not occur within the Project Disturbance Area. There is no potential for a significant impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	VEC (TSC)	This ecological community generally occurs at the interface of Narrabeen Sandstone and Permian sediments in the Hunter Valley and typically forms a low to mid-high woodland. The community is characterised by an overstorey of slaty gum (*Eucalyptus dawsonii*) and/or grey box (*E. moluccana*) with a moderately dense to dense shrub stratum. The ground layer is generally sparse to very sparse and generally species poor.	Located in the Sydney Basin Bioregion.	Wollemi NP Goulburn River NP	This community does not occur within the Project Disturbance Area. There is no potential for a significant impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC (TSC)	Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20 m (rarely above 10 m) elevation.	Known from parts of the LGAs of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes, Port Stephens, Maitland, Newcastle, Cessnock, Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Hawkesbury, Baulkham Hills, Hornsby, Lane Cove, Blacktown, Auburn, Parramatta, Canada Bay, Rockdale, Kogarah, Sutherland, Penrith, Fairfield, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these LGAs. Major examples once occurred on the floodplains of the Clarence, Macleay, Hastings, Manning, Hunter, Hawkesbury, Shoalhaven and Moruya Rivers.	There are no known occurrences of this EEC within the conservation reserves of the region.	This community does not occur within the Project Disturbance Area. There is no potential for a significant impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions	EEC (TSC)	The EEC occurs on Permian sediments in the Hunter Valley and typically forms an open forest to woodland on slopes and undulating hills. Dominated by narrow-leaved ironbark (*Eucalyptus crebra*), spotted gum (*Corymbia maculata*) and grey box (*E. moluccana*) with a sparse to moderately dense ground layer dominated by numerous forbs and a few grasses.	Located in the NSW North Coast and Sydney Basin Bioregions.	Belford NP	This community does not occur within the Project Disturbance Area. There is no potential for a significant impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Central Hunter Grey Box - Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC (TSC)	The EEC occurs on Permian sediments in the Hunter Valley and typically forms a woodland to open forest on slopes and undulating hills. Dominated by narrow-leaved ironbark (*Eucalyptus crebra*) and grey box (*E. moluccana*) with a moderately dense to dense ground layer dominated by grasses and forbs.	Located in the NSW North Coast and Sydney Basin Bioregions	There are no known occurrences of this EEC within the conservation reserves of the region.	This community has been recorded in the Project Disturbance Area and the community is potentially sensitive to the Project.	**Yes**
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South east Corner Bioregions	EEC (TSC)	Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains.	This EEC occurs in the NSW North Coast, Sydney Basin and South-east corner bioregions. The Project Disturbance Area is within the known distribution of this species.	There are no known occurrences of this EEC within the conservation reserves of the region.	This community does not occur within the Project Disturbance Area. There is no potential for a significant impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Project Disturbance Area	Reservation Within the Region[1]	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
White Box – Yellow Box – Blakely's Red Gum Woodland	EEC (TSC)	This TEC can occur as either woodland or derived grassland. The groundlayer consists of native tussock grasses and herbs, and a sparse, scattered shrub layer. White box (*Eucalyptus albens*), yellow box (*E. melliodora*), or Blakely's red gum (*E. blakelyi*), dominate, where trees remain. This ecological community occurs in areas where rainfall is between 400 and 1200 millimetres per annum, on moderate to highly fertile soils at altitudes of 170 metres to 1200 metres.	This TEC occurs in an arc along the western slopes and tablelands of the Great Dividing Range from Southern Queensland through NSW to central Victoria. It occurs in the Brigalow Belt South, Nandewar, New England Tableland, South Eastern Queensland, Sydney Basin, NSW North Coast, South Eastern Highlands, South East Corner, NSW South Western Slopes, Victorian Midlands and Riverina Bioregions.	Towarri NP Goulburn River NP	This TEC does not occur within the Project Disturbance Area. There is no potential for a significant impact on this community.	No

Notes:

CE	Critically endangered
CEEC	Critically endangered ecological community
E	Endangered
EEC	Endangered ecological community
EP	Endangered population
EPBC	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
LGA	Local Government Area
NP	National Park
NR	Nature Reserve

SF: State Forest
TSC: NSW *Threatened Species Conservation Act 1995*
V Vulnerable

1 The following conservation areas were searched for record s of each species, population or community: Belford NP, Goulburn River NP, Manobalai NR, Towarri NP, Watagans NP, Werakata NP, Werakata SCA, Wingen Maid NR, Wollemi NP, Yengo NP

Table 2 Threatened Fauna Species and Threatened Fauna Populations Known or Predicted to Occur within the Project Disturbance Area

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
THREATENED FAUNA SPECIES						
AMPHIBIANS						
Booroolong frog *Litoria booroolongensis*	E (TSC) E (EPBC)	Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins. Shelter under rocks or amongst vegetation near the ground on the stream edge.	The Booroolong frog is restricted to NSW and north-eastern Victoria, predominantly along the western-flowing streams of the Great Dividing Range. It has disappeared from the Northern Tablelands and is now rare throughout most of the remainder of its range. Most recent records are from the south-west slopes of NSW.	Mt Royal NP	The Project Disturbance Area or its surrounds do not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
REPTILES						
Pink-tailed worm-lizard *Aprasia parapulchella*	V (TSC) V (EPBC)	This species typically inhabits areas which are well-drained, sloping, rocky, and open woodland with a mostly native grassland understorey. These lizards can usually be found beneath partially embedded rocks and make their burrows in black ant and termite nests.	This species is only known to be distributed across the Central and Southern Tablelands and the South-western Slopes. The strongest known concentration of this species is in the Canberra/Queanbeyan Region, however, other populations have been recorded in proximity to Cooma, Yass, Bathurst, Albury and West Wyalong.	Goulburn River NP	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No
BIRDS						
Australasian bittern *Botaurus poiciloptilus*	E (TSC) E (EPBC)	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleoacharis* spp.).	This species may be found over most of NSW except for the far north-west.	This species is not known to occur in any reserves in the region.	The Project Disturbance Area or its surrounds do not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Australian painted snipe *Rostratula australis, Rostratula benghalensis* s. lat	E (TSC) V (EPBC)	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowal, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin.	This species is not known to occur in any reserves in the region.	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No
spotted harrier *Circus assimilis*	V (TSC)	Their habitat of choice is open grassy woodland, grassland, inland riparian woodland and shrub steppe. Although mostly associated with native grasslands it has also been identified in agricultural farmland. Their nest is made in a tree and composed of sticks. Individuals of this species are sparsely distributed throughout Australia and occur as a single population.	The spotted harrier can be found throughout mainland Australia except for areas of dense forest on the coast, escarpments and ranges and rarely ever in Tasmania.	Wollemi NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
little eagle *Hieraaetus morphnoides*	V (TSC)	This species is typically identified in open eucalypt forests, woodlands and open woodlands, and other areas where prey are plentiful. The nest in tall living trees within remnant patches. This species occurs as a single population within Australia.	The little eagle is distributed throughout mainland Australia except for the most densely forested parts of the Great Dividing Range escarpment.	Mt Royal NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No
black falcon *Falco subniger*	V (TSC)	This species inhabits woodland, scrubland and grassland in the arid and semi-arid zones, especially wooded watercourses and agricultural land with scattered remnant trees. The species usually feeds on other birds, but also some small mammals.	The black falcon is found sparsely across northern, eastern, southern and central Australia. In NSW, it is mainly known from inland regions, but has been recorded on the tablelands and coast.	This species is not known to occur in any reserves in the region	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
gang-gang cockatoo *Callocephalon fimbriatum*	V (TSC)	In summer this species occurs in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter this species moves to drier more open eucalypt forests and woodlands. It favours old growth trees for nesting and roosting.	In NSW this species occurs from the south east coast to the Hunter region and inland to the Central Tablelands and South-west Slopes. The Proposed Modification Areas occur within the known distribution of this species.	Wollemi NP Yengo NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No
glossy black-cockatoo *Calyptorhynchus lathami*	V (TSC)	Habitat for this species includes forests on low-nutrient soils, specifically those containing key *Allocasuarina* feed species. They will also eat seeds from eucalypts, angophoras, acacias, cypress pine and hakeas, as well as eating insect larvae. Breeding occurs in autumn and winter, with large hollows required.	The glossy black-cockatoo has a sparse distribution along the east coast and adjacent inland areas from western Victoria to Rockhampton in Queensland. In NSW, it has been recorded as far inland as Cobar and Griffith. This species was recorded in the Anvil Hill Project EA (Umwelt 2006).	Wollemi NP Yengo NP Mount Royal NP Manobalai NR	This species was recorded in the wider study area. The Project Disturbance Area provides preferred foraging resources for this species. This species is potentially sensitive to the proposed development.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
little lorikeet *Glossopsitta pusilla*	V (TSC)	This species can be found in dry-open eucalypt forests and woodlands, and have been identified in remnant vegetation, old growth vegetation, logged forests, and roadside vegetation. The little lorikeet usually forages in small flocks, not always with birds of their own species. They nest in hollows, mostly in living smooth-barked apples.	This species is distributed from just north of Cairns, around the east coast of Australia down to Adelaide. In NSW this species is found from the coast to the western slopes of the Great Dividing Range, extending as far west as Albury, Dubbo, Parkes and Narrabri.	Manobalai NR Wollemi NP Yengo NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Swift parrot *Lathamus discolor*	E (TSC) E (EPBC)	This species often visits box-ironbark forests, feeding on nectar and lerps. In NSW, typical tree species in which this species forages include mugga ironbark (*Eucalyptus sideroxylon*), grey box (*E. moluccana*), swamp mahogany (*E. robusta*), spotted gum (*Corymbia maculata*), red bloodwood (*C. gummifera*), narrow-leaved red ironbark (*E. crebra*), forest red gum (*E. tereticornis*) and yellow box (*E. melliodora*). This species is a migratory species that breeds in Tasmania during the spring and summer, and migrates to the mainland during the cooler months of the year.	In NSW this species has been recorded from the western slopes region along the inland slopes of the Great Dividing Range, as well as forests along the coastal plains from southern to northern NSW. The Project Disturbance Area is within the known distribution of this species.	Wollemi NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
turquoise parrot *Neophema pulchella*	V (TSC)	This species lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. It nests in tree hollows, logs or posts, from August to December.	The turquoise parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range.	Wollemi NP Yengo NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No
barking owl *Ninox connivens*	V (TSC)	Habitat for this species includes dry forests and woodlands, often in association with hydrological features such as rivers and swamps.	The barking owl is distributed sparsely throughout temperate and semi-arid areas of mainland Australia, however it is most abundant in the tropical north. Most records for this species occur west of the Great Dividing Range.	Wollemi NP Yengo NP Manobalai NR	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
powerful owl *Ninox strenua*	V (TSC)	The powerful owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. It generally requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation.	The powerful owl occurs in eastern Australia, mostly on the coastal side of the Great Dividing Range, from south western Victoria to Bowen in Queensland.	Wollemi NP Yengo NP Mt Royal NP Belford NP Manobalai NR	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
masked owl *Tyto novaehollandiae*	V (TSC)	This species is generally recorded from open forest habitat with sparse mid-storey but patches of dense, low ground cover. It is also recorded from ecotones between wet and dry eucalypt forest, along minor drainage lines and near boundaries between forest and cleared land.	The masked owl occurs sparsely throughout the continent and nearby islands, including Tasmania and New Guinea.	Wollemi NP Yengo NP Mt Royal NP Manobalai NR	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No
brown treecreeper (eastern subspecies) *Climacteris picumnus victoriae*	V (TSC)	Typical habitat for this species includes drier forests, woodlands and scrubs with fallen branches; river red gums on watercourses and around lake-shores; paddocks with standing dead timber; and margins of denser wooded areas. This species prefers areas without a dense understorey.	This species occurs over central NSW, west of the Great Dividing Range and sparsely scattered to the east of the divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys.	Wollemi NP Yengo NP Manobalai NR	This species was recorded in the wider study area. The Project Disturbance Area provides foraging habitat for this species. This species is potentially sensitive to the proposed development.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
speckled warbler *Chthonicola sagittata*	V (TSC)	In NSW, occupies eucalypt and cypress woodlands, generally on the western slopes of the Great Dividing Range. Inhabits woodlands with a grassy understorey, leaf litter and shrub cover, often on ridges or gullies (Garnett and Crowley 2000).	The speckled warbler has a distribution from south-eastern Queensland, through central and eastern NSW to Victoria.	Wollemi NP	This species was recorded in the wider study area. The Project Disturbance Area provides foraging habitat for this species. This species is potentially sensitive to the proposed development.	Yes
painted honeyeater *Grantiella picta*	V (TSC)	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	The greatest concentration of this species and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution.	Wollemi NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Regent honeyeater *Anthochaera phrygia*	CE (TSC) CE (EPBC)	This species generally occurs in temperate eucalypt woodlands and open forests of south eastern Australia. It is commonly recorded from box-ironbark eucalypt associations, wet lowland coastal forests dominated by swamp mahogany, spotted gum and riverine *Casuarina* woodlands. An apparent preference exists for the wettest, most fertile sites within these associations, such as creek flats, river valleys and foothills.	Once recorded between Adelaide and the central coast of Queensland, this species range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland.	Wollemi NP Yengo NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
grey-crowned babbler (eastern subspecies) *Pomatostomus temporalis temporalis*	V (TSC)	Open box-gum woodlands on the slopes. Box-cypress-pine and open box woodlands on alluvial plains. Also found in acacia shrubland and adjoining areas. Feeds on invertebrates; forage on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses (DECCW 2010). Occupy territories from 1 to 50 hectares.	Occurs throughout northern and south-eastern Australia. In NSW, this species occurs on the western slopes of the Great Dividing Range and on the western plains reaching as far west as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW.	Belford NP Wollemi NP Yengo NP	This species was recorded in the wider study area. The Project Disturbance Area provides foraging habitat for this species. This species is potentially sensitive to the proposed development.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
varied sittella *Daphoenositta chrysoptera*	V (TSC)	The varied sittella can typically be found in eucalypt forests and woodlands, especially of rough-barked species and mature smooth-barked gums with dead branches, it can also be identified in mallee and acacia woodlands. This species builds a cup shaped nest made of plant fibres and spiders webs which is placed at the canopy level in the fork of a living tree.	The varied sittella is a sedentary species that inhabits the majority of mainland Australia with the exception of the treeless deserts and open grasslands. Its NSW distribution is basically continuous from the coast to the far west.	Manobalai NR Wollemi NP Yengo NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No
hooded robin (south-eastern form) *Melanodryas cucullata cucullata*	V (TSC)	This species prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Hooded robins require structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses (DECCW 2010).	This form of the hooded robin is distributed throughout south-eastern Australia, from central Queensland to the Spencer Gulf, South Australia. This form occurs throughout NSW except for the north-west, where it intergrades with the northern form *M. cucullata picata*.	Wollemi NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
scarlet robin *Petroica boodang*	V (TSC)	This robin can be found in woodlands and open forests from the coast through to inland slopes. The birds can sometimes be found on the eastern fringe of the inland plains in the colder months of the year. Woody debris and logs are both important structural elements of its habitat. It forages from low perches on invertebrates either on the ground or in woody debris or tree trunks.	The scarlet robin can be found in south-eastern Australia, from Tasmania to the southern end of Queensland, to western Victoria and south SA. In NSW it is found throughout the eastern areas of the state, no further than 500 km from the coast.	Wollemi NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No
diamond firetail *Stagonopleura guttata*	V (TSC)	Habitat includes a range of eucalypt dominated communities with a grassy understorey, including woodland, forest and mallee. It appears that populations are unable to persist in areas where there are no vegetated remnants larger than 200 hectares.	The diamond firetail occurs through central and eastern NSW, north into southern and central Queensland and south through Victoria to South Australia. In NSW it mainly occurs west of the Great Dividing Range, although populations are known from drier coastal areas such as the Cumberland Plain and the Hunter, Clarence, Richmond and Snowy River valleys.	Wollemi NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
MAMMALS						
Spotted-tailed quoll (SE mainland population) *Dasyurus maculatus maculatus*	V (TSC) E (EPBC)	Habitat for this species is highly varied, ranging from sclerophyll forest, woodlands, coastal heathlands and rainforests. Records exist from open country, grazing lands and rocky outcrops. Suitable den sites include hollow logs, tree hollows, rocky outcrops and caves.	In NSW this species occurs on both sides of the Great Dividing Range, with the highest densities occurring in the north east of the state. This species occurs from the coast to the snowline and inland to the Murray River.	Wollemi NP Yengo NP Mt Royal NP Belford NP	The Project Disturbance Area provides suitable habitat for this species. This species has been recorded in the local area. This species is potentially sensitive to the proposed development.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Koala *Phascolarctos cinereus*	V (TSC) V (EPBC)	This species inhabits eucalypt forests and woodlands. The species is known to feed on a large number of eucalypt species; however it tends to specialise on a small number in different areas. *Eucalyptus tereticornis, E. punctata, E. cypellocarpa, E. viminalis, E. microcorys, E. robusta, E. albens, E. camaldulensis* and *E. populnea* are some preferred species.	This species has a fragmented distribution throughout eastern Australia, with the majority of records from NSW occurring on the central and north coasts, as well as some areas further west. This species is known to occur along inland rivers on the western side of the Great Dividing Range.	Wollemi NP Yengo NP Mt Royal NP Manobalai NR	The Project Disturbance Area provides suitable habitat for this species. This species has been recorded in the local area. This species is potentially sensitive to the proposed development.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
squirrel glider *Petaurus norfolcensis*	V (TSC)	Inhabits a variety of mature or old growth habitats, including box, box-ironbark woodlands, river red gum forest, and blackbutt-bloodwood forest with heath understorey. It prefers mixed species stands with a shrub or acacia mid-storey, and requires abundant tree hollows for refuge and nest sites.	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Wollemi NP Yengo NP Mt Royal NP Belford NP	This species was tentatively recorded in the wider study area. The Project Disturbance Area provides foraging and den habitat for this species. This species is potentially sensitive to the proposed development.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Brush-tailed rock-wallaby *Petrogale penicillata*	E (TSC) V (EPBC)	This species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. This species browses on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. This species shelters or basks during the day in rock crevices, caves and overhangs and is most active at night.	The brush-tailed rock-wallaby was once abundant and ubiquitous throughout the mountainous country of south-eastern Australia. This species distribution roughly followed the Great Dividing Range for 2500 kilometres from the Grampians in West Victoria to Nanango in south-east Queensland, with outlying populations in coastal valleys and ranges to the east of the divide, and the slopes and plains as far west as Cobar in NSW and Injune (500 kilometres NW of Brisbane) in Queensland.	Wollemi NP Yengo NP Manobalai NR Barrington Tops NP Watagans NP	The Project Disturbance Area does not provide suitable habitat for this species and it has not been recorded in the Project Disturbance Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Grey-headed flying-fox *Pteropus poliocephalus*	V (TSC) V (EPBC)	This species occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 kilometres of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	This species is found within 200 kilometres of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria.	Yengo NP Wollemi NP Barrington Tops NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
yellow-bellied sheathtail-bat *Saccolaimus flaviventris*	V (TSC)	This species forages for insects, flies high and fast over the forest canopy, but lower in more open country. It forages in most habitats across its very wide range, with and without trees; and appears to defend an aerial territory. It roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to use mammal burrows.	The yellow-bellied sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes.	Wollemi NP Manobalai NR	This species was detected within the wider study area via echolocation recording. The Project Disturbance Area provides potential foraging and roosting habitat for this species. This species is potentially sensitive to the proposed development.	**Yes**
east coast freetail-bat *Mormopterus norfolkensis*	V (TSC)	This species occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures.	The eastern freetail-bat is found along the east coast from south Queensland to southern NSW. This species was recorded in the Anvil Hill Project EA (Umwelt 2006).	Wollemi NP Yengo NP Manobalai NR Belford NP Barrington Tops NP	This species was not detected within the wider study area. The Project Disturbance Area provides potential foraging and roosting habitat for this species. This species is potentially sensitive to the proposed development.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Large-eared pied bat *Chalinolobus dwyeri*	V (TSC) V (EPBC)	This species is generally found in a variety of drier habitats, including dry sclerophyll forests and woodlands however, it probably tolerates a wide range of habitats. This species tends to roost in the twilight zones of mines and caves, generally in colonies or common groups.	This species has a distribution from south western Queensland to NSW from the coast to the western slopes of the Great Dividing Range. In NSW this species is not known to occur further west than Warrumbungle NP.	Wollemi NP Yengo NP Manobalai NR Watagans NP	This species was detected within the wider study area via echolocation recording. The Project Disturbance Area provides potential foraging habitat for this species. This species is potentially sensitive to the proposed development.	**Yes**
eastern false pipistrelle *Falsistrellus tasmaniensis*	V (TSC)	Habitat for this species includes sclerophyll forest. It prefers wet habitats, with trees over 20 metres high, and generally roosts in tree hollows or trunks.	This species has a range from south eastern Queensland, through NSW, Victoria and into Tasmania, and occurs from the Great Dividing Range to the coast. This species was recorded in the Anvil Hill Project EA (Umwelt 2006).	Wollemi NP Yengo NP Barrington Tops NP	This species was not detected within the wider study area. The Project Disturbance Area provides potential foraging and roosting habitat for this species. This species is potentially sensitive to the proposed development.	**Yes**

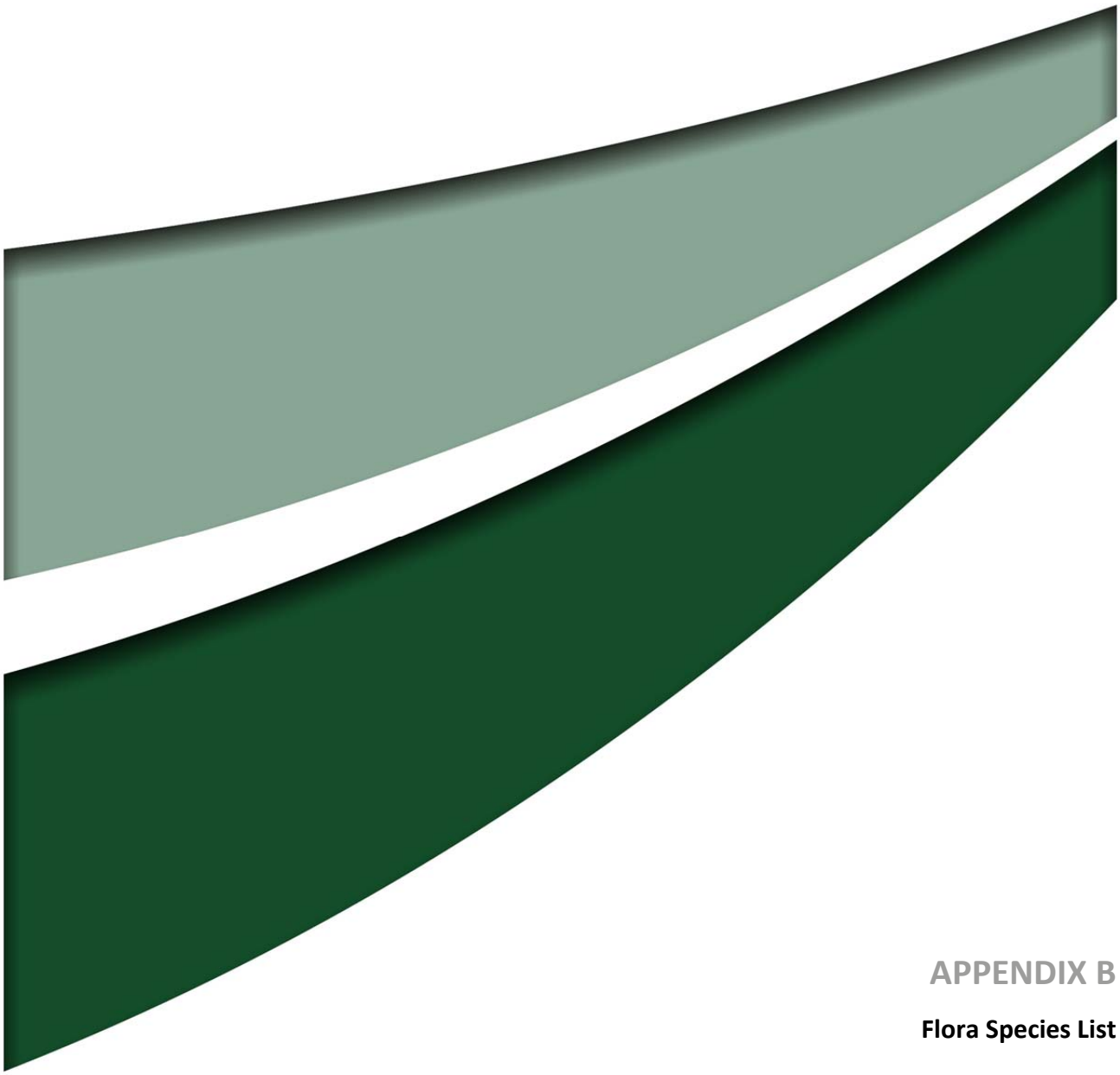
Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
little bentwing-bat *Miniopterus australis*	V (TSC)	Prefers moist eucalypt forest, rainforest or dense coastal banksia scrub. This species roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Occurs in coastal north-eastern NSW and eastern Queensland.	Wollemi NP	This species was detected within the wider study area via echolocation recording. The Project Disturbance Area provides potential foraging and roosting habitat for this species. This species is potentially sensitive to the proposed development.	**Yes**
eastern bentwing-bat *Miniopterus schreibersii oceanensis*	V (TSC)	This species hunts in forested areas and uses caves as the primary roosting habitat, but also uses derelict mines, storm-water tunnels, buildings and other man-made structures. It forms discrete populations centered on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Eastern bentwing-bats occur along the east and north-west coasts of Australia. This species was recorded in the Anvil Hill Project EA (Umwelt 2006).	Yengo NP Wollemi NP Mount Royal NP Belford NP Manobalai NR	This species was detected within the wider study area via echolocation recording. The Project Disturbance Area provides potential foraging habitat for this species. This species is potentially sensitive to the proposed development.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
South-eastern long-eared bat *Nyctophilus corbeni*	V (TSC) V (EPBC)	This species inhabits a variety of vegetation types, including mallee, bulloak (*Allocasuarina luehmanni*) and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. This species roosts in tree hollows, crevices, and under loose bark.	The distribution of the south eastern form of this species coincides approximately with the Murray Darling Basin with the Pilliga Scrub region a distinct stronghold for this species. This species has been recorded throughout NSW with the exception of the extreme north-west of the state, and most areas east of the Great Dividing Range (with the exception of the areas around Sydney).	Manobalai NR Wollemi NP	This species was not detected within the wider study area. The Project Disturbance Area provides potential foraging and roosting habitat for this species. This species is potentially sensitive to the proposed development.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in Relation to Project Disturbance Area	Reservation in the Region	Occurrence in Project Disturbance Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
greater broad-nosed bat *Scoteanax rueppellii*	V (TSC)	The greater broad-nosed bat appears to prefer moist environments such as moist gullies in coastal forests, or rainforest. They have also been found in gullies associated with wet and dry sclerophyll forests and open woodland. It roosts in hollows in tree trunks and branches and has also been found to roost in the roofs of old buildings.	The greater broad-nosed bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however it does not occur at altitudes above 500 metres. This species was recorded in the Anvil Hill Project EA (Umwelt 2006).	Wollemi NP Yengo NP	This species was not detected within the wider study area. The Project Disturbance Area provides potential foraging and roosting habitat for this species. This species is potentially sensitive to the proposed development.	**Yes**
eastern cave bat *Vespadelus troughtoni*	V (TSC)	This species is a cave-roosting bat that is usually found in dry open forest and woodland, near cliffs or rocky overhangs. It has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals, and is occasionally found along cliff-lines in wet eucalypt forest and rainforest.	The eastern cave bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Wollemi NP Manobalai NR Yengo NP	This species was not recorded in the Project Disturbance Area. The Project Disturbance Area provides potential foraging habitat for this species. There is no potential for a significant impact on this species.	No

Notes:

CE:	Critically Endangered
E:	Endangered
EPBC:	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
LGA:	Local Government Area
MAR:	Marine
MIG:	Migratory
NP:	National Park
NR:	Nature Reserve
SF:	State Forest
SCA:	State Conservation Area
TSC:	NSW *Threatened Species Conservation Act 1995*
V:	Vulnerable



APPENDIX B

Flora Species List

Appendix B – Flora Species List

The following list was developed from surveys of the Project Area and surrounds as detailed in Section 3.3 of the main report. It includes all species of vascular plants observed during fieldwork completed by Umwelt in 2014. Although substantial, the list will not be comprehensive, because 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 6 modified Braun-Blanquet cover-abundance score (see Section 3.3.4.1 of main report);

X Species recorded during a rapid assessment or opportunistically with no cover abundance data;

asterisk (*) denotes species not native to the wider study area;

subsp. subspecies;

var. variety; and

Bold font denotes threatened plant species or populations.

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 2015), 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.

Table 1 lists the flora species recorded in quadrats, rapid assessment sites and transect sites recorded as part of the flora survey effort for the Project within the Project Disturbance Area and wider study area.

The location of these survey points is shown on Figure 3.1 of the main report.

Table 1 Flora Species Recorded in Quadrat Sites, Rapid Assessment Sites and Opportunistic Observations for the Wider Study Area

Family	Scientific Name	Common Name	Quadrats													Rapid Assessments										
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	OPS
Filicopsida																										
Adiantaceae	*Cheilanthes distans*	bristly cloak fern	2					3									1									
Adiantaceae	*Cheilanthes sieberi* subsp. *sieberi*	poison rock fern	3	3	2			3	3	2		2	2	2	1	1	1	1		1	1					
Magnoliopsida (Flowering Plants) - Lillidae																										
Anthericaceae	*Arthropodium minus*	small vanilla lily		1																						
Anthericaceae	*Laxmannia gracilis*	slender wire lily			1	1	2							1												
Asphodelaceae	*Bulbine bulbosa*	bulbine lily		2				2							1			1					1			
Cyperaceae	*Cyperus gracilis*	slender flat-sedge		2																						
Cyperaceae	*Lepidosperma laterale*	variable sword-sedge							2																X	
Hypoxidaceae	*Hypoxis spp.*					2																				
Lomandraceae	*Lomandra filiformis* subsp. *coriacea*	wattle matt-rush			3						1															
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	many-flowered mat-rush					1																			
Orchidaceae	*Dendrobium speciosum*	rock lily																								X
Orchidaceae	***Diuris tricolor***	**pine donkey orchid**		2		1								2	1											
Orchidaceae	*Microtis unifolia*	common onion orchid		1											3											

Family	Scientific Name	Common Name	Quadrats													Rapid Assessments										
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	OPS
Orchidaceae	***Prasophyllum petilum***																									X
Orchidaceae	*Pterostylis bicolor*	black-tip greenhood		1																						X
Phormiaceae	*Dianella caerulea*	blue flax-lily											1													
Poaceae	**Aira cupaniana*	silvery hairgrass	2	2																						
Poaceae	**Aira spp.*	a hairgrass													2											
Poaceae	*Aristida personata*													3												
Poaceae	*Aristida ramosa*	purple wiregrass		4	3	3	3								3	X									X	
Poaceae	*Aristida spp.*	a wiregrass																X		X	X					
Poaceae	*Aristida vagans*	threeawn speargrass								3	3			3												
Poaceae	*Austrostipa scabra subsp. falcata*	rough speargrass				2	3	3	2	3	3				3											
Poaceae	*Austrostipa spp.*	a speargrass	2	4														X								
Poaceae	*Austrostipa verticillata*	slender bamboo grass																				X				
Poaceae	**Avena fatua*	wild oats																						X		
Poaceae	*Bothriochloa decipiens*	red grass									2															
Poaceae	*Bothriochloa spp.*	redgrass, bluegrass	3			3	3								3											
Poaceae	**Briza minor*	shivery grass	2	2											2											
Poaceae	*Chloris ventricosa*	tall chloris										2														
Poaceae	*Cymbopogon refractus*	barbed wire grass		4	3	3	3				2			3		X				X						

Family	Scientific Name	Common Name	Quadrats													Rapid Assessments										
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	OPS
Poaceae	*Eragrostis brownii*	brown's lovegrass									2			2												
Poaceae	*Eragrostis falcata*	sickle lovegrass					2			2		2		2												
Poaceae	*Eragrostis leptostachya*	paddock lovegrass									2															
Poaceae	**Lolium perenne*	perennial ryegrass	2																							
Poaceae	*Microlaena stipoides var. stipoides*	weeping grass							3			3	3										X			
Poaceae	*Oplismenus aemulus*												2													
Poaceae	*Oplismenus spp.*							1																		
Poaceae	*Paspalidium distans*									2		3														
Poaceae	*Rytidosperma spp.*			1										2												
Poaceae	*Sporobolus creber*	slender rat's tail grass	3					3			2				3									X		
Magnoliopsida (Flowering Plants) - Magnoliidae																										
Apiaceae	*Hydrocotyle laxiflora*	stinking pennywort																								X
Apocynaceae	**Gomphocarpus fruticosus*	narrow-leaved cotton bush																								X
Asteraceae	**Arctotheca calendula*	capeweed													2											
Asteraceae	*Brachycome multifida var. multifida*				3																					

Family	Scientific Name	Common Name	Quadrats													Rapid Assessments										
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	OPS
Asteraceae	*Brachyscome multifida var. multifida*					1																				
Asteraceae	*Brachyscome spp.*																X				X					
Asteraceae	*Calotis cuneifolia*	purple burr-daisy						1																		
Asteraceae	*Calotis lappulacea*	yellow burr-daisy			2																					
Asteraceae	**Carthamus lanatus*	saffron thistle																						X		
Asteraceae	*Cassinia aculeata*	dolly bush						2	3			2									X	X				
Asteraceae	*Cassinia arcuata*	sifton bush				1								1												
Asteraceae	*Chrysocephalum apiculatum*	common everlasting	1	3		3	2		1	2	2		2	2	2					X						
Asteraceae	**Cirsium vulgare*	spear thistle																	X					X		
Asteraceae	*Cymbonotus lawsonianus*												1													
Asteraceae	*Euchiton spp.*	a cudweed	2																							
Asteraceae	**Hypochaeris radicata*	catsear	3	3					2			1		2	3											
Asteraceae	*Olearia elliptica*	sticky daisy-bush							3			1														
Asteraceae	**Senecio madagascariensis*	fireweed	3	3		1					2			1	3				X	X				X		
Asteraceae	**Sonchus oleraceus*	common sowthistle		1																						
Asteraceae	*Xerochrysum viscosum*	sticky everlasting												1												

Family	Scientific Name	Common Name	Quadrats													Rapid Assessments										
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	OPS
Bignoniaceae	*Pandorea pandorana*	wonga wonga vine							2				1													
Boraginaceae	*Cynoglossum australe*													2												
Boraginaceae	**Echium plantagineum*	patterson's curse	2																							
Cactaceae	**Opuntia aurantiaca*	tiger pear		2		2	2	1		1	2	2		2												
Cactaceae	**Opuntia humifusa*	creeping pear								1																
Cactaceae	**Opuntia stricta var. stricta*	common prickly pear		2	1	2			1		2			2												
Campanulaceae	*Wahlenbergia communis*	tufted bluebell							3					2						X						
Campanulaceae	*Wahlenbergia gracilis*	sprawling bluebell				2															X					
Campanulaceae	*Wahlenbergia luteola*	bluebell					3				2		3													
Campanulaceae	*Wahlenbergia stricta*	tall bluebell		2	1	2				2		2		2								X				
Caryophyllaceae	**Petrorhagia nanteuilii*	proliferous pink	3	2										1	3									X		
Caryophyllaceae	**Silene latifolia*	white campion	3	2											3											
Casuarinaceae	*Allocasuarina luehmannii*	bulloak	X		2	2	3				4			3	2	X				X					X	
Casuarinaceae	*Allocasuarina verticillata*	drooping sheoak						3	3	3											X					
Casuarinaceae	*Casuarina cunninghamiana*	river oak																	X							

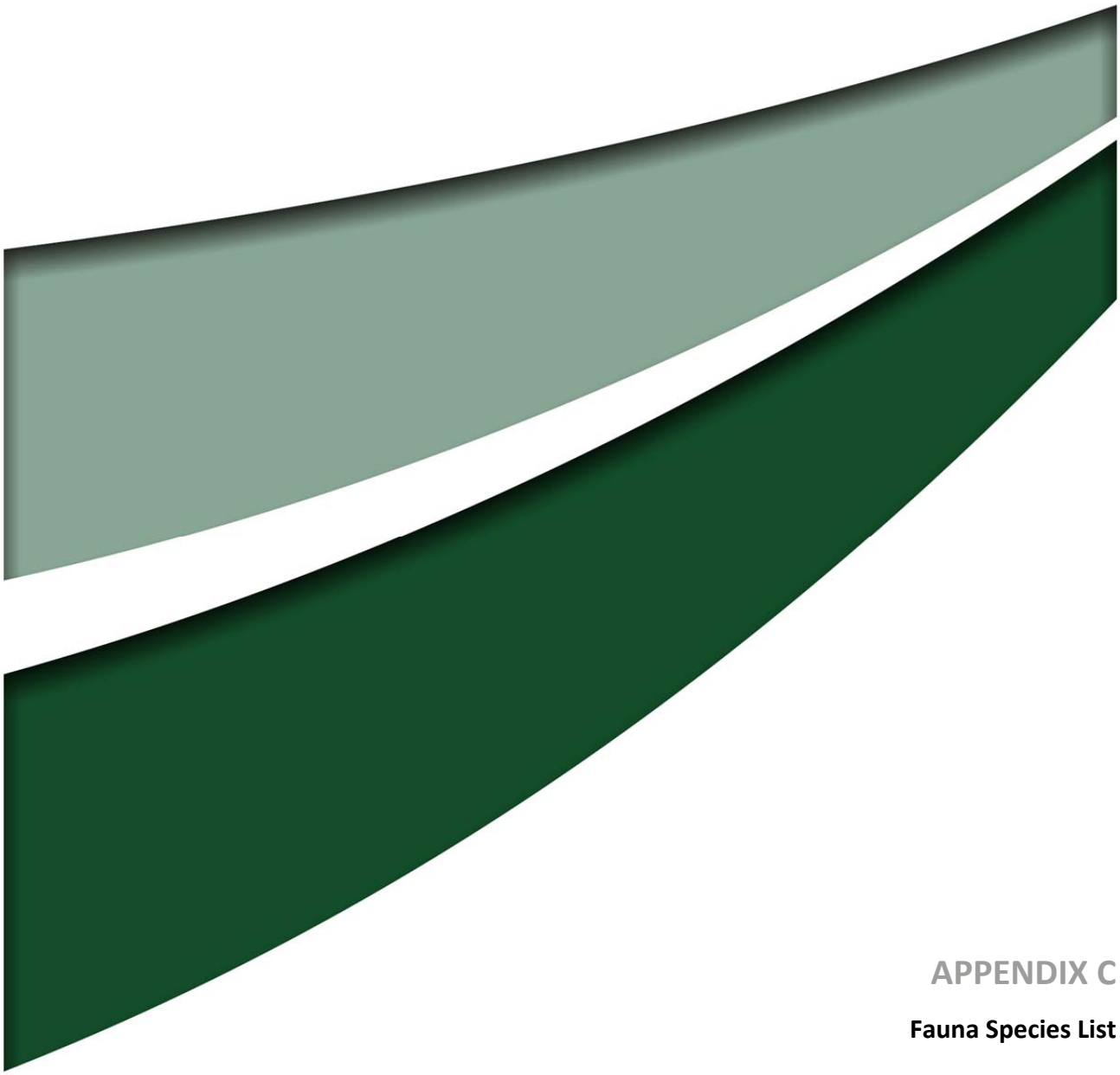
Family	Scientific Name	Common Name	Quadrats													Rapid Assessments										
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	OPS
Chenopodiaceae	*Einadia hastata*	berry saltbush							1	1			2													
Colchicaceae	*Wurmbea dioica*	early nancy		2	1	1								1	3											
Convolvulaceae	*Dichondra repens*	kidney weed												2			X									
Crassulaceae	*Crassula sieberiana*	australian stonecrop			2																					
Cupressaceae	*Callitris endlicheri*	black cypress pine							3	3		2	2				X	X		X	X	X	X		X	
Dilleniaceae	*Hibbertia acicularis*									2																
Dilleniaceae	*Hibbertia spp.*													1												
Droseraceae	*Drosera peltata*	a sundew													1											X
Ericaceae	*Leucopogon muticus*	blunt beard-heath			1	1								2				X								
Ericaceae	*Styphelia triflora*	pink five-corners		1						2																
Fabaceae (Faboideae)	*Daviesia ulicifolia*	gorse bitter pea															X									X
Fabaceae (Faboideae)	*Desmodium gunnii*	slender tick-trefoil		1	1																					
Fabaceae (Faboideae)	*Desmodium varians*	slender tick-trefoil									2															
Fabaceae (Faboideae)	*Glycine clandestina*	twining glycine			1									2												
Fabaceae (Faboideae)	*Glycine tabacina*	variable glycine		2			1				2			2												
Fabaceae (Faboideae)	*Hovea linearis*								2								X									
Fabaceae (Faboideae)	**Medicago sativa*	lucerne																						X		

Family	Scientific Name	Common Name	Quadrats													Rapid Assessments										
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	OPS
Fabaceae (Faboideae)	**Medicago spp.*	a medic	2												3											
Fabaceae (Faboideae)	*Podolobium ilicifolium*	prickly shaggy pea							2																	
Fabaceae (Faboideae)	*Pultenaea spp.*				2																					
Fabaceae (Faboideae)	**Trifolium subterraneum*	subterranean clover	2																					X		
Fabaceae (Mimosoideae)	*Acacia doratoxylon*	currawang						3	3	3		3	2				X					X				
Fabaceae (Mimosoideae)	*Acacia falcata*				1		2																			
Fabaceae (Mimosoideae)	*Acacia linearifolia*	narrow-leaved wattle												2												
Goodeniaceae	*Dampiera lanceolata var. lanceolata*											2	2													
Goodeniaceae	*Dampiera stricta*																									X
Goodeniaceae	*Goodenia hederacea*	ivy goodenia															X									
Goodeniaceae	*Goodenia ovata*	hop goodenia							3																	
Haloragaceae	*Gonocarpus tetragynus*	poverty raspwort						2				2														
Lamiaceae	*Prostanthera prunelloides*							3				3									X	X				
Lamiaceae	*Spartothamnella juncea*	bead bush							2	3			3	1			X									
Loranthaceae	*Amyema miquelii*	box mistletoe				2		1																		

Family	Scientific Name	Common Name	Quadrats													Rapid Assessments										
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	OPS
Loranthaceae	*Amyema spp.*	mistletoe												1											X	
Malvaceae	*Sida corrugata*	corrugated sida		1	1	2	2	2		3	2		2													
Myrsinaceae	**Anagallis arvensis*	scarlet pimpernel	3	3	3	2	1			2				2	3											
Myrtaceae	*Angophora floribunda*	rough-barked apple											2		X			X		X					X	
Myrtaceae	*Eucalyptus blakelyi <--> tereticornis*			3		3								4												
Myrtaceae	*Eucalyptus crebra*	narrow-leaved ironbark	X		4			3	3	3	3	3	3		X	X	X	X		X	X		X		X	
Myrtaceae	*Eucalyptus dawsonii*	slaty gum					4																			
Myrtaceae	*Eucalyptus dwyeri*	dwyer's red gum						2				2										X				
Myrtaceae	*Eucalyptus moluccana*	grey box				3									X										X	
Myrtaceae	*Eucalyptus punctata*	grey gum						2	4			3	4			X	X	X			X	X	X			
Myrtaceae	*Kunzea ericoides*	burgan													1											
Myrtaceae	*Kunzea sp. 'Mt Kaputar'*				3	2	1				2	3		2		X	X			X			X		X	
Myrtaceae	*Melaleuca decora*				3						2					X										
Oleaceae	*Notelaea longifolia*	large mock-olive											3	2									X			
Oleaceae	*Notelaea microcarpa var. microcarpa*			1	2	3	2	2	2	3		3	3			X							X			
Oxalidaceae	*Oxalis perennans*			2					2	2		2		2												

Family	Scientific Name	Common Name	Quadrats													Rapid Assessments										
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	OPS
Oxalidaceae	**Oxalis pes-caprae*	soursob	3																							
Pittosporaceae	*Bursaria spinosa subsp. spinosa*	native blackthorn						3	3			3	3				X				X		X		X	
Plantaginaceae	**Plantago lanceolata*	lamb's tongues	2																							
Proteaceae	*Persoonia linearis*	narrow-leaved geebung						2	3			3	3	2								X				
Rhamnaceae	*Alphitonia excelsa*	red ash								3		3	2								X		X			
Rubiaceae	*Galium leptogonium*			1										1												
Rubiaceae	*Opercularia spp.*					1			1																	
Rubiaceae	*Pomax umbellata*	pomax						1	1																	
Rubiaceae	*Psydrax odorata*	shiny-leaved canthium			1	1		1	2	2			2									X				
Rutaceae	*Boronia anemonifolia*							2																		
Sapindaceae	*Dodonaea viscosa subsp. cuneata*	wedge-leaf hop-bush			2								1					X								
Scrophulariaceae	**Linaria pelisseriana*	pelisser's toadflax	3	2											3											
Solanaceae	**Lycium ferocissimum*	african boxthorn																	X							
Solanaceae	*Solanum brownii*	violet nightshade							2	2			3								X					
Solanaceae	*Solanum cinereum*	narrawa burr				1				2				2												
Stackhousiaceae	*Stackhousia viminea*	slender stackhousia																								X

Family	Scientific Name	Common Name	Quadrats													Rapid Assessments										
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	OPS
Verbenaceae	**Verbena bonariensis*	purpletop		1																						
Violaceae	*Hybanthus monopetalus*	slender violet-bush						2		1		2														



APPENDIX C

Fauna Species List

Appendix C – Fauna Species List

The following list was developed from surveys of the wider study area as detailed in Section 3.5 of the main report.

The following abbreviations or symbols are used in the list:

asterisk (*)	Denotes species not indigenous to the Dolwendee Quarry Project Disturbance Area or wider study area
numbers	numbers of individuals (threatened species only) for each observation
subsp.	Subspecies
X	Identified during field surveys
H	Hair sample identification
D	Definite bat call identification (Echo Ecology 2015)
Pro	Probable bat call identification (Echo Ecology 2015)
Pos	Possible bat call identification (Echo Ecology 2015)
MAR	Listed marine species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
MIG	Listed migratory species under the EPBC Act
PV	Potential to be a Vulnerable species (Identification method not sufficient to be certain)
V	Vulnerable
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	Conservation Status		Record Type
		TSC Act	EPBC Act	
BIRDS				
Anatidae				
Anas superciliosa	Pacific black duck			X
Chenonetta jubata	Australian wood duck			X
Podicipedidae				
Tachybaptus novaehollandiae	Australasian grebe			X
Pelecanidae				
Pelecanus conspicillatus	Australian pelican			X
Ardeidae				
Egretta novaehollandiae	white-faced heron			X
Accipitridae				
Aquila audax	wedge-tailed eagle			X
Elanus notatus	black-shouldered kite			X
Haliastur sphenurus	whistling kite			X
Falconidae				
Falco berigora	brown falcon			X
Falco cenchroides	nankeen kestrel			X
Charadriidae				
Vanellus miles	masked lapwing			X
Columbidae				
Ocyphaps lophotes	crested pigeon			X
Phaps chalcoptera	common bronzewing			X
Podargidae				
Podargus strigoides	tawny frogmouth			X
Cacatuidae				
Calyptorhynchus lathami	**glossy black-cockatoo**	**V**		**2,2**
Calyptorhynchus funereus	yellow-tailed black cockatoo			X
Cacatua galerita	sulphur-crested cockatoo			X
Cacatua roseicapilla	galah			X
Psittacidae				
Alisterus scapularis	Australian king-parrot			X
Glossopsitta concinna	musk lorikeet			X
Platycercus elegans	crimson rosella			X

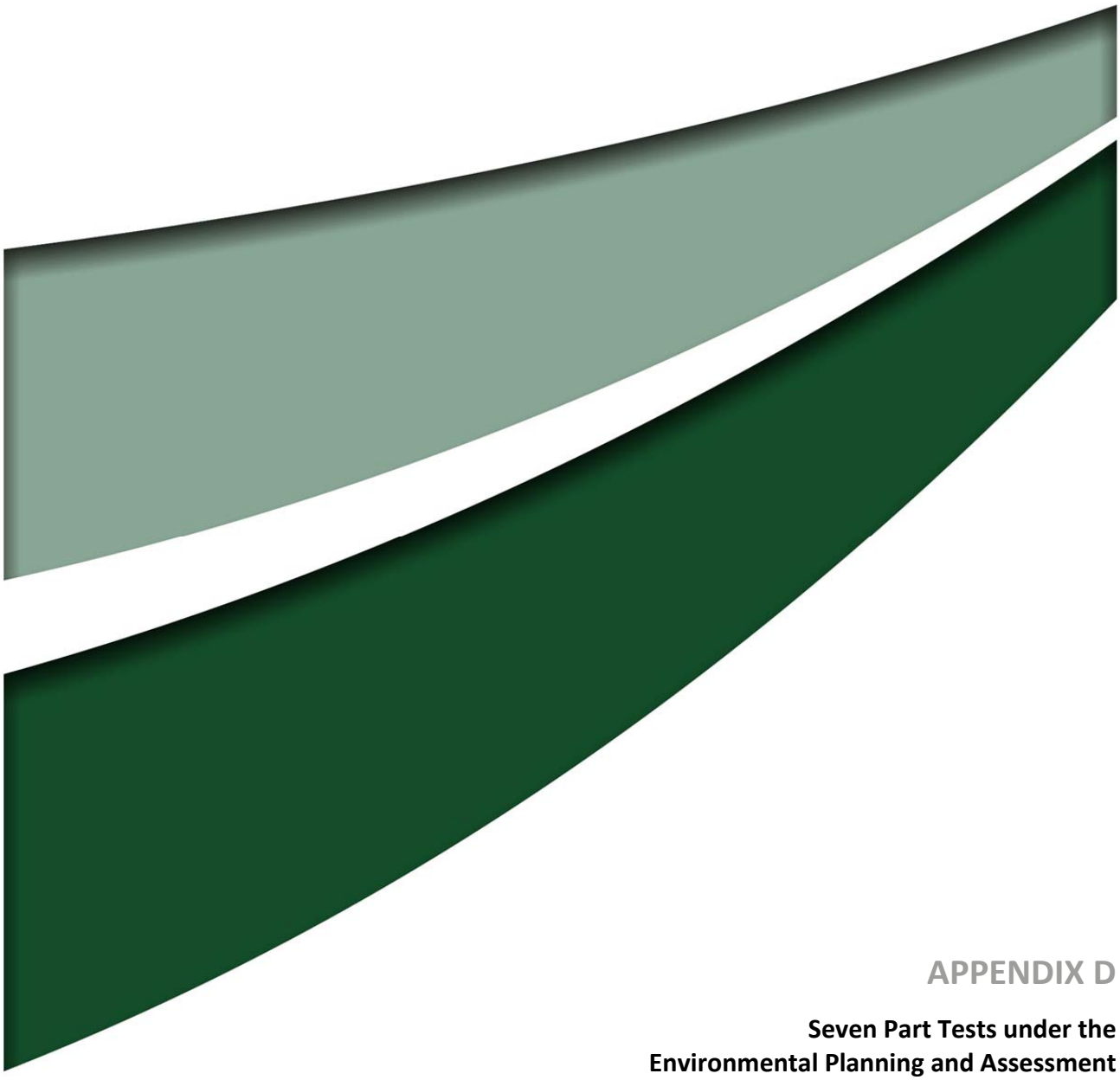
Scientific Name	Common Name	Conservation Status		Record Type
		TSC Act	EPBC Act	
Platycercus eximius	eastern rosella			X
Psephotus haematodus	red-rumped parrot			X
Trichoglossus haematodus	rainbow lorikeet			X
Cuculidae				
Cacomantis flabelliformis	fan-tailed cuckoo			X
Strigidae				
Ninox novaeseelandiae	southern boobook			X
Aegothelidae				
Aegotheles cristatus	Australian owlet-nightjar			X
Halcyonidae				
Dacelo novaeguineae	laughing kookaburra			X
Todiramphus sanctus	sacred kingfisher			X
Meropidae				
Merops ornatus	**rainbow bee-eater**		**MIG**	**2,1**
Climacteridae				
Climacteris picumnus victoriae	**brown treecreeper (eastern subsp.)**	**V**		**Envirofactor 2008**
Corombates leucophaeus	white-throated treecreeper			X
Maluridae				
Malurus cyaneus	superb fairy-wren			X
Malurus lamberti	variegated fairy-wren			X
Pardalotidae				
Pardalotus punctatus	spotted pardalote			X
Pardalotus striatus	striated pardalote			X
Acanthizidae				
Acanthiza chrysorrhoa	yellow-rumped thornbill			X
Acanthiza lineata	striated thornbill			X
Acanthiza nana	yellow thornbill			X
Acanthiza pusilla	brown thornbill			X
Acanthiza reguloides	buff-rumped thornbill			X
Chthonicola sagittata	**speckled warbler**	**V**		**3,2,2,2,2,2,1,1**
Gerygone olivacea	white-throated gerygone			X

Scientific Name	Common Name	Conservation Status		Record Type
		TSC Act	EPBC Act	
Sericornis frontalis	white-browed scrubwren			X
Smicrornis brevirostris	weebill			X
Meliphagidae				
Acanthorhynchus tenuirostris	eastern spinebill			X
Anthochaera carunculata	red wattlebird			X
Lichenostomus chrysops	yellow-faced honeyeater			X
Manorina melanocephala	noisy miner			X
Philemon corniculatus	noisy friarbird			X
Petroicidae				
Eopsaltria australis	eastern yellow robin			X
Microeca leucophaea	jacky winter			X
Eupetidae				
Psophodes olivaceus	eastern whipbird			X
Pomatostomidae				
Pomatostomus temporalis temporalis	**grey-crowned babbler (eastern subsp.)**	**V**		**5,1,1,1,1**
Pachycephalidae				
Colluricincla harmonica	grey shrike-thrush			X
Pachycephala pectoralis	golden whistler			X
Pachycephala rufiventris	rufous whistler			X
Dicruridae				
Grallina cyanoleuca	magpie-lark			X
Rhipidura fuliginosa	grey fantail			X
Rhipidura leucophrys	willie wagtail			X
Campephagidae				
Coracina novaehollandiae	black-faced cuckoo-shrike			X
Artamidae				
Cracticus nigrogularis	pied butcherbird			X
Cracticus torquatus	grey butcherbird			X
Gymnorhina tibicen	Australian magpie			X
Strepera graculina	pied currawong			X
Corvidae				
Corvus coronoides	Australian raven			X
Corcoracidae				

Scientific Name	Common Name	Conservation Status		Record Type
		TSC Act	EPBC Act	
Corcorax melanorhamphos	white-winged chough			X
Motacilidae				
Anthus novaeseelandiae	Australasian pipit			X
Passeridae				
**Passer domesticus*	house sparrow			X
Estrildidae				
Neochmia temporalis	red-browed finch			X
Taeniopygia bichenovii	double-barred finch			X
Hirundinidae				
Hirundo neoxena	welcome swallow			X
Petrochelidon ariel	fairy martin			X
Zosteropidae				
Zosterops lateralis	silvereye			X
Sturnidae				
**Acridotheres tristis*	common myna			X
**Sturnus vulgaris*	common starling			X
REPTILES				
Gekkonidae				
Diplodactylus vittatus	stone gecko			X
Underwoodisaurus milii	thick-tailed gecko			X
Varanidae				
Varanus varius	lace monitor			X
Agamidae				
Pogona barbata	eastern bearded dragon			X
Scincidae				
Ctenotus robustus	striped skink			X
Lampropholis delicata	grass skink			X
Liopholis modesta	rock skink			X
Liopholis striolata	tree skink			X
AMPHIBIANS				
Myobatrachidae				
Crinia signifera	common eastern froglet			X
Platyplectrum ornatum	ornate burrowing frog			X
Hylidae				
Litoria fallax	dwarf tree frog			X

Scientific Name	Common Name	Conservation Status		Record Type
		TSC Act	EPBC Act	
Litoria latopalmata	broad-palmed frog			X
Litoria peronii	Peron's tree frog			X
MAMMALS				
Vombatidae				
Vombatus ursinus	common wombat			X
Petauridae				
Petaurus sp	glider species	**PV**		**H**
Phalangeridae				
Trichosurus vulpecula	common brushtail possum			X
Pseudocheiridae				
Pseudocheirus peregrinus	common ringtail possum			X
Macropodidae				
Macropus giganteus	eastern grey kangaroo			X
Macropus robustus	common wallaroo			X
Macropus rufogriseus	red-necked wallaby			X
Wallabia bicolor	swamp wallaby			X
Emballonuridae				
Saccolaimus flaviventris	**yellow-bellied sheathtail-bat**	**V**		**D**
Rhinolophidae				
Rhinolophus megaphyllus	eastern horseshoe-bat			D
Molossidae				
Mormopterus planiceps	southern freetail-bat			D
Nyctinomus australis	white-striped freetail-bat			D
Vespertilionidae				
Chalinolobus dwyeri	**large-eared pied bat**	**V**	**V**	**D**
Chalinolobus gouldii	Gould's wattled bat			D
Chalinolobus morio	chocolate wattled bat			D
Miniopterus australis	**little bentwing-bat**	**V**		**Po**
Miniopterus schreibersii oceanensis	**eastern bentwing-bat**	**V**		**D**

Scientific Name	Common Name	Conservation Status		Record Type
		TSC Act	EPBC Act	
Vespadelus vulturnus	little forest bat			D
Canidae				
**Canis familiaris*	dog			X
**Vulpes vulpes*	fox			X
Cervidae				
**Dama dama*	fallow deer			X
Felidae				
**Felis catus*	cat			X
Leporidae				
**Lepus capensis*	brown hare			X
**Oryctolagus cuniculus*	rabbit			X



APPENDIX D

Seven Part Tests under the Environmental Planning and Assessment Act 1979

Appendix D – Seven Part Tests under the *Environmental Planning and Assessment Act 1979*

Seven part tests are provided below for those threatened species, endangered populations (EPs) and threatened ecological communities (TECs) considered (refer to **Appendix A**) to have the potential to be impacted by the Project. The following species, EPs and TECs are assessed:

Threatened Ecological Communities

- Central Hunter Grey Box– Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions; and

Endangered Populations

- pine donkey orchid (*Diuris tricolor*) in the Muswellbrook Local Government Area

Endangered Species

- Tarengo leek orchid (*Prasophyllum petilum*)
- Vulnerable Species
- pine donkey orchid (*Diuris tricolor*)
- austral toadflax (*Thesium australe*)
- glossy black-cockatoo (*Calyptorhynchus lathami*)
- brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- speckled warbler (*Chthonicola sagittata*);
- grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*);
- spotted-tailed quoll (*Dasyurus maculatus*);
- koala (*Phascolarctos cinereus*);
- squirrel glider (*Petaurus norfolcensis*);
- yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*);
- east coast freetail-bat (*Mormopterus norfolkensis*);
- little bentwing-bat (*Miniopterus australis*);
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
- eastern false pipistrelle (*Falsistrellus tasmaniensis*);
- greater broad-nosed bat (*Scoteanax rueppellii*), and
- large-eared pied bat (*Chalinolobus dwyeri*).

All assessments are undertaken without any consideration of impact mitigation or offsetting opportunities or commitments. Impact mitigation and biodiversity offsetting commitments are addressed in Sections 6.0 and 7.0 of the main report. Species descriptions are referenced from the Office of Environment and Heritage (OEH 2014) and Department of the Environment (2014) online species profiles, unless otherwise noted.

Threatened Ecological Communities

Central Hunter Grey Box– Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions – Endangered Ecological Community

The Project will result in the removal of approximately 7.4 hectares of Central Hunter Grey Box – Ironbark Woodland EEC. Interrogation of the Hunter Remnant Vegetation Project (HRVP) shows that the mapped extent of this community across its distribution prior to 2006 was approximately 14,800 hectares (Peake 2006).

While the previous extent of TECs can be determined from previous studies, the current extent of communities is difficult to determine. Peake (2006) estimated the extent of TECs within the Central Hunter Valley in 2006. However the current extent of TECs in the Central Hunter Valley is likely less than that listed in Peake (2006), due to a number of major development approvals since 2006. In addition to reductions due to major development approvals, the extent of TECs may have also increased due to natural regeneration of derived native grassland communities into TEC woodland communities. The current extents of TECs in the Central Hunter Valley are unknown.

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;

Not applicable.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

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

The removal of approximately 7.4 hectares of the community is not likely to have an adverse effect on the extent of the community such that its local occurrence would be placed at the risk of extinction.

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;

The removal of approximately 7.4 hectares of the community as a result of the Project is unlikely to result in the loss of species diversity that would adversely modify the composition of the community such that its local occurrence may place it at risk of extinction.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

Approximately 7.4 hectares of the community would be removed for the Project.

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

Fragmentation of remaining remnants of the community within the wider study area, and adjoining the Project Disturbance Area, is likely to increase as a result of the Project. However, this community on a regional scale largely occurs as small fragmented remnants (Peake 2006) and the increase in fragmentation is not considered significant.

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;

The habitat for this community within the Project Disturbance Area is not likely to be important to its long-term survival in the locality.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

The Project Disturbance Area is not located in proximity to any areas of declared or recommended critical habitat. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this community. There are no threat abatement plans of relevance to the proposed action.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the EEC:

- **bushrock removal (TSC Act);**
- **clearing of native vegetation (TSC Act);**
- **human-caused climate change (TSC and FM Act);**
- **loss of hollow-bearing trees (TSC Act); and**
- **removal of dead wood and dead trees (TSC Act).**

<u>Conclusion</u>

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the Central Hunter Grey Box – Ironbark Woodland EEC due to the small area of the community that will be impacted by the Project.

Endangered Populations and Threatened Species

Pine donkey orchid (*Diuris tricolor*) Endangered Population in the Muswellbrook Local Government Area and Vulnerable species

Seven individuals comprising this population were recorded within the Project Disturbance Area during surveys.

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;

A total of seven pine donkey orchids were recorded within the Project Disturbance Area. A further 453 plants were recorded across the wider study area. As such, it is considered that the removal of seven individuals as a result of the proposed action is unlikely 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.

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;

Seven individuals comprising this population were recorded within the Project Disturbance Area during surveys. A further 453 plants were recorded across the wider study area. As such, it is considered that the removal of seven individuals as a result of the proposed action is unlikely 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

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in disturbance of 22.1 hectares of potential habitat for this species and endangered population.

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

The Project will not result in the species being fragmented or isolated from areas of known habitat.

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;

A total of 453 plants and approximately 217 hectares of habitat (commensurate with that inside the Project Disturbance Area) was recorded within the wider study area during surveys. As such, the 22.1 hectares of potential habitat to be removed is considered to be of low importance to the long-term survival of the species and population.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Disturbance Area for this threatened species.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans has been prepared for this species.

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.

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act); and**
- human-caused climate change (TSC and FM Act).

Conclusion

Based on the information provided above the Project is considered unlikely to result in a significant impact on the pine donkey orchid (*Diuris tricolor*) as a vulnerable species or the endangered population in the Muswellbrook LGA .

Tarengo leek orchid (*Prasophyllum petilum*)

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;

Tarengo leek orchid (*Prasophyllum petilum*) has not been recorded within the Project Disturbance Area. One individual of this species was recorded within the wider study area, to the south west of the Project Disturbance Area.

The Project Disturbance Area is considered to provide potential habitat for this species. Substantial targeted flora survey was undertaken in the Proposed Disturbance Area and this species was not identified during surveys. The Project will involve the disturbance of approximately 22.1 hectares of woodland and DNG that provides potential habitat for the 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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

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

Not applicable.

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;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project would result in the loss of approximately 22.1 hectares of potential habitat for this species.

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

The proposed development will not result in further isolation or fragmentation of potential habitat for this species.

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;

Approximately 217 hectares of habitat (commensurate with that inside the Project Disturbance Area) was recorded within the wider study area during surveys. Therefore the loss of approximately 22.1 hectares of potential habitat for this species is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

The Project Disturbance Area is not located in proximity to any areas of declared or recommended critical habitat areas. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act).**

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on Tarengo leek orchid (*Prasophyllum petilum*).

Austral toadflax (*Thesium australe*)

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;

Austral toadflax (*Thesium australe*) has not been recorded within the Project Disturbance Area. The species is known to occur in dry sclerophyll forest and woodlands and is generally restricted around an area north of Rylstone in NSW.

The Project Disturbance Area is considered to provide potential habitat for this species, however there is a low likelihood of occurrence due to past disturbances and current grazing pressures. Substantial targeted flora survey was undertaken in the Proposed Disturbance Area and this species was not identified during surveys. The Project will involve the disturbance of approximately 14.8 hectares of DNG that provides potential habitat for the 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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

iii) 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

Not applicable.

iv) 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;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

iv) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project would result in the loss of approximately 14.8 hectares of potential habitat for this species.

v) 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

The proposed development will not result in further isolation or fragmentation of potential habitat for this species.

vi) 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;

The Project would result in the loss of approximately 14.8 hectares of potential habitat for this species. The potential habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

The Project Disturbance Area is not located in proximity to any areas of declared or recommended critical habitat areas. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act).**

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on austral toadflax (*Thesium australe*).

Glossy black-cockatoo (*Calyptorhynchus lathami*)

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;

The glossy black-cockatoo (*Calyptorhynchus lathami*) was observed within the wider study area during field surveys. This species was observed foraging in Allocasuarina trees on the rocky escarpments to the east of the Project Disturbance Area.

The Proposed Disturbance Area is considered to provide limited potential foraging habitat for this species. The Project will involve the disturbance of approximately 7.4 hectares of eucalypt woodland that provides potential foraging habitat for the species. Therefore it is considered unlikely that the Project would disrupt the life cycle of this species such that any viable local population would be placed at risk of extinction.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

v) 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

Not applicable.

vi) 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;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

vii) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project would result in the loss of approximately 7.4 hectares of potential foraging habitat for this species.

viii) 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

The proposed development will not result in further isolation or fragmentation of potential habitat for this species.

ix) 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;

The Project would result in the loss of approximately 7.4 hectares of potential foraging habitat for this species. The potential habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

The Project Disturbance Area is not located in proximity to any areas of declared or recommended critical habitat areas. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act);**
- **human-caused climate change (TSC and FM Act);**
- **loss of hollow-bearing trees (TSC Act);**
- **removal of dead wood and dead trees (TSC Act); and**
- **aggressive exclusion by abundant noisy miners (TSC Act).**

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the glossy black-cockatoo (*Calyptorhynchus lathami*).

Brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)

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;

The brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) has been recorded in the wider study area (EnviroFactor 2008), south of the Project Disturbance Area. The species is known to occur in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range.

The Project will result in the loss of approximately 7.4 hectares of probable woodland foraging habitat for the species. Approximately 124 hectares of comparable foraging habitat was mapped in the wider study area. Therefore the proposed action is considered unlikely 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

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 7.4 hectares of probable foraging habitat for the species.

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

The proposed development will not result in further isolation or fragmentation of probable foraging habitat for this species as a vegetated area will remain to the east of the quarry allowing north-south movement between like habitats.

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;

The Project will result in the loss of approximately 7.4 hectares of probable foraging habitat for this species. The potential habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Disturbance Area for this threatened species.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act);**
- **human-caused climate change (TSC and FM Act);**
- **loss of hollow-bearing trees (TSC Act);**
- **removal of dead wood and dead trees (TSC Act); and**
- **aggressive exclusion by abundant noisy miners (TSC Act).**

Conclusion

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*).

Speckled warbler (Chthonicola sagittata)

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;

The speckled warbler (*Chthonicola sagittata*) has been recorded in the Project Disturbance Area during field surveys. A total of five individuals were observed.

The Project will result in the loss of approximately 7.4 hectares of known and potential woodland habitat for the species. Approximately 124 hectares of comparable foraging habitat was mapped in the wider study area. Therefore the proposed action is considered unlikely 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.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 7.4 hectares of known woodland habitat for the species.

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

The proposed development will not result in further isolation or fragmentation of known habitat for this species as a vegetated area will remain to the east of the quarry allowing north-south movement between like habitats.

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;

The Project will result in the loss of approximately 7.4 hectares of known foraging habitat for this species. The potential habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Disturbance Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act);**
- **human-caused climate change (TSC and FM Act);**
- **removal of dead wood and dead trees (TSC Act); and**
- **aggressive exclusion by abundant noisy miners (TSC Act).**

Conclusion

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the speckled warbler (*Chthonicola sagittata*).

Grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)

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;

The grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) has been recorded in the Project Disturbance Area. A total of five individuals were observed.

The Project will result in the loss of approximately 7.4 hectares of known woodland habitat for the species. Approximately 124 hectares of comparable quality habitat was mapped in the wider study area. Therefore the proposed action is considered unlikely 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.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 7.4 hectares of known foraging habitat for the species.

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

The proposed development will not result in further isolation or fragmentation of known habitat for this species as a vegetated area will remain to the east of the quarry allowing north-south movement between like habitats.

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;

The Project will result in the loss of approximately 7.4 hectares of known foraging habitat for this species. The habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Disturbance Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act);**
- **human-caused climate change (TSC and FM Act); and**
- **aggressive exclusion by abundant noisy miners (TSC Act).**

Conclusion

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*).

Spotted-tailed quoll (*Dasyurus maculatus*)

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;

The spotted-tailed quoll (*Dasyurus maculatus*) has not been recorded in the Project Disturbance Area. The Project Disturbance Area is considered to provide potential foraging habitat for this species.

The Project will result in the loss of approximately 7.4 hectares of woodland foraging habitat for the species. Approximately 124 hectares of comparable quality habitat was mapped in the wider study area. Therefore the proposed action is considered unlikely 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.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 7.4 hectares of potential woodland habitat for the species.

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

The proposed development will not result in further isolation or fragmentation of potential habitat for this species as a vegetated area will remain to the east of the quarry allowing north-south movement between like habitats.

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;

The Project will result in the loss of approximately 7.4 hectares of potential habitat for this species. The habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Disturbance Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

The 'Recovery plan for *Dasyurus maculatus* (Spotted-tailed Quoll) 2005 – 2009' (Long and Nelson 2004) is applicable to this species. The Project contravenes with the following objective of the recovery plan: *'*Reduce the rate of loss and fragmentation of Spotted-tailed Quoll habitat'. The Project will contribute to the loss of spotted-tailed quoll habitat.

The NSW 'Threat abatement plan for predation by the red fox (*Vulpes vulpes*)' (OEH 2011) is relevant to this threatened species. The Project does not contravene any of the objectives or actions of this plan.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **bushrock removal (TSC Act);**
- **clearing of native vegetation (TSC Act);**
- **human-caused climate change (TSC and FM Act;**
- **loss of hollow-bearing trees (TSC Act); and**
- **removal of dead wood and dead trees (TSC Act).**

Conclusion

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the spotted-tailed quoll (*Dasyurus maculatus*).

Koala (Phascolarctos cinereus)

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;

The koala (*Phascolarctos cinereus*) was not recorded within the Project Disturbance Area.

The Project will result in the loss of approximately 7.4 hectares of potential eucalypt woodland habitat for the species that has low levels of preferred koala food trees. As the habitats in the Project Disturbance Area do not contain suitable densities of preferred koala food trees it is considered unlikely that the species would be resident in the Project Disturbance Area. Therefore the proposed action is considered unlikely 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.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 7.4 hectares of potential eucalypt woodland habitat for the species.

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

The Project will not result in further isolation or fragmentation of potential habitat for this species as a vegetated area will remain to the east of the quarry allowing north-south movement between like habitats.

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;

The Project will result in the loss of approximately 7.4 hectares of marginal koala habitat. The habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

The 'Recovery plan for the koala (*Phascolarctos cinereus*)' (DECC 2008) is relevant to this species. The proposed action does not contravene with any of the objective or actions listed within this recovery plan.

No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act); and**
- **human-caused climate change (TSC and FM Act).**

Conclusion

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the koala (*Phascolarctos cinereus*).

Squirrel glider (Petaurus norfolcensis)

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;

The squirrel glider (*Petaurus norfolcensis*) was recorded in the wider study area via hair analysis. The hair analysis results indicated that a *Petaurus* sp. was detected but was unable to determine whether it was the squirrel glider (*Petaurus norfolcensis*) listed as vulnerable under the TSC Act, or the more common sugar glider (*Petaurus breviceps*) which is not listed under state or Commonwealth legislation. In the absence of a definitive identification and with the application of the precautionary principle, it is accepted as a squirrel glider record.

This species was not detected within the Project Disturbance Area. The Project Disturbance Area does, however, provide potential foraging and den habitat for this species.

The Project will result in the loss of approximately 7.4 hectares of potential woodland habitat for the species. Approximately 124 hectares of comparable quality habitat was mapped in the wider study area. Therefore the proposed action is considered unlikely 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.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 7.4 hectares of potential woodland habitat for the species.

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

The Project will not result in further isolation or fragmentation of potential habitat for this species as a vegetated area will remain to the east of the quarry allowing north-south movement between like habitats.

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;

The Project will result in the loss of approximately 7.4 hectares of potential habitat for this species. The habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act);**
- **human-caused climate change (TSC and FM Act);**
- **loss of hollow-bearing trees (TSC Act); and**
- **removal of dead wood and dead trees (TSC Act).**

Conclusion

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the squirrel glider (*Petaurus norfolcensis*).

Yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)

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;

The yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*) was detected within the wider study area via echolocation recording. The species was not recorded within the Project Disturbance Area. The species is wide-ranging and found across northern and eastern Australia, roosting in tree hollows and buildings. The woodland and open habitats of the Project Disturbance Area provide potential foraging and roosting habitat for the species.

The Project will result in the loss of approximately 22.1 hectares of potential foraging and, where trees are present (7.4 hectares), potential roosting habitat for the species. Approximately 217 hectares of comparable quality habitat was mapped in the wider study area. Therefore the proposed action is considered unlikely 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.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 22.1 hectares of potential foraging habitat for the species.

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

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known and potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact on this species.

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;

The Project will result in the loss of approximately 22.1 hectares of potential habitat for this species. The habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Disturbance Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act);**
- **human-caused climate change (TSC and FM Act);**
- **loss of hollow-bearing trees (TSC Act); and**
- **removal of dead wood and dead trees (TSC Act).**

Conclusion

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*).

East coast freetail-bat (*Mormopterus norfolkensis*)

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;

The east coast freetail-bat (*Mormopterus norfolkensis*) was not detected within the wider study area during surveys. The Project Disturbance Area does provide potential foraging and roosting habitat for this species.

The Project will result in the loss of approximately 22.1 hectares of potential foraging and roosting habitat for the species. Approximately 217 hectares of comparable quality habitat was mapped in the wider study area. Therefore the proposed action is considered unlikely 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.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 22.1 hectares of potential foraging habitat for the species.

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

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known and potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact on this species.

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;

The Project will result in the loss of approximately 22.1 hectares of potential habitat for this species. The habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act);**
- **human-caused climate change (TSC and FM Act);**
- **loss of hollow-bearing trees (TSC Act); and**
- **removal of dead wood and dead trees (TSC Act).**

Conclusion

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the east coast freetail-bat (*Mormopterus norfolkensis*).

Little bentwing-bat (*Miniopterus australis*)

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;

The little bentwing-bat (*Miniopteris australis*) was detected within the wider study area via echolocation recording. The species was not recorded within the Project Disturbance Area. The species is found along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW and roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and occasionally buildings. The woodland and open habitats of the Project Disturbance Area provide potential foraging and roosting habitat for the species.

The Project will result in the loss of approximately 22.1 hectares of potential foraging and, where trees are present (7.4 hectares), potential roosting habitat for the species. Approximately 217 hectares of comparable quality habitat was mapped in the wider study area. Therefore the proposed action is considered unlikely 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.

h) 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;

Not applicable.

i) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

j) in relation to the habitat of a threatened species, population or ecological community;

iv) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 22.1 hectares of potential foraging habitat for the species.

v) 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

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known and potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact on this species.

vi) 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;

The Project will result in the loss of approximately 22.1 hectares of potential habitat for this species. The habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

k) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

l) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

m) 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.

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act);**
- **human-caused climate change (TSC and FM Act);**
- **loss of hollow-bearing trees (TSC Act); and**
- **removal of dead wood and dead trees (TSC Act).**

<u>Conclusion</u>

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the little bentwing-bat (*Miniopterus australis*).

Eastern bentwing-bat (Miniopterus schreibersii oceanensis)

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;

The eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) was detected within the wider study area via echolocation recording. The species was not recorded within the Project Disturbance Area. The species is found along the east and north-west coasts of Australia and roost in caves, tunnels, buildings and other man-made structures. The habitats of the Project Disturbance Area provides potential foraging habitat for the species, however it is unlikely to provide suitable roosting habitat.

The Project will result in the loss of approximately 22.1 hectares of potential foraging habitat for the species. Approximately 217 hectares of comparable quality habitat was mapped in the wider study area. Therefore the proposed action is considered unlikely 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.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 22.1 hectares of potential foraging habitat for the species.

i) 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

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known and potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact on this species.

ii) 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;

The Project will result in the loss of approximately 22.1 hectares of potential habitat for this species. The habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act); and**
- **human-caused climate change (TSC and FM Act).**

Conclusion

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the eastern bentwing-bat (*Miniopterus schreibersii oceanensis*).

Eastern false pipistrelle (*Falsistrellus tasmaniensis*)

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;

The eastern false pipistrelle (*Falsistrellus tasmaniensis*) was not detected within the wider study area during surveys. The Project Disturbance Area does provide potential foraging and roosting habitat for this species.

The Project will result in the loss of approximately 22.1 hectares of potential foraging and roosting habitat for the species. Approximately 217 hectares of comparable quality habitat was mapped in the wider study area. Therefore the proposed action is considered unlikely 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.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 22.1 hectares of potential foraging habitat for the species.

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

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known and potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact on this species.

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;

The Project will result in the loss of approximately 22.1 hectares of potential habitat for this species. The habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Disturbance Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act);**
- **human-caused climate change (TSC and FM Act);**
- **loss of hollow-bearing trees (TSC Act); and**
- **removal of dead wood and dead trees (TSC Act).**

Conclusion

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the eastern false pipistrelle (*Falsistrellus tasmaniensis*).

Greater broad-nosed bat (*Scoteanax rueppellii*)

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;

The greater broad-nosed bat (*Scoteanax rueppellii*) was not detected within the wider study area during surveys. The Project Disturbance Area does provide potential foraging and roosting habitat for this species.

The Project will result in the loss of approximately 22.1 hectares of potential foraging and roosting habitat for the species. Approximately 217 hectares of comparable quality habitat was mapped in the wider study area. Therefore the proposed action is considered unlikely 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.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 22.1 hectares of potential foraging habitat for the species.

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

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known and potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact on this species.

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;

The Project will result in the loss of approximately 22.1 hectares of potential habitat for this species. The habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Disturbance Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act);**
- **human-caused climate change (TSC and FM Act);**
- **loss of hollow-bearing trees (TSC Act); and**
- **removal of dead wood and dead trees (TSC Act).**

Conclusion

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the greater broad-nosed bat (*Scoteanax rueppellii*).

South-eastern long-eared bat (*Nyctophilus corbeni*)

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;

The south-eastern long-eared bat (*Nyctophilus corbeni*) was not detected within the wider study area during surveys. The Project Disturbance Area does provide potential foraging and roosting habitat for this species.

The Project will result in the loss of approximately 22.1 hectares of potential foraging and roosting habitat for the species. Approximately 217 hectares of comparable quality habitat was mapped in the wider study area. Therefore the proposed action is considered unlikely 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.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 22.1 hectares of potential foraging habitat for the species.

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

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known and potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact on this species.

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;

The Project will result in the loss of approximately 22.1 hectares of potential habitat for this species. The habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Disturbance Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act);**
- **human-caused climate change (TSC and FM Act);**
- **loss of hollow-bearing trees (TSC Act); and**
- **removal of dead wood and dead trees (TSC Act).**

Conclusion

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the south-eastern long-eared bat (*Nyctophilus corbeni*).

Large-eared pied bat (*Chalinolobus dwyeri*)

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;

The large-eared pied bat (*Chalinolobus dwyeri*) was detected within the wider study area via echolocation recording. This species was not recorded within the Project Disturbance Area. The species is mainly found in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. The species mainly roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel)*.

The Project will result in the loss of approximately 22.1 hectares of potential foraging habitat for the species. Approximately 217 hectares of comparable quality habitat was mapped in the wider study area. Therefore the proposed action is considered unlikely 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.

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;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will result in the loss of approximately 22.1 hectares of potential foraging habitat for the species.

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

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known and potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact on this species.

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;

The Project will result in the loss of approximately 22.1 hectares of potential habitat for this species. The habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Disturbance Area for this threatened species.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

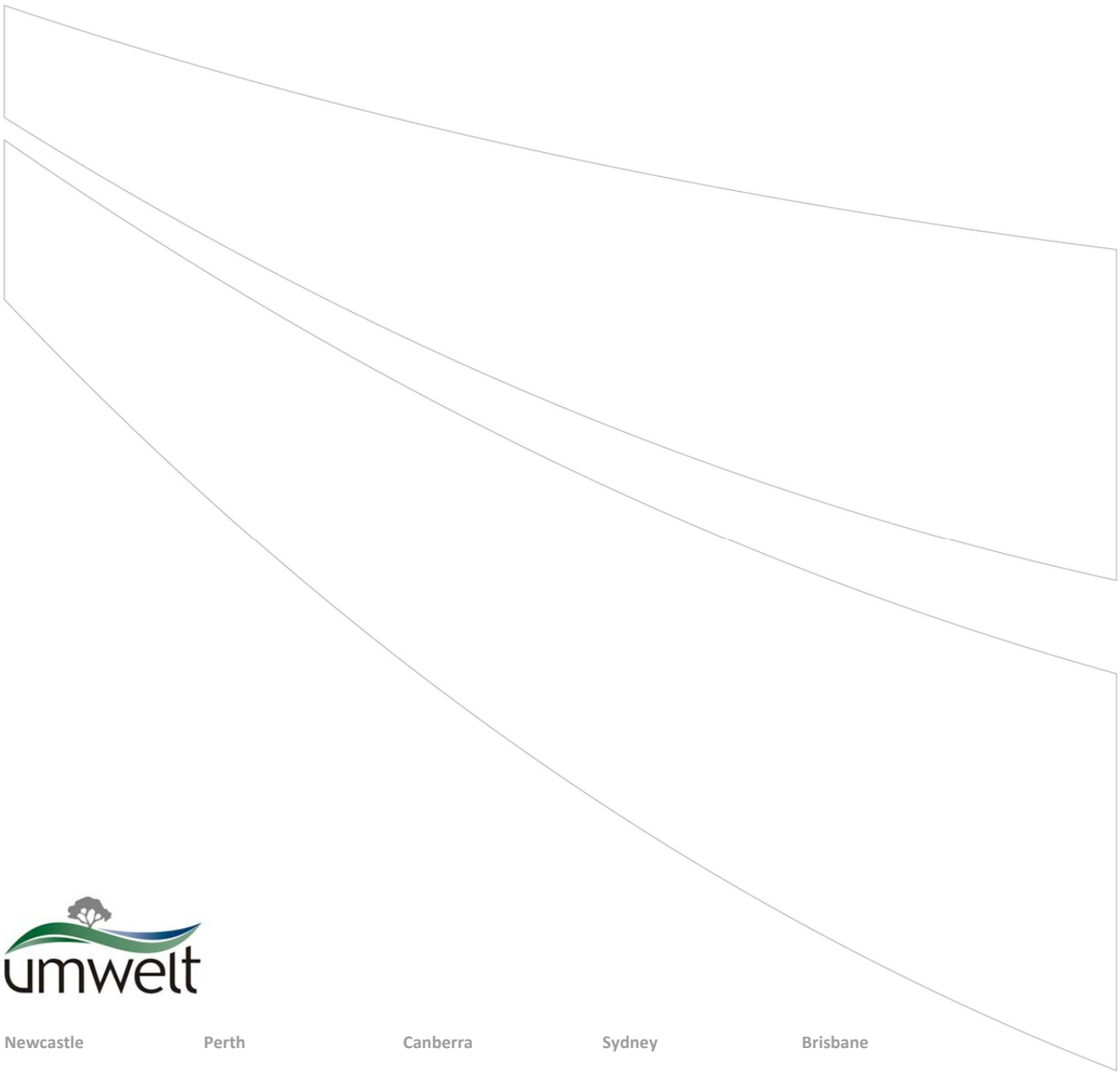
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- **clearing of native vegetation (TSC Act); and**
- **human-caused climate change (TSC and FM Act).**

Conclusion

Based on the information provided above and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the large-eared pied bat (*Chalinolobus dwyeri*).



umwelt

Newcastle	Perth	Canberra	Sydney	Brisbane
75 York Street Teralba NSW 2284	PO Box 8177 Subiaco East WA 6008 33 Ventnor Avenue West Perth WA 6005	PO Box 6135 56 Bluebell Street O'Connor ACT 2602	50 York Street Sydney NSW 2000	GPO Box 459 Brisbane QLD 4001
Ph. 02 4950 5322	Ph. 08 6260 0700	Ph. 02 6262 9484	Ph. 1300 793 267	Ph. 1300 793 267

www.umwelt.com.au