appendix 6

Ecology Assessment

Oceanic Coal Australia Limited

Ecological Assessment
West Wallsend Colliery
Continued Operations Project

July 2010

Umwelt
Environmental Consultants

Ecological Assessment
West Wallsend Colliery
Continued Operations Project

Prepared by

Umwelt (Australia) Pty Limited

on behalf of

Oceanic Coal Australia Limited

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Report No.	2553/R05/Final	Date: July 2010

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1.0 Introduction

West Wallsend Colliery (WWC) is an underground mine that has been operating since 1969 and is located within the Newcastle Coalfield of New South Wales (refer to **Figure 1.1**). WWC pit-top is located approximately 1 kilometre east of the residential area of Killingworth and approximately 1.25 kilometres south-west of the residential area of Barnsley (refer to **Figure 1.1**). Underground mining has previously extended to the north and south of the pit-top and longwall mining is currently progressing south-westerly beneath areas of bushland west of the F3 Freeway.

WWC currently mines the West Borehole coal seams using longwall mining techniques. The majority of the coal from WWC is washed and loaded onto trains at the Macquarie Coal Preparation Plant (MCPP) (refer to **Figure 1.1**) to be transported to Newcastle Port for export. A minor percentage of coal mined from West Wallsend has been periodically transported from MCPP to Eraring Power Station via coal haul trucks on a private coal haul road.

WWC currently operates under a number of existing development consents, existing mining leases that encompass the remaining Life of Mine (LOM) coal reserves and an approved Subsidence Management Plan (SMP). The approved SMP covers the first five longwall panels in the area referred to as the Western Domain, as shown in **Figure 1.2**. The SMP details all surface features within the mining area and the relative subsidence management strategies that have been developed with the respective stakeholders. The majority of the surface land for the continued underground mining at WWC is managed by the Department of Environment, Climate Change and Water (DECCW) as part of the Sugarloaf State Conservation Area (SCA). WWC has well established subsidence management protocols, all developed in close consultation with the relevant stakeholders.

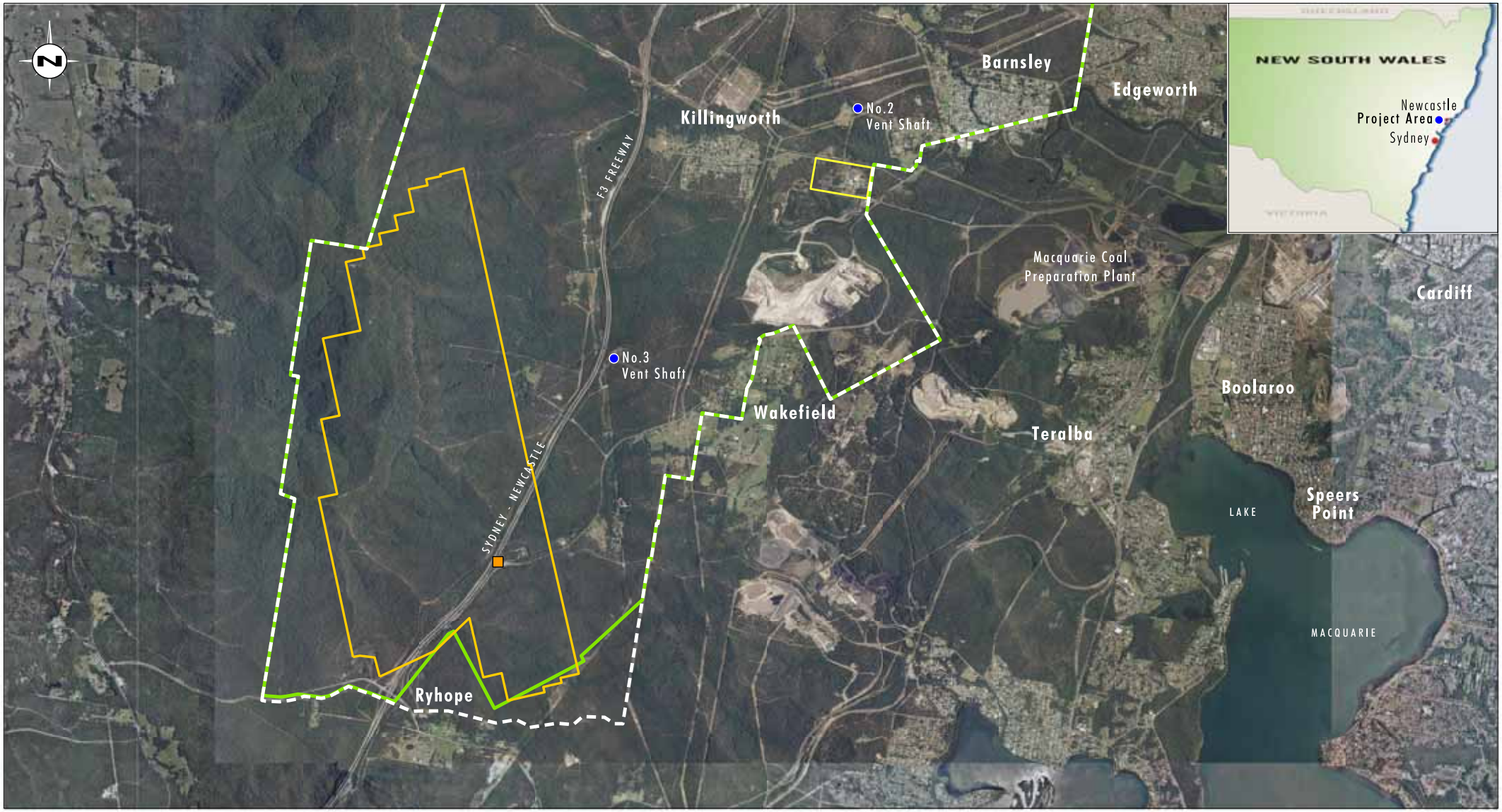
An updated planning approval is required for two small portions of the continued underground mining area of WWC which are currently approved for mining under the Savings Provisions of the Lake Macquarie Local Environmental Plan (LEP, 2004). The Savings Provisions expire in December 2010 and hence WWC will require a new development consent for these areas.

Whilst this approval issue relates to two small areas within WWC continued underground mining area, the overall objective of the project application is to provide WWC with one updated approval for the remaining operations of WWC. Therefore this project not only assesses these two small areas but also covers the entire LOM coal reserves for WWC, the existing pit top and other related ancillary surface facilities. It is important to note that no significant changes to the existing underground mining or associated surface operations are proposed as part of the project application, the existing operations will continue as per the current operations. Coal haulage and coal preparation are covered by existing separate approvals, to which no changes are proposed as a part of the project application.

1.1 Background and History of West Wallsend Colliery

WWC has been operating since development consent was issued for the operation in 1969 by Lake Macquarie City Council (LMCC). Early operations were mainly bord and pillar workings and longwall mining has been undertaken since 1985.

Mining at WWC is undertaken in three main areas, referred to as the Northern, the Western and Southern Domains, as shown in **Figure 1.2**. Mining is currently being undertaken in the Western Domain in longwall 38. The majority of mining within the Western and Southern domains is encompassed within CCL 718. Mining within CCL 718 has current development



Source: OCAL

0 1.0 2.0 3km
1:60 000

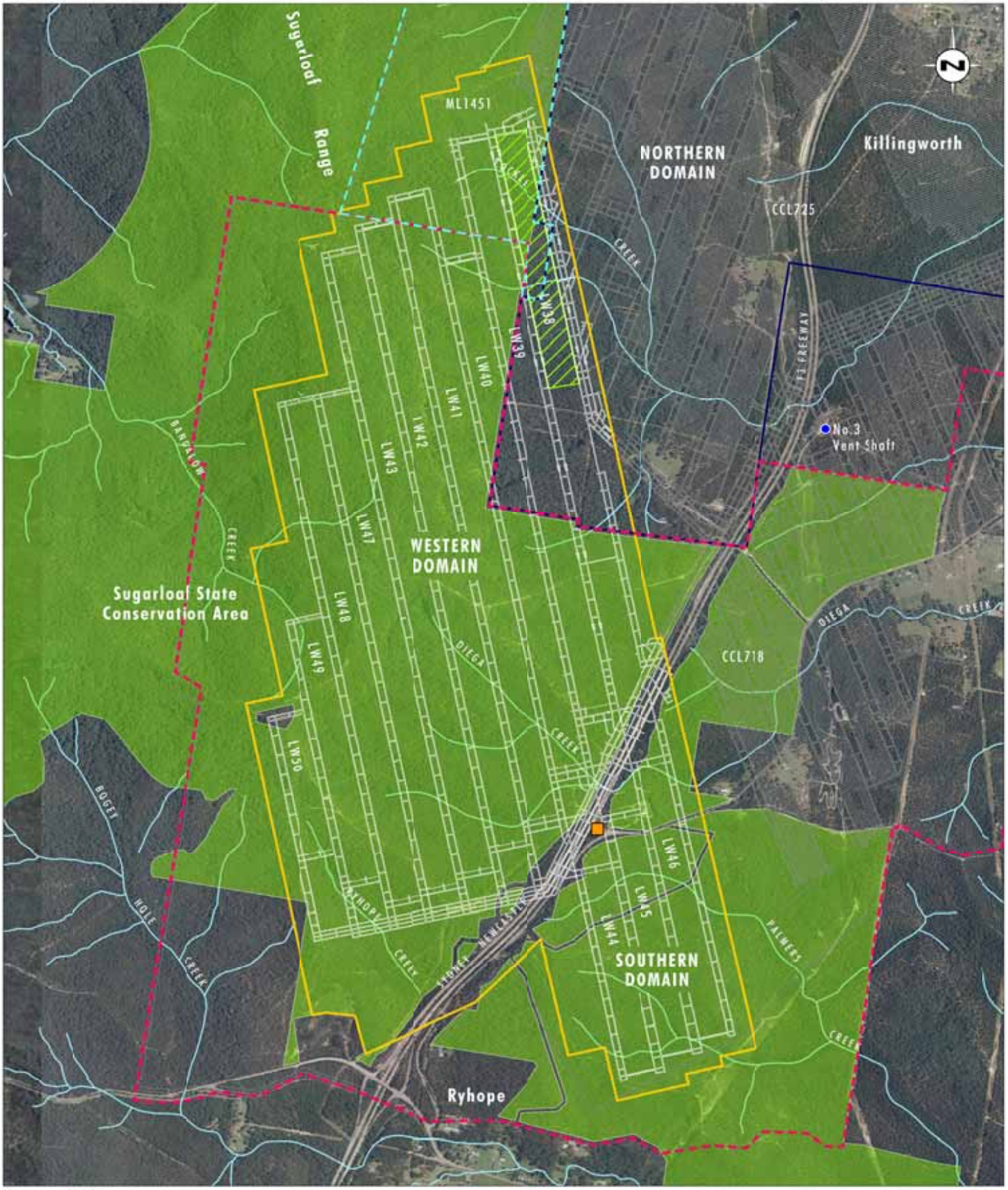
Legend

- Continued Underground Mining Area
- West Wallsend Colliery Holding
- West Wallsend Colliery Pit Top Facility
- Project Application Boundary
- Proposed Mining Services Facility

FIGURE 1.1

Locality Plan

File Name (A4): R05_V1/2553_042.dgn



Source: OCAL

0 0.5 1.0 1.5km
1:30 000

Legend

- Continued Underground Mining Area
- Proposed Underground Workings in the West Borehole Seam
- Longwall Progression as of 1st March 2010
- Former Underground Workings
- Sugarloaf State Conservation Area
- Proposed Mining Services Facility
- CCL725
- CCL718
- ML1451

FIGURE 1.2

Project Area

File Name (A4): R05_V1/2553_043.dgn

consent under the 1981 Stockton Borehole Consent (the 1981 Consent), which provides for the continuation of mining within this area. However two small portions of mining in the Western Domain are located within CCL 725 and Mining Lease (ML) 1451, which are not covered by the 1981 consent.

Mining within CCL 725 and ML 1451 is currently being undertaken under a Part 5 Approval granted under the *Environmental Planning and Assessment Act 1979* (EP&A Act) by the Department of Industry and Investment (DII) (previously Department of Primary Industries). This approval is based on the savings provisions of the Lake Macquarie LEP, which enable underground mining to be undertaken, without development consent, where an existing mining lease is related to an existing mining operation.

The savings provisions under the LMCC LEP will expire in December 2010. After December 2010 all mining within CCL 725 and ML 1451 will require a development consent under the EP&A Act. Therefore a new Part 3A project approval under the EP&A Act will be required for all future mining within CCL 725 and ML 1451 after December 2010.

The overall aim of the project application is to provide for ongoing mining in CCL 718, 725 and ML 1451 and to enable continued mining under one consolidated approval that will cover the remaining operations of WWC.

The impacts of mining on ecological values of the western domain were monitored by Umwelt (Australia) Pty Limited (Umwelt) between 2005 and 2008 (Umwelt 2005; 2006; 2007; 2009). Subsidence impacts in the northern domain were within predicted levels and the impact of mining on vegetation communities and fauna habitats was shown to be negligible.

1.2 Key Features of West Wallsend Colliery Continued Operations Project

The key features of the WWC Continued Operations Project are outlined below in **Table 1.1**.

Table 1.1 – Key Features of West Wallsend Colliery Continued Operations Project

Major Project Components/Aspects	Proposed Operations
Limits on Extraction	Up to 5.5Mtpa ROM
Estimated Mine Life	Approximately 12 years of mining
Operating Hours	24 hours per day, 7 days per week
Number of Employees	Approximately 390 Full Time Equivalents
Mining Methods	Underground Mining – longwall method
Mining Areas	Western and Southern Domains and existing mains access from longwall areas to pit bottom. Also encompasses all former workings of WWC.
Infrastructure	Existing West Wallsend Pit Top infrastructure. Existing No.2, No.3 Vent Shafts and existing ballast borehole. Existing Longwall 11 borehole facility. Proposed future ventilation infrastructure and minor surface infrastructure. Proposed Mining Services Facility.

At this stage, there will be no major modification to the existing WWC pit top facilities as a result of the Project, apart from the proposed semi-permanent training building, potable water borehole, water re-use project and noise mitigation measures associated with the Bradford breaker and the No.2 Vent Fan. The proposed Mining Services Facility seeks to improve efficiency of delivery of materials to the underground operations by reducing the travel distance underground. It is proposed to be located approximately 6 kilometres south-west of the existing pit top facilities close to Wakefield Road, as shown on **Figure 1.2**. The Mining Services Facility will be comprised of a 20 metre by 35 metre compound housing the facility and a constructed access road off Wakefield Road. It will be located in an existing disturbed area between Wakefield road and the F3 Freeway, currently comprised of an access area and regrowth vegetation. The Mining Services Facility is proposed to be used for a range of services including a ballast and concrete borehole (providing materials for use underground) and for the provision of solcenic oil for use underground. Power to the services facility will be provided by an extension of the existing powerline which is adjacent to Wakefield Road.

As underground mining progresses, additional ancillary surface infrastructure associated with continued mining operations may also be required, including the installation of additional ventilation infrastructure and potential gas injection infrastructure. The locations of this infrastructure will be determined as mining progresses, with appropriate planning, to minimise environmental impacts, consultation and management strategies to be implemented for each new facility. Refer to Section 2.3.3.4 of the main text for further details on the proposed ancillary surface infrastructure.

Whilst no modification to the former workings of WWC is proposed under this application, the former workings have been included in the project application boundary (**Figure 1.1**) to provide a consolidated approval for all workings within the WWC holding. This will provide for any future works required in those existing mining areas, such as works associated with mine closure.

As a result of the preliminary studies for this Part 3A approval process, significant changes have been made to the original project design. These changes relate to the proposed longwall area to avoid significant Aboriginal archaeological and ecological features, as well as low depth of cover areas with potential groundwater impacts. The details of these changes are discussed further in **Section 5.1**.

1.3 Continued Underground Mining Area

The project application area relates to all land proposed for continued underground mining and the upgrade of associated surface infrastructure (refer to **Figure 1.1**). The project area for the ecological assessment (the continued underground mining area) refers only to the area proposed for the continuation of underground mining and the construction of the Mining Services Facility adjacent to Wakefield Road (refer to **Figure 1.2**). The upgrade and expansion of associated mining infrastructure will be limited to existing disturbed and developed areas.

The continued underground mining area covers approximately 1085 hectares and is located almost entirely within the Sugarloaf SCA, as shown on **Figure 1.2**. Analysis of aerial photographs shows that the continued underground mining area is heavily vegetated, with disturbance limited to linear corridors associated with the F3 Freeway and vehicular tracks within the SCA and a small area of regrowth vegetation associated with the extraction of fill for the F3 Freeway construction.

1.4 Purpose of this Document

This ecological assessment has been prepared by Umwelt to report on the potential impact of the project on threatened flora and fauna species, endangered populations, threatened ecological communities (TECs) and their habitats occurring in the continued underground mining area. Terrestrial vegetation communities, flora and fauna species, fauna habitat, aquatic flora and fauna species and aquatic habitat, present in the continued underground mining area have been identified and considered as part of the impact assessment. The assessment addresses potential impacts on any threatened species, endangered populations, TECs, or their habitats (terrestrial or aquatic), that may occur in, or in the general vicinity of the continued underground mining area.

The objectives of the ecological assessment were to:

- record the flora and fauna species (both terrestrial and aquatic) within the continued underground mining area;
- identify any threatened flora and fauna species, endangered populations, TECs, or their habitats, within the continued underground mining 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 flora and fauna species, threatened species, endangered populations, TECs, or their habitats recorded (or with potential to occur) in the continued underground mining area; and
- provide management options to minimise ecological impacts associated with the project, including modifications to the design or operation of the project, and other on-site impact mitigation.

This ecological assessment accompanies (and is based on) the findings of the broader Environmental Assessment prepared for the project.

1.5 Relevant Legislation and Guidelines

The ecological survey and assessment completed as part of this project was prepared in accordance with the relevant Department of Planning (DoP) Director-General's Requirements (DGRs) for the project, being:

- 'Biodiversity – including:
  - baseline flora and fauna surveys, describing vegetation communities, habitat types and species assemblages present;
  - assessment of the potential direct and indirect impacts on threatened species, their habitats, populations and ecological communities and a description of any measures taken to avoid and/or mitigate potential impacts;
  - assessment of the potential impacts on Sugarloaf SCA; and
  - details of any measures to avoid or mitigate potential biodiversity impacts and, in instances where impacts cannot be avoided, appropriate details on offset habitat packages or strategies'.

In addition, the ecological survey and assessment completed as part of this project considered the following guidelines and relevant legislation:

- Department of Environment Conservation (DEC) (2004) Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities. Working Draft, November 2004;
- Department of Environment and Climate Change (DECC) and Department of Primary Industries (DPI) (2005) Draft Guidelines for Threatened Species Assessment (Part 3A), July 2005;
- Department of Primary Industries (DPI) (2008) Threatened Species Assessment Guidelines – The Assessment of Significance. February 2008;
- Commonwealth EPBC Act Policy Statement 1.1 – Significant Impact Guidelines – Matters of National Environmental Significance. October 2009;
- NSW *Environmental Planning and Assessment Act 1979* (EP&A Act);
- NSW *Threatened Species Conservation Act 1995* (TSC Act);
- NSW *Fisheries Management Act 1994* (FM Act);
- State Environmental Planning Policy (SEPP) 44 (Koala Habitat Protection) (2000); and
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

2.0 Regional Setting

2.1 Physiography, Geology and Soils

The continued underground mining area is situated in the upper reaches of the western extent of the 640 km^2 Lake Macquarie catchment, and is situated about 18 kilometres west of the coast at Glenrock State Recreation Area.

The Western and Southern Domains are located within the Awaba Hills physiographic region of the Lower Hunter (Matthei 1995). The Awaba Hills region comprises three main landscape types: the steep southern and eastern slopes of the Sugarloaf Range, the lower slopes and foothills of the Sugarloaf Range and the Cockle Creek floodplain/flat. The continued underground mining area is located within the lower slopes and foothills of the Sugarloaf Range.

Steep upper slopes of the Sugarloaf Range generally vary in elevation between 100 metres and 300 metres above sea level. Gradients are generally more than 30%. Valleys are generally steep and bedrock confined with cascades, benches (and small waterfalls) and pools. The majority of this landscape is uncleared and consists of moist forest communities. The creeks within the continued underground mining area originate in this landscape.

Lower slopes and foothills of the Sugarloaf Range are characterised by east-west oriented spurs stemming from the main Sugarloaf Range ridge. The elevation of the spurs is generally between 60 metres and 100 metres above sea level. The valleys between spurs are around 20 metres above sea level and vary in width between 10 metres (upper catchment) to 400 metres (mid catchment). The upper section of this landscape is generally uncleared and consists of moist forest vegetation. However, there are numerous vehicular tracks and cleared powerline easements, which display severe erosion.

The flat expanse associated with Cockle Creek is approximately 1 kilometre wide with an elevation of less than 10 metres above sea level. The lower section of this landscape, outside of the continued underground mining area, is highly disturbed, having been cleared, filled and developed as industrial/commercial land. The upper section remains generally well vegetated with woodland.

Geology

The geology of the Sugarloaf Range is predominantly Narrabeen Group quartz and lithic sandstones, conglomerates, siltstones and reddish shales (Matthei 1995). The soil profile on the upper to mid-slopes of the ridges is judged to comprise residual gravelly, sandy clays overlying extremely, to distinctly, weathered sandstone and conglomerate (Strata Engineering 2006). These soils are skeletal and prone to slope wash and a variety of other erosion types such as rill, scald and gullying, especially where soils are exposed or in the many steeper gradient headwater creeks below the main ridge crest. Sandstone and conglomerate outcrops are present on the ridge crests with loose boulders or talus observed on the mid-slopes and foot slopes of the ridges; this is typical of the natural weathering processes in the area.

Soil Landscapes

The Newcastle 1:100,000 Soil Landscapes Map Sheet (Matthei 1995) indicates that the Killingworth, Killingworth variant, Sugarloaf, Sugarloaf variant, Warners Bay and Cockle Creek soil landscape units occur within the continued underground mining area (refer to Figure 2.2 of the main text).

Killingworth soils and Killingworth variant soils occur over approximately half of the continued underground mining area. Killingworth soils are located on rolling hills, whilst the Killingworth variant soils are restricted to small areas of steep hills. The soils are shallow (<60 centimetres) to moderately deep (<150 centimetres), well to imperfectly drained Yellow Podzolic Soils, Yellow Soloths, Gleyed Podzolic Soils and Gleyed Soloths on the crests and hillslopes, with shallow well-drained Structured Loams, Bleached Loams and Lithosols on some crests. The Killingworth and Killingworth variant soils have a high water erosion hazard, very strong acidity and low to very low fertility.

Sugarloaf soils and Sugarloaf variant soils occur over approximately 40 per cent of the continued underground mining area. Sugarloaf soils are located on rolling to steep hills with gradients greater than 30 per cent. Sugarloaf variant soils are located on the summit surfaces and crests. The soils are shallow to moderately deep (50 centimetres – 150 centimetres) well to imperfectly drained Yellow Soloths, Yellow Earths and Lithosols on summit surfaces, with moderately deep to deep Yellow Podzolic soils, Yellow Soloths, Red Podzolic soils and Yellow Earths on step side slopes. The Sugarloaf and Sugarloaf variant soils have an extreme water erosion hazard, very strong acidity and low to very low fertility.

Warners Bay soils occur in the south-western portion of the Southern Domain. The Warners Bay soils are located on undulating rises and lows hills with gradients of 3 per cent to 20 per cent. The soils are moderately deep (100 centimetres) to deep (>150 centimetres) imperfectly to poorly drained Gleyed Podzolic Soils, moderately well-drained Yellow Podzolic soils, and yellow Soloths with moderately deep (>60 centimetres) poorly drained Structured Loams in drainage lines. Water erosion hazard is moderate, with moderate gully erosion occurring in unvegetated drainage lines and moderate sheet and rill erosion occurring in disturbed, cleared areas. The Warners Bay soils have low to very low nutrient storage capacity and are extremely acidic.

Cockle Creek soils are located along the narrow floodplains of Cockle Creek, which traverse the northern portion of the continued underground mining area. The soils are deep (>200 centimetres), poorly drained yellow Soloths and Yellow Podzolic Soils on the floodplains. Water erosion hazard for the Cockle Creek soils are described as being moderate to high with soils being sodic, dispersible soils of low wet strength. The soils are also considered to be infertile.

2.2 Catchment Characteristics

The continued underground mining area is located in the upper reaches of the Cockle, Diega, Palmer, Bangalow and Burkes Creek systems. Diega Creek, Burkes Creek and the upper reaches of Cockle Creek all drain to Lake Macquarie via Cockle Creek. Bangalow Creek is a part of the Wallis Creek system which forms a tributary of the Hunter River and is located in the western portion of the continued underground mining area. Palmers Creek drains directly to Lake Macquarie and will not be undermined as part of this project.

Previous investigations have been conducted into the nature of the alluvial deposits in Cockle Creek, Palmers Creek and nearby Ryhope Creek. The investigations concluded that the alluvium in Cockle Creek in the proposed underground mining area does not contain any significant aquifers, and that the alluvial groundwater resource in this area is of minor significance, due to its variable quality, and limited volume. The alluvium in Ryhope Creek was found to be similar to that of Cockle Creek, with no major aquifer identified and the groundwater resources considered to be of minor significance due to its variable quality and limited volume.

2.3 Land Use in the Continued Underground Mining Area and Region

The land use within and surrounding the continued underground mining area includes other coal mines, the Sugarloaf SCA, rural residential holdings and the residential areas of Killingworth, Barnsley, Wakefield and Ryhope. No residential areas are within the proposed longwall mining areas.

The major land use within the continued underground mining area is encompassed by the Sugarloaf SCA, managed by DECCW. This area is accessed by various stakeholders mainly for recreational purposes, such as bushwalking and recreational vehicle use.

Other land uses within the proposed underground mining area include two small private properties, however the properties are not currently used for significant agricultural production. The properties are used mainly for rural residential purposes with no commercial crops or significant livestock activities at either property.

The F3 Freeway and adjacent services easement bisects the proposed underground mining area in a north-south orientation. The services easement comprises oil and gas pipelines and fibre optic cables.

Two communications towers also occur along the Sugarloaf Ridge road within the continued underground mining area.

The land use surrounding the WWC pit-top is mainly vacant land owned by Oceanic Coal Australia Limited (OCAL). The residential areas of Killingworth and Barnsley are located approximately one kilometre to the west and one kilometre to the north-east, of the WWC pit-top (see **Figure 1.1**).

2.4 Vegetation Types and Plant Species

The Lower Hunter region is dominated by valley floors which are fringed in the south-west and north-east by the ranges of Cessnock and Maitland local government areas (LGAs). The coast contains the expansive lake system of Lake Macquarie, the mouth of the Hunter River at Newcastle and the extensive dune systems and estuary of Port Stephens. The region covers approximately 430,000 hectares of which roughly 60% (or 264,000 hectares), is covered with native vegetation (DECC 2009a).

The region is of biogeographic and scientific significance as it supports a transition between northern and southern ecological communities. The Lower Hunter, via the Liverpool Ranges and the extensive Wollemi National Park also provides a link to the drier fauna habitats of the western slopes. The area also forms an east-west migratory pathway and a drought refuge for inland species (DECC 2009a). As a consequence, the vegetation is unique when compared to the neighbouring regions. The flora of the Hunter Valley floor is remarkably diverse, with approximately 2000 species of vascular plants (DECC 2009a).

Of the 61 vegetation communities that occur in the Lower Hunter, 19 communities are considered to be regionally significant, including ten listed endangered ecological communities (EECs) (RBCS 2003). The Lower Hunter Region currently has 37 threatened plant species including 13 endangered and 24 vulnerable species (DECC 2009a).

The vegetation communities mapped in the continued underground mining area are consistent with the vegetation community descriptions of Bell and Driscoll (2009), who mapped the vegetation of the Sugarloaf SCA on behalf of DECCW. That study area covered

approximately 5000 hectares of forested vegetation along the Sugarloaf Range in north-western Lake Macquarie, and included the sampling and analysis of 1469 Rapid Data Points and 68 systematic flora plots.

Twenty-three vegetation communities were delineated by Bell and Driscoll (2009) in the Sugarloaf SCA, comprising one rainforest community, 20 forest communities and two paperbark thickets. Five are listed as threatened ecological communities (TECs) under the TSC Act.

Bell and Driscoll (2009) recorded 388 plant species in the Sugarloaf SCA, 12 of which (3%) were not native to the area.

2.5 Fauna Habitats and Species

The Lower Hunter contains fauna habitats of national and international significance. The Hunter Valley marks a transition zone for many fauna species between the sub-tropical influences of the north and the cooler, less fertile conditions to the south. There is a wide array of fauna habitats in the lower Hunter that are known, or are likely, to support 80 threatened species, including 17 endangered species (DECC 2009a).

The broad fauna habitat types of forest, riparian, and aquatic habitat found within the continued underground mining area are representative of most of the broad habitat types within the surrounding region. Woodland and forests of the lower Hunter Valley support a range of fauna species. Drier habitats in the western portion of the region support species that are adapted to a dry environment with little or no standing water. Important habitat for threatened woodland dependent species occurs in these dry woodland forests; habitat is provided by a moderately open canopy and sclerophyllous understorey that ranges from very dense to sparse, and a ground cover that is generally sparse and dominated by grasses and forbs.

Moist forest habitat of the ranges provides habitat for additional fauna species that are unable to be supported in the drier environments to the west of the ranges. These include threatened species such as the giant barred frog (*Mixophyes iteratus*), stuttering frog (*Mixophyes balbus*), wompoo fruit-dove (*Ptilinopus magnificus*), sooty owl (*Tyto tenebricosa*) and Stephen's banded snake (*Hoplocephalus stephensii*). Remnants of important lowland and coastal (littoral) rainforest habitat have disjunct occurrences in the Lower Hunter region (DECC 2009a).

Alluvial forests generally provide a denser vegetation cover than woodland and forest habitats. The relatively larger sizes of trees supported by the alluvial soils often also provide larger-sized hollows than those found on surrounding, drier slopes and ridges. The habitats also provide ephemeral standing and moving water, with small wetlands and farm dams occurring in some areas. Aquatic habitat provided by permanent and ephemeral creek lines and drainage lines are common across the landscape surrounding the continued underground mining area.

2.6 Conservation Areas

The continued underground mining area lies within bushland associated with the Sugarloaf Range linking the Watagan Mountains to Mount Sugarloaf. Most of the Sugarloaf Range was gazetted as Sugarloaf SCA in 2007, covering 3937 hectares. The Sugarloaf SCA, formerly Awaba and Heaton State Forests, was formed as part of the implementation of the Lower Hunter Regional Strategy (Regional Strategy) (DoP 2006) and Lower Hunter Regional

Conservation Plan (Conservation Plan) (DECCW 2009c) in 2007. On a regional scale, this large remnant ultimately links with larger bushland areas to the south including Olney State Forest, Jilliby State Conservation Area and Watagans National Park.

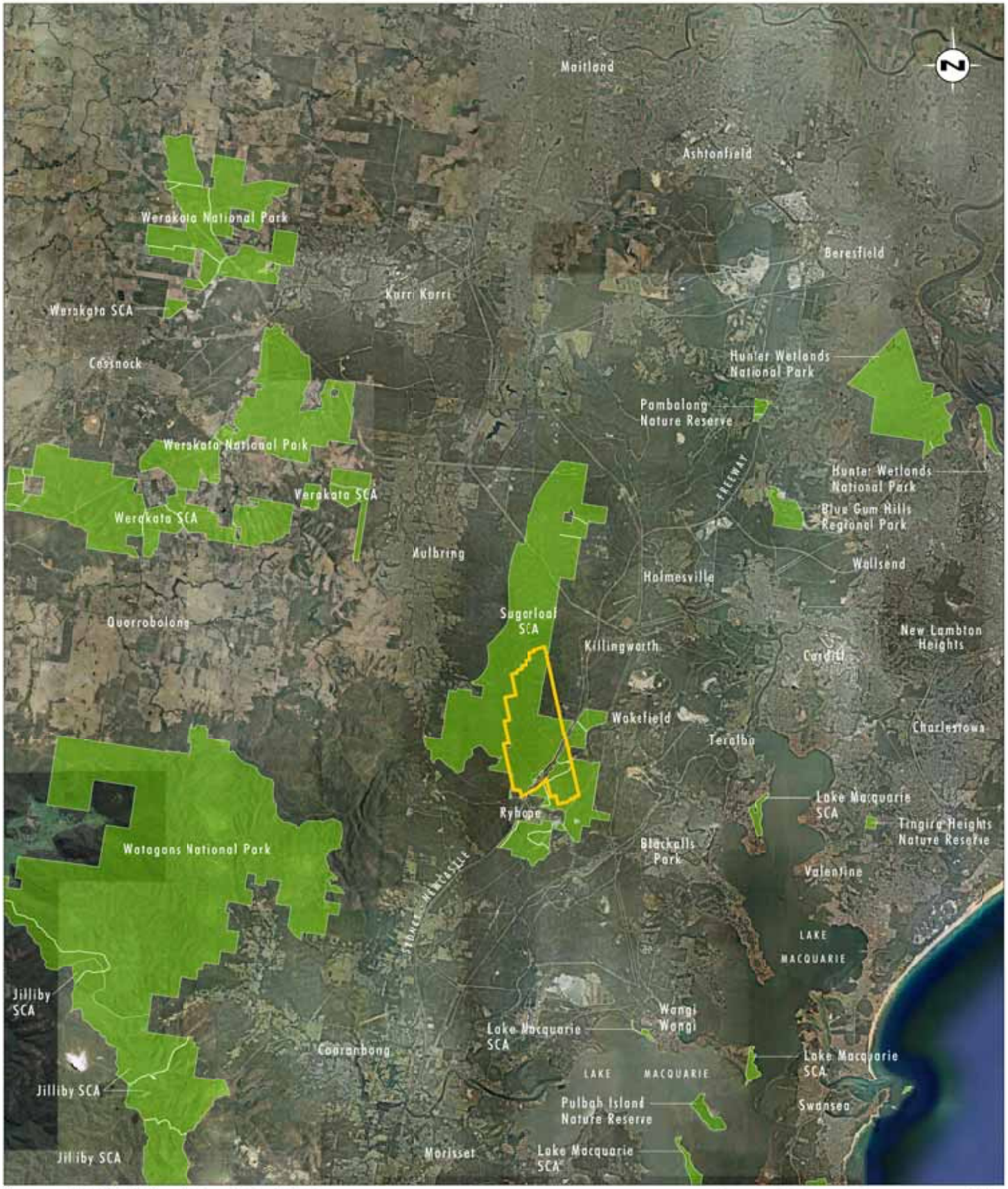
The continued underground mining area occurs approximately five kilometres from the north-eastern boundary of Watagans National Park (NP) (refer to **Figure 2.1**) and is linked by a substantial vegetated corridor in excess of 10 kilometres wide. Werakata NP and Werakata SCA occur to the north west of the continued underground mining area, conserving drier woodland communities and habitats of the central Hunter Valley floor. Numerous small conservation areas are located to the east of the continued underground mining area which are generally isolated from the continued underground mining area as a result of linear infrastructure corridors and urban development. These small conservation areas form part of the Lake Macquarie SCA and in the north-east the Hunter Estuary NP and the coastal Glenrock SCA.

State conservation areas are reserved under the *National Parks and Wildlife Act 1974* (NPW Act) to protect and conserve areas that contain significant or representative ecosystems, landforms or natural phenomena or places of cultural significance; that are capable of providing opportunities for sustainable visitor use and enjoyment, the sustainable use of buildings and structures or research; and that are capable of providing opportunities for uses permitted under other provisions of the NPW Act (DECC 2008).

2.7 Connectivity

One of the most significant areas of remaining vegetation in the Hunter Region is the Mount Sugarloaf to Port Stephens corridor, which provides a vegetated link through the 'Tank Paddock', near Minmi, from the sandstone mountains down through the foothills to the coastal plain. This is one of only a few remaining vegetated links between the Great Dividing Range and the east coast. This corridor is highly significant and allows for fauna movements such as seasonal migration and juvenile dispersal (DECC 2009a).

In the context of a regional system of reserves (refer to **Figure 2.1**), the Sugarloaf SCA provides a significant linkage to the north and south. A significant ecological corridor occurs in the region, stretching along the coastal ranges from the Hunter River estuary in the north to the Hawkesbury River estuary in the south. The vegetated corridor and reserve system complement the large, predominantly sandstone reserves of the Greater Blue Mountains World Heritage Area to the west and Popran and Brisbane Water National Parks to the south. To the north-west, on the floor of the Hunter Valley, are Werakata National Park, Werakata SCA and Belford National Park and to the east the significant coastal reserves of Lake Macquarie, the Central Coast and Newcastle (DECC 2008).



Source: DECCW 2009 and Google Earth 2009

Legend

- Continued Underground Mining Area
- Regional Conservation Area

FIGURE 2.1

Regional Conservation Areas

3.0 Survey Methodology

A detailed survey methodology was designed and completed in order to gain a thorough understanding of the ecological features of the continued underground mining area (refer to **Figure 1.2**). The methods include a detailed literature review of relevant reports and vegetation mapping, as well as searches of relevant ecological databases. Information gathered from the literature reviews and database searches was then used to design a field survey program to survey and map vegetation communities, and to target threatened species, endangered populations, TECs, and their habitats.

3.1 Objectives of the Flora and Fauna Surveys

The objectives of the flora and fauna surveys were to:

- describe the vegetation communities and fauna habitat types present within the continued underground mining area;
- describe the health and condition of the vegetation and habitats of the continued underground mining area;
- obtain information on the general floristics and fauna species diversity of the continued underground mining area;
- identify threatened flora and fauna species, endangered populations, TECs or their habitats occurring within or having potential to occur within the continued underground mining area; and
- accrue sufficient information to enable an accurate assessment of the impacts of the proposed mining activity on the ecological values of the continued underground mining area.

3.2 Literature Review

A review of all relevant and available literature was undertaken in order to gain a greater understanding of the ecological values of the continued underground mining area and the locality. Documents reviewed included previous ecological studies relating to sites in proximity to the continued underground mining area, regional vegetation mapping, relevant papers in scientific journals and threatened species information resources such as the DECCW internet resources.

The literature review also included a search of relevant ecological databases to identify threatened species, endangered populations and TECs that have been previously recorded or have potential to occur in, or with proximity to, the continued underground mining area.

A summary of the ecological findings of the key literature is provided in the following sections.

3.2.1 Vegetation and Floristics of Sugarloaf State Conservation Area, Lake Macquarie, NSW (Bell and Driscoll 2009)

The vegetation communities mapped in the continued underground mining area by Umwelt are consistent with the vegetation community descriptions of Bell and Driscoll (2009) who mapped the vegetation of the Sugarloaf SCA on behalf of DECCW. That study area covered approximately 5000 hectares of forested vegetation along the Sugarloaf Range in north-western Lake Macquarie and included the sampling and analysis of 1469 Rapid Data Points and 68 systematic flora plots.

Twenty-three vegetation communities were delineated by Bell and Driscoll (2009) in the Sugarloaf SCA, comprising one rainforest community, 20 forest communities and two paperbark thickets. Five are listed as threatened ecological communities (TECs) under the TSC Act.

Bell and Driscoll (2009) recorded 388 plant species in the Sugarloaf SCA, 12 of which (3%) were not native to the area. Targeted surveys undertaken for this and previous vegetation mapping projects allowed for the refinement of the broad vegetation communities mapped as part of the regional scale Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) vegetation mapping (NPWS 2000 and House 2003), with surveys and data analysis allowing for the delineation of discrete vegetation units formerly contained under one broad classification. In relation to the continued underground mining area, this is particularly true for spotted gum ironbark communities and smooth-barked apple – bloodwood – peppermint – mahogany dominated communities for which three discrete communities have each been delineated.

The 13 vegetation communities recorded by Bell and Driscoll (2009) in the continued underground mining area include:

- Coastal Warm Temperate Rainforest;
- Coastal Ranges Dry Blackbutt Forest;
- Coastal Foothills Spotted Gum Ironbark Forest;
- Coastal Ranges Mesic Peppermint Forest;
- Riparian Paperbark Peppermint Forest;
- Alluvial Tall Moist Forest;
- Coastal Wet Gully Forest;
- Mesic Paperbark Thicket;
- Hunter Valley Moist Spotted Gum Ironbark Forest;
- Freemans Peppermint Apple Bloodwood Forest;
- Sugarloaf Uplands Smooth-barked Apple Forest;
- Sugarloaf Uplands Spotted Gum Ironbark Forest; and
- Disturbed Regrowth.

3.2.2 Lower Hunter and Central Coast Regional Environmental Management Strategy Vegetation Mapping (NPWS 2000 and House 2003)

The Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) Vegetation Mapping is a broad based vegetation mapping system for the Lower Hunter and Central Coast regions incorporating seven LGAs, from Port Stephens to Gosford and west to Cessnock. The aim of this report is to provide cross tenure maps of the distribution of vascular plant communities in the Lower Hunter and Central Coast regions.

The LHCCREMS vegetation community map was used to gain an understanding of the types of vegetation communities that might be present in the continued underground mining area prior to the commencement of field studies. The regional scale of the vegetation map limits its application at a local scale.

3.2.3 Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy, Results of Regional Conservation Assessment (House 2003)

The Regional Biodiversity Conservation Strategy (RBCS) was prepared by the seven councils of the Lower Hunter and Central Coast with the objectives of:

- supporting ecosystem management as a fundamental requirement for conserving biodiversity;
- identifying threats, ameliorative actions and opportunities for conserving biodiversity; and
- involving the community, industry, local government and state government in developing and implementing the Strategy.

The aim of the strategy is to protect the natural, biological diversity of the Lower Hunter Central Coast region by identifying the scope of diversity of terrestrial ecosystems and the regionally significant areas that require long-term protection for maintaining existing ecological processes. This was accomplished through the collection of comprehensive and systematic data which assists in the identification of regionally significant areas of high biodiversity value.

The RBCS contributed to the identification of the regional significance of vegetation communities in the continued underground mining area. Since the preparation of the RBCS, additional vegetation mapping has been conducted within the lower Hunter and Central Coast which has resulted in the refinement and further delineation of vegetation communities (Bell and Driscoll 2009; Bell 2004; Bell 2006; Bell and Driscoll 2008a and 2008b). Therefore, the results of the RBCS were considered in the context of providing a guide to the conservation significance of communities, in the absence of an updated assessment.

3.2.4 Review of Environmental Factors for the Western Domain, West Wallsend Colliery (Umwelt 2006a)

This document aimed to assess the environmental impacts of the proposed longwall mining activities on the area of the Western Domain (refer to **Figure 1.2**) not covered by the existing development consent (DA75/20049) (hereafter referred to as the REF area). A flora and fauna survey of the study area was undertaken in April 2006. The purpose of the survey was to describe the vegetation communities present; ground truth existing vegetation mapping by LHCCREMS; record the presence of any threatened species, populations or TECs; and assess the availability, type and diversity of fauna habitat present within the study area.

The vegetation of the Western Domain forms part of a large expanse of remnant vegetation and is continuous and relatively undisturbed. One threatened flora species, black-eyed Susan (*Tetratheca juncea*), was recorded in the study area during surveys. No endangered flora populations or TECs were identified. As a result of the ground-truthing, refinements to the LHCCREMS vegetation mapping were undertaken. The study area was found to provide potential habitat for a variety of fauna species, but no threatened fauna species were recorded during the surveys. There were also no endangered fauna populations or areas of critical habitat identified within the study area.

The likely subsidence resulting from the longwall mining activities was considered unlikely to result in any net loss of floral diversity or significant impact on the survival of any fauna species occurring in the study area.

3.2.5 Hydrology and Ecology Assessment for the Western Domain, West Wallsend Colliery (Umwelt 2006b)

The document aimed to assess the potential impact of expected subsidence on the hydrological and ecological features within the entire Western Domain of the West Wallsend Colliery (refer to **Figure 1.2**), as a result of proposed longwall mining operations. A field survey was undertaken in April 2006, which involved traversing the study area on foot with a focus on drainage lines. The aim of the field survey was to describe the vegetation communities present, ground truth existing vegetation mapping by the Lower Hunter and Central Coast Regional Environmental Strategy (LHCCREMS), record the presence of any threatened species, populations or endangered ecological communities and assess the availability, type and diversity of fauna habitat present within the study area.

The vegetation was found to be continuous and relatively undisturbed, dominated by Coastal Plains Smooth-barked Apple Woodland with Alluvial Tall Moist Forest dominating the drainage lines. Following ground-truthing, some minor alterations were made to the boundaries of the LHCCREMS mapping. One threatened flora species, black-eyed Susan (*Tetratheca juncea*), was recorded in the study area during surveys. No endangered flora populations or TECs were identified within the Western Domain. The Western Domain provides potential habitat for a variety of fauna species, but no threatened fauna species were recorded during the surveys. There were also no endangered fauna populations or areas of critical habitat identified within the Western Domain.

The likely subsidence resulting from the longwall mining activities was considered unlikely to result in any net loss of floral diversity or significant impact on the survival of any fauna species across the Western Domain.

3.2.6 Hydrology, Ecology and Archaeology Assessment for the Southern Domain, West Wallsend Colliery (Umwelt 2006c)

The document aimed to assess the potential impact of expected subsidence on the hydrological and ecological features within the Southern Domain (refer to **Figure 1.2**) of WWC, as a result of longwall mining operations. A field survey was undertaken on 30 November 2006. The survey focused on the vegetation and habitats of the riparian areas, as these areas were predicted to be affected by the impacts of subsidence or potential surface remediation works associated with longwall mining.

The field survey described the vegetation communities present, ground-truthed existing vegetation mapping by the LHCCREMS, record the flora present within each vegetation community, recorded the presence of threatened species, populations or TECs and assessed the availability, type and diversity of fauna habitat present within the study area.

The vegetation was identified as continuous and relatively undisturbed, dominated by Coastal Plains Smooth-barked Apple Woodland and Alluvial Tall Moist Forest. A small number of the threatened flora species black-eyed Susan (*Tetratheca juncea*) and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) were recorded within the Coastal Plains Smooth-barked Apple Woodland. No endangered flora populations or TECs were identified within the study area. The Southern Domain provides potential habitat for a variety of fauna species, but no threatened fauna species were recorded during the surveys. There were also no endangered fauna populations or areas of critical habitat identified within the Southern Domain.

The likely subsidence resulting from the longwall mining activities was considered unlikely to result in any net loss of floral diversity or significant impact on the survival of any fauna species across the Southern Domain.

3.2.7 Xstrata Biodiversity and Land Management Strategy Stage 2b Report (Umwelt 2009)

The Xstrata Biodiversity and Land Management Strategy (BLMS) (Umwelt 2009) aims to document the vegetation communities, threatened species, populations and ecological communities on non-operational land managed by Xstrata Coal NSW (XCN).

A gap analysis was conducted initially to determine the information available for each XCN operation. For areas where there was limited existing ecological information, field surveys were conducted to delineate and describe vegetation communities, and to document the occurrence of threatened species, populations and ecological communities. For areas where there was existing and reliable information available, surveys were conducted to ground-truth existing vegetation mapping and to record any additional threatened species, endangered populations or TECs.

This report included non-operational land owned by the Macquarie Coal Joint Venture (MCJV). The continued underground mining area was not included in the assessment, however the report provided contextual information regarding vegetation mapping and information on threatened species, populations and ecological communities within the local area, particularly at nearby Westside Mine.

3.2.8 Watagans National Park and Jilliby State Conservation Area – Draft Plan of Management (DECC 2008)

This document drafts a set of strategies to effectively manage the natural and cultural values of Watagans National Park and Jilliby State Conservation Area with the aim to conserve biodiversity and protect ecological integrity. Watagans National Park and Jilliby State Conservation Area are located to the south of the continued underground mining area, as shown on **Figure 2.1**. The strategies recommended in the Plan of Management were to:

- conserve and protect the threatened flora, fauna and their habitats;
- collect information on ‘common’ species to ensure that any notable changes are identified and appropriate mitigation measure put in place;
- implement the appropriate management recommendations as listed in any recovery plans relevant to threatened species;
- ensure that no native fauna are introduced to a site unless stated as such in a recovery plan;
- encourage research projects;

- encourage the community to contribute to the Atlas of NSW Wildlife; and
- encourage bird observers and environmental groups to carry out surveys.

The Plan of Management identified the following rare flora species that have been previously identified within the Watagans NP:

- *Bosistoa transversa* (V EPBC & TSC);
- *Acacia prominens* (Rare ROTAP);
- *Eucalyptus fergusonii* subsp. *fergusonii* (poorly known ROTAP); and
- *Eucalyptus hypostomatica* (rare ROTAP).

This draft plan of management identified the following threatened fauna species within the Watagans NP:

- giant barred frog (*Mixophyes iteratus*) E (TSC), E (EPBC);
- stuttering frog (*Mixophyes balbus*) E (TSC), V (EPBC);
- barking owl (*Ninox connivens*) V (TSC);
- glossy black-cockatoo (*Calyptorhynchus lathami*) V (TSC);
- masked owl (*Tyto novaehollandiae*) V (TSC);
- sooty owl (*Tyto tenebricosa*) V (TSC);
- brush-tailed rock wallaby (*Petrogale penicillata*) E (TSC), V (EPBC);
- yellow-bellied glider (*Petaurus australis*) V (TSC);
- koala (*Phascolarctos cinereus*) V (TSC);
- large-eared pied bat (*Chalinolobus dwyeri*) V (TSC) and V (EPBC); and
- spotted-tailed quoll (*Dasyurus maculatus*) V (TSC) and E (EPBC).

Potential habitat was also identified in the National Park for Hunter Lowland Redgum Forest EEC and Lowland Rainforest EEC.

These species and communities were included in the list of potentially occurring species requiring dedicated field survey as part of the ecological surveys for the project due to the proximity of the records and the expected similarity in habitats between the Sugarloaf SCA and Watagans National Park and Jilliby SCA.

3.2.9 West Wallsend Colliery Biodiversity Monitoring Report (Umwelt 2008)

OCAL commissioned Umwelt to undertake a program of biodiversity monitoring which commenced in spring 2005 (Umwelt 2005). The ecological monitoring program was completed in accordance with the requirements of Xstrata Coal's HSEC STD5.09 Biodiversity and Land Management (Xstrata Coal NSW 2005).

All Xstrata Coal sites are required to implement the biodiversity and land management standard as a minimum. The purpose of the standard is 'to develop and implement scientifically-sound technologies and procedures for:

- the effective management and conservation of biodiversity, and
- rehabilitation of disturbed land to a planned post-closure use.' (Section 1, Xstrata Coal NSW 2005).

Specifically relevant to biodiversity monitoring are six criteria to be addressed under the standard:

- species and habitat loss or gains;
- factors that impact on biodiversity;
- security of protected areas;
- management of biological resources;
- on-going rehabilitation and restoration of ecosystems; and
- resilience of the ecosystem.

Umwelt recommended detailed ecological monitoring of two sites during 2005 to examine the impact of the mine on native flora and fauna that occur on the surface above current longwall operations. This baseline monitoring included both flora and fauna and focussed on identifying vegetation structure and floristics, as well as species diversity and abundance at two sites above longwall panels 32 and 33 (refer to **Figure 1.2** for longwall panel locations).

Additional monitoring sites were established in 2006 above longwall panels 32 and 34 (Umwelt 2006). During the 2007 monitoring period, an additional flora and fauna monitoring site was established adjacent to the creek line above the northern section of longwall panel 35 (Umwelt 2007). During the 2008 monitoring period, two additional flora and fauna monitoring sites were established adjacent to creek lines above Longwalls 36 and 37 and one monitoring site established to monitor the offset area established as a result of subsidence incurred from the underground mining operation of longwall panel LW12 (Umwelt 2008).

The report concludes that the vegetation had not changed significantly between 2005 and 2008 and there have been no measurable impacts on flora from underground mining activities. No observable impacts on fauna habitat quality from underground mining activities have been recorded at any of the monitoring sites during this time period. The variation in species diversity observed over the monitoring period is not considered likely to be attributable to underground mining operations.

3.2.10 Ecological Database Searches

A search of the DECCW Atlas of NSW Wildlife database was undertaken to identify threatened species, endangered populations and TECs that have been previously recorded within a 10 kilometre radius of the continued underground mining area. Similarly, the Department of the Environment, Water, Heritage and the Arts (DEWHA) Protected Matters database was searched to identify Commonwealth listed flora and fauna species and ecological communities whose range falls within the continued underground mining area, and/or have been previously recorded within a 10 kilometre radius. The data obtained from

these two database searches was used to compile a list of threatened species, endangered populations and TECs with potential to occur within the continued underground mining area (refer to **Appendix A** for the full list of species, populations and ecological communities identified). A comparison between habitat requirements for each of these species and the habitat types present within the continued underground mining area was undertaken to determine the likelihood of listed flora and fauna species and communities occurring.

3.3 Flora Survey

Flora surveys were undertaken between 8 and 12 December 2008, 20 and 23 January 2009 and 4 March 2009. The locations of the flora survey sites are identified on **Figure 3.1**. The vegetation mapping of the Sugarloaf SCA (Bell and Driscoll 2009) (that covered most of the continued underground mining area), was ground-truthed during December 2009. This ground-truthing was completed via the conduct of rapid assessment points.

3.3.1 Systematic Plot-based Survey

A total of 30 systematic vegetation quadrats were sampled in the continued underground mining area during surveys conducted for the project. The quadrats were positioned at sites that were selected by considering a range of attributes that influence or determine the type of vegetation community present, particularly topographic position, slope, aspect and soil type. The selection of quadrat locations also aimed to achieve effective coverage of the continued underground mining area, particularly areas in which the vegetation was thought to have potential to support TECs or any other potentially significant vegetation type.

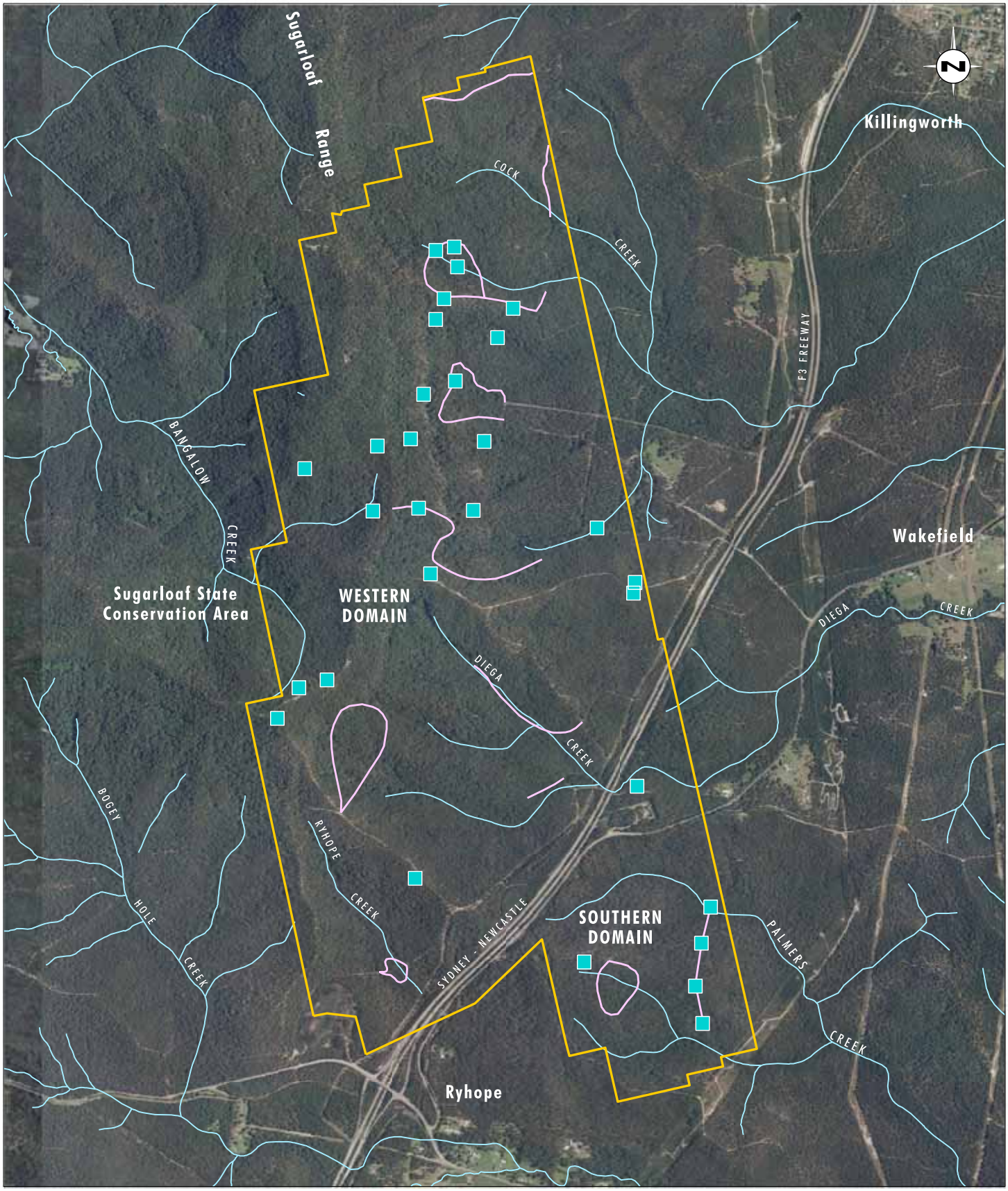
Each vegetation quadrat had dimensions of 20 metres by 20 metres (400 m^2), which is a standard size used widely for systematic flora surveys throughout NSW and is recognised by DECCW and the Royal Botanic Gardens Sydney. Within each quadrat, two ecologists spent approximately 45 minutes to 1 hour searching for species, walking along-side each other in parallel lines throughout the extent of the quadrat.

A modified Braun-Blanquet 6-point scale (Braun-Blanquet 1927, with selected modifications sourced from Poore 1955 and Austin *et al.* 2000) was used to estimate cover-abundances of all plant species within each quadrat. **Table 3.1** shows the cover-abundance categories used.

Table 3.1 - Modified Braun-Blanquet Crown Cover-Abundance Scale

Class	Cover-abundance*	Notes
1	Few individuals (less than 5% cover)	Herbs, sedges and grasses: <5 individuals Shrubs and small trees: <5 individuals
2	Many individuals (less than 5% 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% cover	
4	20 – less than 50% cover	
5	50 – less than 75% cover	
6	75 – 100% cover	

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



Source: OCAL

0 0.5 1.0 1.5km
1:30 000

Legend

- Continued Underground Mining Area
- Flora Transect
- Flora Quadrat

FIGURE 3.1

Flora Survey Sites

Information on the structural characteristics of the vegetation in the quadrat was also recorded, including the height range and canopy cover of each stratum and the dominant species in each stratum. Information on the general health and condition of the vegetation within the quadrat was also recorded, including presence of introduced species, disturbances such as fire and feral animals, and evidence of dieback or insect attack.

3.3.2 Targeted Threatened Flora Transects

A total of 9.5 kilometres of targeted threatened flora transects were traversed throughout the continued underground mining area, the locations of which are shown on **Figure 3.1**. The objectives of these transects were to:

- search for threatened flora species and their habitats;
- assist in the delineation of vegetation communities;
- enable greater coverage of the continued underground mining area than would be achieved by plot-based sampling alone; and
- contribute to floristic knowledge of the continued underground mining area.

The transects were variable in length and location, and were tailored to suit the environment in which they occurred. Their locations were selected to achieve broad coverage of the full range of environments across the continued underground mining area.

3.3.3 Determination of Threatened Ecological Communities

Vegetation communities identified in the continued underground mining area were compared to TECs listed under the NSW TSC Act and the Commonwealth EPBC Act.

The assessment of similarity with TECs was made using the following approach:

- comparison with published species lists, including lists of 'important species,' for the TECs;
- comparison with habitat descriptions and distributions for the TECs;
- assessment using relevant community-specific guidelines published by the DEWHA and the DECCW;
- comparison with floristic descriptions of communities mapped and described as part of the *Draft Vegetation and Floristics of the Sugarloaf State Conservation Area, Lake Macquarie, NSW* (Bell and Driscoll 2009), including consideration of the conservation assessment of the report;
- mapping of alluvium to identify potential habitat for Alluvial Tall Moist Forest which is considered to form a sub-community of River-flat Eucalypt Forest on Coastal Floodplains EEC; and
- comparison with other assessments of TECs in the region.

3.3.4 Plant Identification and Taxonomic Review

All vascular plants recorded or collected were identified using keys and nomenclature from Harden (1992, 1993, 2000 & 2002) and Wheeler *et al.* (2002). Recent changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2009), 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 common names. 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.

3.3.4.1 Biases and Limitations

The survey was influenced by limitations in time and by seasonal factors as the survey was primarily conducted during two seasons (summer and autumn) and over a four month period, however, spring and summer are the peak flowering periods for many cryptic species, such as orchids. Significant previous survey has been undertaken in the continued underground mining area during winter and spring as part of due diligence assessments for borehole sites and REFs for subsidence related impact assessment and management (refer to **Section 3.2**).

The use of consistent surveyors for the sampling effort also helped to minimise observer bias which may occur when surveys are conducted by more than one surveyor.

For herbaceous and graminoid species, such as those belonging to the families Asteraceae, Orchidaceae, Cyperaceae and Poaceae, the allocation of specimens to sub-specific levels was affected by the availability of adequate flowering of fruiting material. In this case specimens were always forwarded to the National Herbarium of New South Wales if they were considered to be of potential significance or importance.

3.4 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the continued underground mining area. Vegetation mapping involved the following key steps:

- preparation of draft vegetation community map based on aerial photograph interpretation of 1:25,000 stereo pairs with preliminary delineation of vegetation communities;
- review of previous mapping undertaken by Umwelt (2006b) and LHCCREMS (NPWS 2000 and House 2003);
- import of regional vegetation community mapping (Bell and Driscoll 2009) from DECCW;
- ground-truthing of vegetation map based on survey effort documented in **Section 3.3**;
- revision of vegetation community floristic delineations based on plot data; and
- 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 *Draft Vegetation and Floristics of Sugarloaf State Conservation Area, Lake Macquarie, NSW* (Bell and Driscoll 2009), and the dendrogram provided in the Bell and Driscoll (2009) report was interrogated to identify those communities that contain similarities in species and structural composition to ensure that the communities identified in the continued underground mining area were not aligned with similar or intergrade communities known to occur elsewhere in the local area.

Communities were then named in accordance with those communities described by Bell and Driscoll (2009), for consistency.

3.5 Fauna Survey

The following sections document the methods employed for the fauna survey components of the project. Fauna survey effort was generally undertaken in accordance with the DEC Draft *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004).

A total of four fauna survey sites were sampled within the continued underground mining area, with several additional fauna surveys also undertaken to target specific habitats within the continued underground mining area. Fauna surveys were undertaken from 8 to 12 December 2008, 2 to 6 February 2009 and 2 to 4 March 2009. The locations of fauna survey sites are identified in **Figure 3.2**.

3.5.1 Fauna Trapping

Fauna trapping was undertaken at each of the four fauna survey sites identified in **Figure 3.2**, two of which were surveyed in summer and two in autumn. The following is a summary of the trapping effort for each survey site.

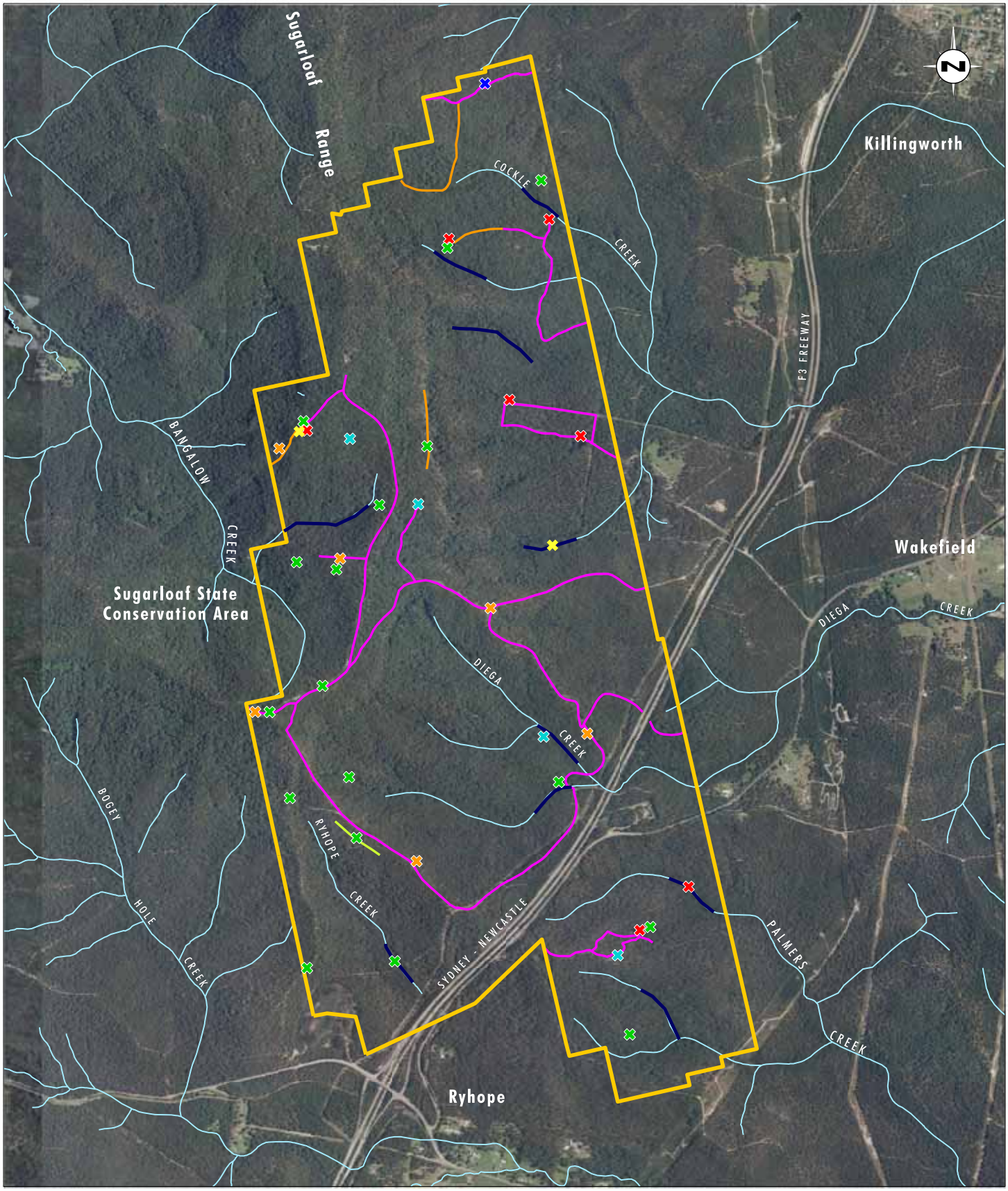
Each trap site was established and set, for four consecutive nights, with a standard trap site comprising:

- 20 terrestrial Elliott A traps;
- 20 terrestrial Elliott B traps;
- 20 terrestrial hair funnels (10 meat bait, 10 peanut butter, honey and oats);
- 10 arboreal Elliott B traps;
- 10 arboreal hair funnels;
- 3 wire cage traps (baited with chicken necks and peanut butter, oat and honey mix); and
- 1 harp trap for two nights.

Unless otherwise stated above, all traps were baited with a peanut butter, honey and oat mixture and the entry of the traps sprayed with a concentrated honey water solution.

3.5.2 Micro-bat Echolocation Recordings

Micro-bat echolocation recordings were made using an ‘Anabat II Bat Detector’ and an ‘Anabat CF Storage ZCAIM‘, hereafter referred to as an ‘Anabat detector’. At each site the Anabat detector was either placed upon a small platform which was attached to a tree trunk at a height of approximately 2 metres or placed on the ground angled up at 45 degrees, for



Source: OCAL

0 0.5 1.0 1.5km
1:30 000

Legend

- Continued Underground Mining Area
- Driving Spotlighting
- Additional Walking Spotlighting
- Additional Hairtube Line
- Aquatic Survey Line
- Additional Anabat
- Additional Call-playback
- Fauna Survey Site
- Additional Diurnal Bird and Herpetological Surveys
- Additional Harp trap
- Additional Fauna Survey Site

FIGURE 3.2

Fauna Survey Sites

File Name (A4): R05_V1/2553_015.dgn

two full nights. Each detector was positioned within potential micro-bat flight paths. The Anabat detector was programmed to start recording at 6 pm and finish at 6 am each day. The Anabat detector was contained in a rain-proof housing and all-night recordings were made regardless of weather conditions.

Recorded bat calls were analysed by Glenn Hoye of Fly By Night Bat Surveys Pty Ltd. The echolocation calls of species were identified to one of three levels of confidence:

- definite;
- probable; and
- possible.

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

3.5.3 Diurnal Bird Survey

Two diurnal bird surveys, each of one person hour, were undertaken at each fauna survey site. Each survey consisted of a slow walking transect within a two hectare area of the survey site. Species were identified from characteristic calls and by observation, using 10 x 42 binoculars. Opportunistic observations were also recorded during other aspects of the survey effort.

3.5.4 Herpetological Survey

Two targeted diurnal herpetological (reptile and amphibian) surveys, each of one person hour on two separate days, were undertaken at each fauna sites. Searches targeted areas of likely habitat within proximity to each site. During the search likely microhabitats were examined including beneath rocks and logs, in tree bark and in ground litter.

3.5.5 Spotlighting Survey

Two nocturnal spotlighting surveys, each of one person hour on two separate nights, were undertaken at each fauna site targeting nocturnal birds, mammals and herpetofauna. Spotlighting was conducted on foot within a two hectare area of the survey site using 30 watt Lightforce hand-held spotlights. Spotlighting was undertaken generally between 8.00 pm and 12.00 midnight, commencing one hour after sunset. Opportunistic spotlighting was undertaken from a slow-moving vehicle while travelling between sites at night.

3.5.6 Call Playback Surveys

Nocturnal call playback sessions were undertaken within the first four hours after dusk. Calls were broadcast using a 10 watt directional loud hailer. Call playback sessions commenced with a quiet listening period of approximately five minutes. Each call was played for a minimum of four minutes followed by a listening period of two minutes before the beginning of the next call. Mammal calls were played before bird calls to prevent the calls of predators (such as owls) decreasing the likelihood of prey species (such as gliders) responding to call playback. Call playback sessions included the calls of:

- squirrel glider (*Petaurus norfolcensis*);
- yellow-bellied glider (*Petaurus australis);*

- koala (*Phascolarctos cinereus*);
- masked owl (*Tyto novaehollandiae*);
- sooty owl (*Ninox connivens*); and
- powerful owl (*Ninox strenua*).

Eleven nocturnal call playback sites were completed in the continued underground mining area, with multiple sessions undertaken over consecutive days at many sites during surveys (refer to **Figure 3.2**). Surveys were undertaken at each of the four Fauna Survey Sites; the Additional Fauna Survey Site; and at an additional six sites.

3.5.7 Habitat Assessment

A habitat assessment was undertaken at each survey site identifying potential habitat and resources for threatened fauna species. Habitat assessments were undertaken at 25 flora quadrat or transect sites. Observations of the following habitat features were made:

- evidence of fire;
- nature of and extent of erosion;
- extent of introduced species;
- presence of feral animals;
- type of ground cover (e.g. litter, rock, soil);
- ground fauna resources;
- wet soaks/drainage lines;
- degree of dieback;
- presence of mistletoe;
- structure and floristics of vegetation cover; and
- number of habitat trees, including size and abundance of hollows/nests.

In addition to these general habitat features, observations of the likely specific requirements of threatened fauna species considered to have potential to occur within the locality were also made, including matters such as the presence of winter-flowering eucalypt species, which are important foraging resources for migratory species such as the regent honeyeater (*Anthochaera phrygia*) and the swift parrot (*Lathamus discolor*).

All habitat features observed were considered when assessing the likely presence or absence of any threatened fauna species. The known habitat requirements of each potentially occurring threatened fauna species were compared with the habitat features recorded within the continued underground mining area.

3.6 Additional Fauna Surveys

Additional fauna surveys were completed in targeted areas for habitat sampling and spatial distribution. The following section outlines the methods involved in the additional fauna survey effort, identified in **Figure 3.2**.

3.6.1 Additional Fauna Trapping

Additional fauna trapping was undertaken at one site in the north of the continued underground mining area during the autumn survey. The following is a summary of the trapping effort for this survey site.

The trap site was established and set, for four consecutive nights, with the trap site comprising:

- 12 terrestrial Elliott A traps;
- 10 terrestrial Elliott B traps;
- 20 terrestrial hair funnels (10 meat bait, 10 peanut butter, honey and oats);
- 10 arboreal hair funnels;
- 3 wire cage traps (baited with chicken necks or a seafood cat food, peanut butter, oat and honey mix);
- 1 harp trap for two nights; and
- 1 micro-bat echolocation recording for two nights.

All traps were baited with a peanut butter, honey and oat mixture and the entry of the traps sprayed with a concentrated honey water solution.

3.6.2 Diurnal Bird and Herpetological Survey

Diurnal bird and herpetological surveys, each for 40 minutes, were undertaken at 16 sites throughout the continued underground mining area. Each survey consisted of a slow walking transect within a specific habitat type.

Bird species were identified from characteristic calls and by observation, using 10 x 42 binoculars. Herpetofauna searches targeted areas of likely habitat within proximity to each site. During the search likely microhabitats were examined including beneath rocks and logs, in tree bark and in ground litter.

3.6.3 Walking Spotlighting Survey

Two kilometres of additional walking nocturnal spotlighting surveys were conducted throughout the continued underground mining area targeting nocturnal birds, mammals and herpetofauna. Spotlighting was conducted on foot using 30 watt Lightforce hand-held spotlights. Spotlighting was undertaken generally between 8.00 pm and 12.00 midnight, commencing one hour after sunset.

3.6.4 Driving Spotlighting Survey

Fifteen kilometres of driving spotlighting surveys were undertaken throughout the continued underground mining area targeting nocturnal birds, mammals and herpetofauna. Spotlighting was conducted using 30 watt Lightforce hand-held spotlights travelling less than 10 kilometres per hour. Spotlighting was undertaken generally between 8.00 pm and 12.00 midnight, commencing one hour after sunset. The general visibility was approximately 30 – 50 metres from the road.

3.6.5 Micro-bat Echolocation Recordings

Seven additional micro-bat echolocation recordings were undertaken throughout the continued underground mining area using an Anabat detector for two nights.

3.6.6 Harp Trapping

Two additional harp trap sites were undertaken in targeted habitat types. Each harp trap was set for two nights.

3.6.7 Indirect Evidence of Faunal Presence

Indirect evidence of faunal presence was recorded throughout the continued underground mining area. Evidence included tracks, scats, scratches, burrows, bones, nests and drays. Scat and hair samples, as required, were forwarded to Barbara Triggs for expert analysis. All opportunistic fauna observations were recorded during all aspects of the survey effort.

Targeted habitat features, such as tree hollows and fallen logs, were examined for any evidence of fauna occupation such as scratches on the trunks of trees, chewed entrances to hollows, scratchings or diggings near logs and scats at the base of trees or in or near logs.

3.7 State Environmental Planning Policy (SEPP) 44 (Koala Habitat) Assessment Methodology

An application for project approval which relates to a site occurring within an LGA specified under State Environmental Planning Policy 44 (SEPP 44) – Koala Habitat Protection, affecting an area of one hectare or greater, must be assessed under SEPP 44. This policy, however does not apply to land dedicated or reserved under the NPW Act.

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 3.2**) 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. Should an area be identified as core koala habitat, a Koala Plan of Management is required to be developed in accordance with the SEPP 44 guidelines.

Table 3.2 – 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 30 flora quadrat sites, identified in **Figure 3.1**. All SEPP 44 listed canopy species were recorded, along with an estimate of the percentage of the total trees that comprise SEPP 44 species within each vegetation quadrat. This allowed an assessment as to whether Schedule 2 species comprised greater than 15% of canopy species in any of the vegetation communities recorded in the continued underground mining area.

Further searches were made to identify preferred koala food trees and evidence of koala faecal pellets during walking transects in the vicinity of koala assessment sites and when moving between survey sites.

3.8 Aquatic Survey and Assessment

3.8.1 Aquatic Fauna and Habitat

Preliminary mapping of the broad scale aquatic habitats within the continued underground mining area was undertaken using recent aerial photography in conjunction with topographic maps prior to field surveys. Topographic maps were used to gain a broad understanding of catchment characteristics including adjacent land use, elevation, access routes, distance from source and location of barriers to fish passage, such as dams and weirs.

An assessment of the aquatic habitat characteristics within each of the sampling sites was undertaken, and indicators of stream condition were also noted. The aquatic habitat characteristics were recorded using standard recording sheets (adapted from those developed for the AUSRIVAS sampling protocol available as a web resource, (AUSRIVAS 2007)).

Some of the habitat features and stream condition indicators assessed included:

- characteristics of bed substrate;
- presence of in-stream woody debris;
- presence of gravel beds;
- presence of drought and flood refuge areas;

- depth of water;
- width of channel;
- presence of pool, riffle and edge habitats;
- height of bank and evidence of erosion;
- channel geomorphology;
- evidence of sediment deposition;
- the presence of natural or artificial barriers to fish passage upstream and downstream;
- colour and clarity of water, and any visual evidence of water quality; and
- characteristics of in-stream, riparian and floodplain vegetation.

The likelihood of aquatic mammals occurring within the continued underground mining area was also considered during the habitat assessment, in particular the water rat (*Hydromys chrysogaster*) and the platypus (*Ornithorhynchus anatinus*). The potential presence of these species was assessed by searching for suitable bank habitat, burrows and also through identification of any scats observed.

Field surveys comprised the assessment of 10 drainage line habitats to determine the potential for aquatic species, particularly threatened species to occur in the continued underground mining area. Assessment of the drainage lines concluded that the ephemeral nature of drainage lines within the continued underground mining area precluded the need to undertake targeted aquatic sampling and the assessment was limited to an assessment of the habitat provided by the ephemeral drainage lines identified.

The assessment of aquatic habitat was undertaken between 2 and 6 February 2009, and further assessment was undertaken on 2 March 2009.

3.8.2 Aquatic Flora

A walking transect was undertaken at each sampling site to assess the presence and types of aquatic flora. These walking transects were conducted to determine species composition and community structure. Walking transects were also used to determine species composition and community structure of fringing riparian vegetation.

Samples of all unknown plant species were collected in the field, pressed and dried for later identification, and forwarded to the National Herbarium of New South Wales if necessary.

3.9 Summary of Survey Effort

Table 3.3 provides a summary of the total trapping effort across the 30 flora survey sites, four fauna survey sites and additional fauna survey sites described from **Sections 3.3** to **3.6**.

Table 3.3 – Summary of the Total Survey Effort in the Continued Underground Mining Area

Vegetation Survey	**Survey Method**
Vegetation Quadrats	30 vegetation quadrats
Vegetation Transects	11 transects
Fauna Survey	
Diurnal Birds	8 x 2 hectare surveys for one person hour each; and 17 x 20 minutes additional surveys. **13.6 person hours total survey effort**
Nocturnal Birds, Mammals and Reptiles	11 nocturnal call playback sessions; 10 x 2 hectare surveys totalling 20 person hour walking spotlighting; 15 kilometres additional driving spotlighting; and 2 kilometres additional walking spotlighting.
Small Mammal Trapping	368 trap nights using Elliot 'A' traps; 360 trap nights using Elliot 'B' traps; and 1400 nights of hair funnels.
Large Mammal trapping	60 trap nights using wire cage traps.
Arboreal Mammal Trapping	160 trap nights using Elliot 'B' traps; and 560 nights of hair funnels.
Micro-bat Surveys	12 Anabat echolocation surveys totalling 24 nights; and 7 harp trap surveys totalling 14 nights.
Diurnal Herpetological Surveys	8 x 2 hectare search areas lasting one person hour; and 17 x 20 minute additional surveys. **13.6 person hours total survey effort**
Fauna Habitat Assessment	25 habitat assessments
SEPP 44 Koala Habitat Assessment	30 SEPP 44 koala habitat assessments
Aquatic Assessment	10 creekline transects

4.0 Survey Results

4.1 Flora

The following sections describe the floristic diversity and vegetation communities of the continued underground mining area, in addition to significant ecological values such as threatened flora species, endangered populations, TECs and any records of regional significance.

4.1.1 Database Searches

The threatened flora species, endangered populations and TECs results from the DECCW Atlas of NSW Wildlife and DEWHA Protected Matters database are included in **Appendix A**.

4.1.2 General Flora

A total of 264 species were recorded within the continued underground mining area from 82 families. Fabaceae (Faboideae) (pea plants) was the most speciose plant family (24 species recorded), followed by Myrtaceae (myrtaceous plants) with 23 species recorded and Poaceae (grasses) with 22 species recorded. Of the 264 species recorded, 250 (95 per cent) were native and 14 (5 per cent) were introduced. A full list of the flora species recorded during the survey effort is presented in **Appendix B**.

4.1.2.1 Introduced Species

A total of 14 introduced species were recorded in native vegetation communities within the continued underground mining area during surveys, including camphor laurel (*Cinnamomum camphora*), lantana (*Lantana camara*), Mickey Mouse plant (*Ochna serrulata*), cassia (*Senna pendula*) and lambs tongue (*Plantago lanceoloata*). Introduced species are not currently dominating any large areas within native vegetation in continued underground mining area. Camphor laurel and lantana are posing the greatest threat to the riparian areas of the continued underground mining area, with camphor laurel occurring within many of the riparian communities in low numbers. Lantana is dominant in patches along the ecotone of riparian communities and occurs in areas with open canopies and high moisture.

Higher proportions of introduced species were recorded in disturbed areas, especially along roadsides. Commonly recorded species included purpletop (*Verbena bonariensis*), cobblers pegs (*Bidens pilosa*) and fleabane (*Conyza* sp.).

4.1.3 Regionally Significant Flora Species

Briggs and Leigh (1996) list species in Australia regarded to be a 'Rare or Threatened Australian Plant' (ROTAP). One species from this list was recorded within the continued underground mining area: *Eucalyptus fergusonii* subsp *fergusonii* which was a dominant canopy species in Hunter Valley Moist Spotted Gum Ironbark Forest.

The continued underground mining area occurs within the lower Hunter region, within which there are numerous flora species considered to have conservation significance (Peake *et al*. 2003). The Hunter Rare Plants Committee of the Hunter Region Botanic Gardens developed a register of regionally significant plant species, populations and vegetation communities using a formal assessment of potential significant species through committee consensus using several assessment criteria. The criteria used to list regionally significant species include:

- endemic taxa – known distribution restricted to this region;
- uncommon taxa – less than 50 known populations;
- records close to the limit of the species' geographical range; and
- significant reductions in population size or area occupied.

The Hunter Rare Plants Database (Peake *et al.* 2003) provides an extensive list of flora species within the Hunter region that are considered to be significant. From this database, there are 52 regionally significant flora species which were recorded within the continued underground mining area (**Table 4.1**).

Table 4.1 - Regionally Significant Species Recorded within the Continued Underground Mining Area

Family	Species	Criteria
Magnoliopsida (Flowering Plants) – Liliidae (Monocots)		
ADIANTACEAE	*Adiantum hispidulum*	?U
DORYANTHACEAE	*Doryanthes excelsa*	N
ORCHIDACEAE	*Cymbidium suave*	?W
ORCHIDACEAE	*Dipodium variegatum*	-
POACEAE	*Imperata cylindrica* var. *major*	?W
POACEAE	*Poa affinis*	N?
ZINGIBERACEAE	*Alpina caerulea*	S
Magnoliopsida (Flowering Plants) – Magnoliidae (Dicots)		
APOCYNACEAE	*Parsonsia straminea*	?W
APOCYNACEAE	*Parsonsia velutina*	U
CELASTRACEAE	*Maytenus silvestris*	U
CUNONIACEAE	*Callicoma serratifolia*	W
DILLENIACEAE	*Hibbertia dentata*	W
EBENACEAE	*Diospyros australis*	W
ELAEOCARPACEAE	*Elaeocarpus obovatus*	D U S W?
EPACRIDACEAE	*Acrotriche divaricata*	N
EPACRIDACEAE	*Lissanthe strigosa*	U
FABACEAE	*Acacia binervia*	N
FABACEAE	*Acacia decurrens*	N
FABACEAE	*Daviesia squarrosa*	N
FABACEAE	*Gompholobium pinnatum*	U
FABACEAE	*Mirbelia speciosa* subsp. *speciosa*	D U
FABACEAE	*Pultenaea euchila*	S
FABACEAE	*Pultenaea rosmarinifolia*	D U N W
FLACOURTIACEAE	*Scolopia braunii*	W
LAURACEAE	*Cryptocarya rigida*	S U
LOMANDRACEAE	*Lomandra confertifolia* subsp. *rubiginosa*	N W
MELIACEAE	*Synoum glandulosum* subsp *glandulosum*	W
MYRSINACEAE	*Embelia australiana*	S D U
MYRTACEAE	*Backhousia myrtifolia*	-
MYRTACEAE	*Corymbia maculate*	W
MYRTACEAE	*Eucalyptus capitellata*	N

Table 4.1 - Regionally Significant Species Recorded within the Continued Underground Mining Area (cont)

Family	Species	Criteria
MYRTACEAE	*Eucalyptus microcorys*	S
MYRTACEAE	*Eucalyptus fergusonii* subsp *fergusonii*	L R
MYRTACEAE	*Eucalyptus punctata*	N W
MYRTACEAE	*Eucalyptus saligna*	W
MYRTACEAE	*Leptospermum polygalifolium* subsp *polygalifolium*	N
MYRTACEAE	*Leptospermum trinervium*	W
MYRTACEAE	*Melaleuca styphelioides*	W
PITTOSPORACEAE	*Pittosporum revolutum*	W
PROTEACEAE	*Banksia oblongifolia*	W
PROTEACEAE	*Grevillea parviflora* subsp *parviflora*	N W D, V (TSC)
PROTEACEAE	*Hakea dactyloides*	N
PROTEACEAE	*Xylomelum pyriforme*	?W ?U
RUTACEAE	*Melicope micrococca*	W
SAPINDACEAE	*Alectryon subcinereus*	W
SAPINDACEAE	*Dodonaea triquetra*	-
SAPOTACEAE	*Planchonella australis*	W
STERCULIACEAE	*Commersonia fraseri*	?U
TREMANDRACEAE	*Tetratheca juncea*	N W, V (TSC)
VERBENACEAE	*Clerodendrum tomentosum*	W
VITACEAE	*Cissus antarctica*	W

Key to Criteria:

U = everywhere uncommon

N, S or W = northern, southern or western distributional limit in Hunter Region

? = code is uncertain

- = code not specified

D = disjunct in the Hunter Region

L = endemic to the Hunter Region

R = rare but extends beyond the Hunter region

V (TSC) = vulnerable under the TSC Act

V (EPBC) = vulnerable under the EPBC Act

These 52 regionally significant flora species emphasise the ecological values of the vegetation of the continued underground mining area, however many of these species are relatively widespread throughout the region, being significant due to the Hunter Valley being the limit of their distribution.

4.2 Vegetation Communities

Fifteen vegetation communities have been delineated within the continued underground mining area. Community delineation was undertaken using a combination of semi-quantitative plot data collected as part of this project and recent vegetation mapping of the SCA (*Vegetation and Floristics of Sugarloaf State Conservation Area, Lake Macquarie, NSW*, Bell and Driscoll 2009). Areas outside the Sugarloaf SCA have been mapped and described based on plot and rapid assessment data collected for this project. Based on plot based data and assessment points completed as part of this project, small areas of the Sugarloaf SCA vegetation map compiled by Bell and Driscoll (2009) have been modified.

The naming convention of the vegetation communities used in this report is consistent with that used in the Sugarloaf SCA mapping (Bell and Driscoll, 2009). The following descriptions are derived from the results of the flora survey undertaken for this project by Umwelt with reference Bell and Driscoll (2009) where appropriate.

Forest communities include:

- Freemans Peppermint – Apple – Bloodwood Forest;
- Regenerating Freemans Peppermint – Apple – Bloodwood Forest;
- Sugarloaf Uplands Bloodwood - Apple Forest;
- Hunter Valley Moist Spotted Gum – Ironbark Forest;
- Sugarloaf Uplands Dry Spotted Gum - Ironbark Forest;
- Coastal Foothills Spotted Gum Ironbark Forest;
- Coastal Ranges Dry Blackbutt Forest;
- Alluvial Tall Moist Forest;
- Riparian Paperbark – Peppermint Forest;
- Swamp Mahogany Paperbark Forest;
- Coastal Ranges Mesic Peppermint Forest; and
- Coastal Wet Gully Forest.

Additional communities include:

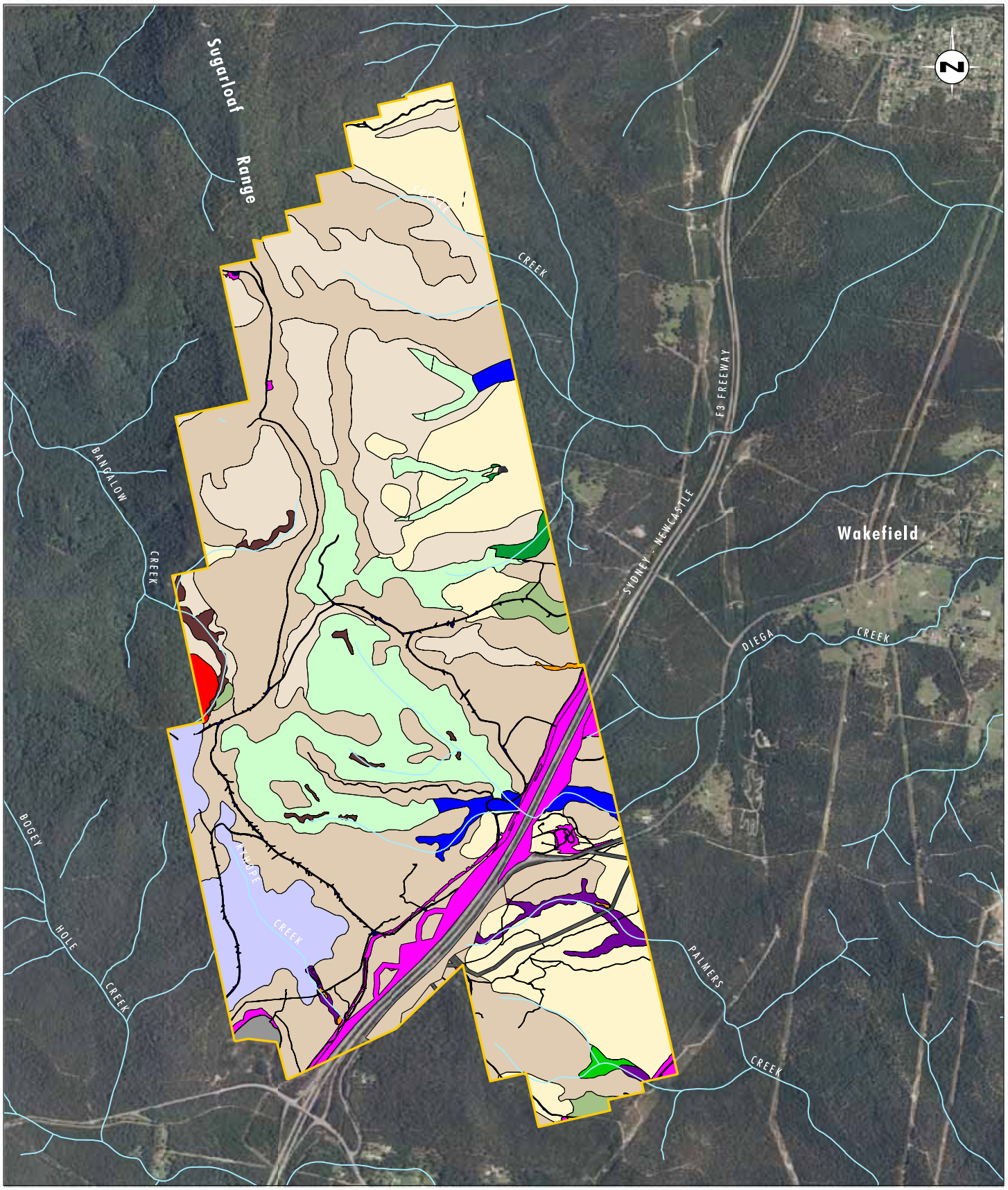
- Coastal Warm Temperate Rainforest;
- Mesic Paperbark Thicket;
- Freshwater Wetland;
- Aquatic Vegetation; and
- Disturbed Areas.

The locations of the vegetation communities are identified in **Figure 4.1**.

4.2.1 Freemans Peppermint - Apple – Bloodwood Forest

Freemans Peppermint - Apple – Bloodwood Forest is the most extensive vegetation community in the continued underground mining area, covering an area of approximately 435 hectares. The community is characterised by the dominant canopy species Sydney peppermint (*Eucalyptus piperita*), occurring with smooth-barked apple (*Angophora costata*) and red bloodwood (*Corymbia gummifera*). The canopy height within this community is approximately 15-20 metres, while the foliage cover ranges between 20 and 30 per cent.

The shrub stratum is consistently less than 3 metres in height. The commonly recorded shrub species include large-leaf hop bush (*Dodonaea triquetra*), Gymea lily (*Doryanthes*



Source: OCAL - Aerial Photograph
LPI - Drainage Lines
Bell & Driscoll 2009 - Vegetation Communities

0 0.5 1.0 1.5km
1:30 000

Legend

- Continued Underground Mining Area
- Drainage Line
- Alluvial Tall Moist Forest
- Cleared Land
- Disturbed - Regrowth
- Swamp Mahogany-Paperbark Forest
- Coastal Wet Gully Forest
- Mesic Paperbark Thicket
- Coastal Foothills Spotted Gum-Ironbark Forest
- Coastal Ranges Dry Blackbutt Forest
- Coastal Ranges Mesic Peppermint Forest
- Coastal Warm Temperate Rainforest
- Freemans Peppermint-Apple-Bloodwood Forest
- Hunter Valley Moist Spotted Gum-Ironbark Forest
- Regenerating Freemans Peppermint-Apple-Bloodwood Forest
- Riparian Paperbark-Peppermint Forest
- Sugarloaf Uplands Smooth-barked Apple Forest
- Sugarloaf Uplands Dry Spotted Gum-Ironbark Forest
- Dam

FIGURE 4.1

Vegetation Communities

File Name (A4): R05_V1/2553_235.dgn

excelsa), mountain devil (*Lambertia formosa*), white wattle (*Acacia linifolia*), two-veined hickory (*Acacia binervata*), sunshine wattle (*Acacia terminalis*), lemon-scented tea tree (*Leptospermum polygalifolium*) and hairpin banksia (*Banksia spinulosa* var. *collina*). The introduced shrub lantana (*Lantana camara*) is also present at some sites, particularly in more open, disturbed sites or adjacent riparian areas.

Characteristic species present in the ground stratum include kangaroo grass (*Themeda australis*), wallaby grass (*Austrodanthonia fulva*), fishbones (*Lomandra obliqua*), *Lepidosperma laterale*, wiry panic (*Entolasia stricta*) and appleberry (*Billardiera scandens*). The threatened flora species, black-eyed Susan (*Tetratheca juncea*) was often recorded in the ground stratum of this community. This stratum was found to be less than one metre in height, with a typical foliage cover of 40-50 per cent.

4.2.2 Regenerating Freemans Peppermint – Apple – Bloodwood Forest

One small area of regenerating woodland occurs in the south-west corner of the continued underground mining area which covers approximately 9 hectares. This site was cleared to provide fill for the construction of the F3 Freeway and following initial regeneration activities has been left to naturally regenerate. This area currently comprises a mosaic of lower grassy areas with patches of more mature and developed shrubland or woodland. Species recorded in the regeneration area are common to those recorded in Freemans Peppermint – Apple – Bloodwood Forest. The regenerating area had a very low proportion of weed species with none recorded in rapid assessment point locations, and well developed species diversity in the ground, shrub and canopy strata.

4.2.3 Sugarloaf Uplands Bloodwood - Apple Forest

Sugarloaf Uplands Bloodwood - Apple Forest is characterised by the dominant canopy species smooth-barked apple (*Angophora costata*), however a wide range of other canopy species occurs with it, including red bloodwood (*Corymbia gummifera*), broad-leaved white mahogany (*Eucalyptus umbra*), Sydney peppermint (*Eucalyptus piperita*) and turpentine (*Syncarpia glomulifera* subsp. *glomulifera*). The canopy height within this community is approximately 15-20 metres, while the foliage cover ranges between 20 and 30 per cent.

A sub-canopy stratum of forest oak (*Allocasuarina torulosa*) is often present within this community, although this is generally sparse, with a cover of less than 15 per cent.

The shrub stratum is typically sparse, generally with 20-30 per cent cover, however some areas in the north and south of the study area can be up to 50 per cent. This stratum is consistently less than 3 metres in height. The commonly recorded shrub stratum species include narrow-leaved geebung (*Persoonia linearis*), prickly shaggy pea (*Podolobium ilicifolium*) and Gymea lily (*Doryanthes excelsa*).

Characteristic species present in the ground stratum include kangaroo grass (*Themeda australis*), fishbones (*Lomandra obliqua*), *Lepidosperma laterale*, wiry panic (*Entolasia stricta*) and wattle mat-rush (*Lomandra filiformis* subsp. *filiformis*). The threatened flora species, black-eyed Susan (*Tetratheca juncea*) was often recorded in the ground stratum of this community. This stratum was found to be less than one metre in height, with a typical foliage cover of 40-50 per cent.

Sugarloaf Uplands Smooth-barked Apple Forest was mapped over 167 hectares within the continued underground mining area.

4.2.4 Hunter Valley Moist Spotted Gum Ironbark Forest

Hunter Valley Moist Spotted Gum – Ironbark Forest is characterised by the dominant canopy species spotted gum (*Corymbia maculata*) and grey ironbark (*Eucalyptus fergusonii* subsp. *fergusonii*). Less frequently occurring canopy species in this community include grey gum (*Eucalyptus punctata*), red bloodwood (*Corymbia gummifera*) and white mahogany (*Eucalyptus acmenoides*). The height of the canopy stratum ranges from 15-25 metres with a foliage cover of 20-40 per cent.

A sub-canopy stratum in this community is typically absent, however some protected areas provide a moderate sub-canopy stratum (to 30 per cent cover) up to 8 metres in height. Where the sub-canopy stratum occurs it is dominated by forest oak (*Allocasuarina torulosa*), cheese tree (*Glochidion ferdinandi* var. *ferdinandi*), scentless rosewood (*Synoum glandulosum*) and giant water vine (*Cissus hypoglauca*).

The shrub stratum in this community is generally open (10-30 per cent cover) to two metres in height. Dominant shrub species include bush-pea (*Pultenaea euchila*), large-leaf hop-bush (*Dodonaea triquetra*), prickly shaggy pea (*Podolobium ilicifolium*) and narrow-leaved geebung (*Persoonia linearis*).

This community comprises a predominantly dense grassy ground stratum, to 60 per cent cover, with the dominant grass species being kangaroo grass (*Themeda australis*), wiry panic (*Entolasia stricta*), blady grass (*Imperata cylindrica* var. *major*) and wallaby grass (*Austrodanthonia fulva*). Other species occurring in the ground stratum include burrawang (*Macrozamia reducta*), many-flowered mat-rush (*Lomandra multiflora*), fishbones (*Lomandra obliqua*) and *Ptilothrix deusta*. The ground stratum grows to a height of 1 metre.

Hunter Valley Moist Spotted Gum – Ironbark Forest was mapped over an area of 170 hectares within the continued underground mining area.

4.2.5 Sugarloaf Uplands Dry Spotted Gum - Ironbark Forest

Sugarloaf Uplands Dry Spotted Gum – Ironbark Forest occurs in two locations on the lower slopes of the continued underground mining area covering an area of approximately 10 hectares. This community was not specifically sampled during the flora survey and the description has been taken from the *Vegetation and Floristics of Sugarloaf State Conservation Area, Lake Macquarie, NSW* (Bell and Driscoll 2009). The community is generally restricted to the higher ridges and exposed slopes of the Sugarloaf Range and is dominated by spotted gum (*Corymbia maculata*), grey ironbark (*Eucalyptus fergusonii* subsp. *fergusonii*), grey gum (*Eucalyptus punctata*) and white mahogany (*Eucalyptus umbra*). This community differs from other spotted gum ironbark communities in the continued underground mining area as it supports a drier understorey.

Commonly recorded shrub species include narrow-leaved geebung (*Persoonia linearis*), the cycad *Macrozamia reducta*, native holly (*Podolobium ilicifolium*) and *Maytenus silvestris*. The grassy understorey is dominated by kangaroo grass (*Themeda australis*), wiry panic (*Entolasia stricta*) and blady grass (*Imperata cylindrica* var. *major*).

4.2.6 Coastal Foothills Spotted Gum Ironbark Forest

Coastal Foothills Spotted Gum – Ironbark Forest is a highly restricted community occurring along the southern boundary of the continued underground mining area, covering 2 hectares. This community was not specifically sampled during the flora survey and the description has been taken from the *Vegetation and Floristics of Sugarloaf State Conservation Area, Lake Macquarie, NSW* (Bell and Driscoll 2009). This community is characterised by the dominant

canopy species and northern grey ironbark (*Eucalyptus siderophloia*) with white mahogany (*Eucalyptus acmenoides*), *Allocasuarina torulosa* and spotted gum (*Corymbia maculata*) also occurring.

A sparse and open shrub layer characteristically includes bush-pea (*Pultenaea euchila*), narrow-leaved geebung (*Persoonia linearis*), hairy clerodendrum (*Clerodendrum tomentosum*) and rough guinea flower (*Hibbertia aspera*).

This community comprises a predominantly grassy ground stratum, with the dominant grass species being wiry panic (*Entolasia stricta*), blady grass (*Imperata cylindrica* var. *major*), two-colour panic (*Panicum similie*), and *Microlaena stipoides* var. *stipoides*. Other species occurring in the ground stratum include many-flowered mat-rush (*Lomandra multiflora*), *Lomandra confertifolia* subsp. *pallida* and kidney weed (*Dichondra repens*).

4.2.7 Coastal Ranges Dry Blackbutt Forest

Coastal Ranges Dry Blackbutt Forest occurs in the south-western portion of the continued underground mining area covering an area of approximately 66 hectares. The community is dominated by blackbutt (*Eucalyptus pilularis*) with forest oak (*Allocasuarina torulosa*) and rough-barked apple (*Angophora floribunda*) also occurring. Shrubs are generally sparse with hickory wattle (*Acacia implexa*) common and narrow-leaved geebung (*Persoonia linearis*) and native holly (*Podolobium ilicifolium*) common on ridge tops within the community.

The ground layer is open and grassy and includes bracken (*Pteridium esculentum*), blady grass (*Imperata cylindrica* var. *major*), kangaroo grass (*Themeda australis*) and *Lepidosperma laterale*.

4.2.8 Alluvial Tall Moist Forest

Alluvial Tall Moist Forest occurs in a small portion of the continued underground mining area along alluvial flats. Canopy species recorded within this community include turpentine (*Syncarpia glomulifera* subsp. *glomulifera*), Sydney blue gum (*Eucalyptus saligna*) and white mahogany (*Eucalyptus acmenoides*). The height of the canopy stratum was 25-35 metres, while the foliage cover ranged between 40-50 per cent.

A sub-canopy stratum growing to a height of 20 metres with a foliage cover of 40-60 per cent is present within this community. Dominant species in this stratum include cheese tree (*Glochidion ferdinandi* var. *ferdinandi*), prickly-leaved tea tree (*Melaleuca styphelioides*), grey myrtle (*Backhousia myrtifolia*) and lilly pilly (*Acmena smithii*).

The shrub stratum in this community consists of settlers flax (*Gymnostachys anceps*), large mock olive (*Notelaea longifolia*), scentless rosewood (*Synoum glandulosum*), bolwarra (*Eupomatia laurina*), black plum (*Diosporus australis*) and scrub turpentine (*Rhodamnia rubescens*). The shrub stratum in this community grows to a height of 1-3 metres, with a foliage cover ranging from 10-30 per cent.

The ground stratum in this community generally comprises a range of grasses, climbers and herbs to one metre with a foliage cover ranging from 10-30 per cent. The more commonly occurring species include tall basket grass (*Oplismenus aemulus*), pastel flower (*Pseuderanthemum variabile*), tall sedge (*Carex appressa*), saw-sedge (*Gahnia clarkei*), common maidenhair (*Adiantum aethiopicum*), rasp fern (*Doodia aspera*), native yam (*Dioscorea transversa*), water vine (*Cissus antarctica*) and giant water vine (*Cissus hypoglauca*).

The introduced species lantana (*Lantana camara*) and camphor laurel (*Cinnamomum camphora*) were recorded in this community.

Alluvial Tall Moist Forest was mapped over an area of approximately 12 hectares within the continued underground mining area.

4.2.9 Coastal Wet Gully Forest

Coastal Wet Gully Forest occurs in protected gullies and lower slopes of the continued underground mining area, covering an area of approximately 126 hectares. Canopy species recorded within this community include turpentine (*Syncarpia glomulifera* subsp*. glomulifera*), Sydney blue gum (*Eucalyptus saligna*) and white mahogany (*Eucalyptus acmenoides*). The height of the canopy stratum was 25-35 metres, while the foliage cover ranged between 40-50 per cent.

The shrub stratum in this community consists of murrogun (*Cryptocarya microneura*), scentless rosewood (*Synoum glandulosum*), bolwarra (*Eupomatia laurina*) and narrow-leaved palm lily (*Cordyline stricta*). The shrub stratum in this community grows to a height of 1-3 metres, with a foliage cover ranging from 10-30 per cent.

The ground stratum in this community generally comprises a range of grasses, climbers and herbs to one metre with a foliage cover ranging from 10-30 per cent. The more commonly occurring species include tall basket grass (*Oplismenus aemulus*), pastel flower (*Pseuderanthemum variabile*), saw-sedge (*Gahnia* sp.), common maidenhair (*Adiantum aethiopicum*), water vine (*Cissus antarctica*) and giant water vine (*Cissus hypoglauca*).

4.2.10 Coastal Warm Temperate Rainforest

Coastal Warm Temperate Rainforest occurs as a restricted community (being 2.5 hectares in size), within the continued underground mining area with the major occurrences adjacent to the western boundary of the continued underground mining area, associated with Bangalow Creek. Very minor occurrences were mapped within the most sheltered portions of the coastal Wet Gully Forest along the eastern slopes of the range. This community was not specifically sampled during the flora survey and the description has been taken from the *Vegetation and Floristics of Sugarloaf State Conservation Area, Lake Macquarie, NSW* (Bell and Driscoll 2009).

Coastal Warm Temperate Rainforest is closely related to Coastal West Gully Forest and the two communities often merge over broad ecotones (Bell and Driscoll 2009). Coastal Warm Temperate Rainforest exhibits similarity in the floristic composition of the shrub and ground layers, however lacks the emergent canopy of eucalypts present in Coastal Wet Gully Forest.

As with Coastal Wet Gully Forest, the shrub stratum consists of murrogun (*Cryptocarya microneura*), scentless rosewood (*Synoum glandulosum*), bolwarra (*Eupomatia laurina*), and narrow-leaved palm lily (*Cordyline stricta*), while the ground stratum generally comprises a range of grasses, climbers and herbs to one metre, including tall basket grass (*Oplismenus aemulus*), pastel flower (*Pseuderanthemum variabile*), saw-sedge (*Gahnia sp*), common maidenhair (*Adiantum aethiopicum*), water vine (*Cissus antarctica*) and giant water vine (*Cissus hypoglauca*).

4.2.11 Coastal Ranges Mesic Paperbark Forest

Coastal Ranges Mesic Paperbark Forest is highly restricted in the continued underground mining area, limited to an approximately 3 hectare area at the head of Bangalow Creek, along the western boundary of the continued underground mining area. This community was not specifically sampled during the flora survey and the description has been taken from the *Vegetation and Floristics of Sugarloaf State Conservation Area, Lake Macquarie, NSW* (Bell

and Driscoll 2009). The community is dominated by Sydney peppermint (*Eucalyptus piperita*), co-occurring with *Allocasuarina torulosa* and smooth-barked apple (*Angophora costata*). A moderately dense understorey of species such as forest maple (*Cryptocarya rigida*), cheese tree (*Glochidion ferdinandi var. ferdinandi*), and *Astrotricha latifolia* occurs over bordered panic (*Entolasia marginata*), barbed wire grass (*Cymbopogon refractus*), saw sedge (*Gahnia melanocarpa*) and spiny-headed mat-rush (*Lomandra longifolia*).

4.2.12 Swamp Mahogany Paperbark Forest

Swamp Mahogany Paperbark Forest is confined to two drainage lines in the eastern portion of the continued underground mining area associated with lower elevations and broad flats, covering an area of approximately 3 hectares. The community is dominated by *Melaleuca linariifolia* and swamp mahogany (*Eucalyptus robusta*) with red mahogany (*Eucalyptus resinifera*) also recorded in isolated locations. The small tree layer is characterised by *Melaleuca linariifolia* and cheese tree (*Glochidion ferdinandi* var*. ferdinandi*), with sweet pittosporum (*Pittosporum undulatum*), bottlebrush (*Callistemon salignus*) also recorded.

A moderately dense ground layer is dominated by saw sedge (*Gahnia clarkei*) and bracken (*Pteridium esculentum*) and grasses and herbs such as *Entolasia stricta, Oplismenus imbecillis*, *Centella asiatica* and kidney weed (*Dichondra repens*) were commonly recorded.

Swamp Mahogany Paperbark Forest is considered to conform to the description provided by the NSW Scientific Committee for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions Endangered Ecological Community (EEC).

4.2.13 Mesic Paperbark Thicket

Mesic Paperbark Thicket is highly restricted, occurring in two locations in the southern portion of the continued underground mining area, covering an area of 1 hectare. The thicket was not specifically sampled during the flora survey and the description has been taken from the *Vegetation and Floristics of Sugarloaf State Conservation Area, Lake Macquarie, NSW* (Bell and Driscoll 2009).

Mesic Paperbark Thicket occurs in areas of impeded drainage which has resulted in dense stands of saw sedge (*Gahnia clarkei*) on the ground and prickly-leaved paperbark (*Melaleuca styphelioides*) in the sub-canopy. Occasionally Sydney peppermint (*Eucalyptus piperita*) and *Melaleuca linariifolia* occur.

4.2.14 Riparian Paperbark Peppermint Forest

Riparian Paperbark Peppermint Forest has been mapped in one drainage line in the southern portion of the continued underground mining area, covering an area of approximately 10 hectares. This community is known to occur in lower elevation, undulating country in the south east portion of the Sugarloaf SCA (Bell and Driscoll 2009). The community is dominated by Sydney peppermint (*Eucalyptus piperita*), *Melaleuca linariifolia*, and smooth-barked apple (*Angophora costata*) and red mahogany (*Eucalyptus resinifera* subsp. *resinifera*) is also recorded. The shrub layer was well represented to a height of approximately 4 metres and was dominated by cheese tree (*Glochidion ferdinandi var. ferdinandi*), *Melaleuca linariifolia,* tea tree (*Leptospermum polygalifolium*) and black wattle (*Callicoma serratifolia*).

Saw sedge (*Gahnia clarkei*) was the dominant species in the ground layer, forming a dense thicket in places to a height of approximately 2 metres. Additional species common in the ground layer included bracken (*Pteridium esculentum*), maidenhair fern (*Adiantum aethiopicum*), *Gonocarpus tetragynus* and *Dampiera stricta*.

4.2.15 Freshwater Wetland

A small freshwater wetland was identified in the northern portion of the continued underground mining area, as shown on **Figure 4.1**. The wetland is known as the 'wet soak'. The wet soak is a natural feature, formed because of the presence of minor claystone units on the local geological strata. The depth of water in the wet soak is limited by the relative elevation of these bed-forming materials and a low sandy barrier or berm that extends across the overflow area from the adjacent in-situ bedrock slopes (Umwelt 2008b). Water levels in the wet soak are recharged by surface runoff during extended rainfall events. Some water continues to flow to the soak through the shallow soil profile after rain has stopped (Umwelt 2008b). The wet soak is not considered to be groundwater-dependent.

The wet soak area is dominated by sedges and rushes including tall spike rush (*Eleocharis sphacelata*), up to 2 metres in height, with saw sedge (*Gahnia* sp.) occurring on the fringes. The wet soak did not support fully aquatic species at the time of survey.

The wet soak is located on the upper ridges and spurs of the Cockle Creek catchment. It is situated on a spur within a small steep sided basin, opening at the north eastern end to the headwaters of a steep sandstone based first order tributary (Umwelt 2008b). It does not occur on a coastal floodplain and is located at an elevation of greater than 110 metres. The wetland is not considered to be 'associated' with a coastal floodplain. Therefore, the community is not considered to conform to the description provided by the scientific committee for Freshwater Wetlands on Coastal Floodplains EEC.

4.2.16 Disturbed Areas

Disturbed areas are generally located along the F3 Freeway, Wakefield Road and fire trails within the Sugarloaf SCA. Disturbed Areas represent areas that have been previously cleared, and are dominated by a mixture of weed species and native species. These areas comprise approximately 69 hectares and do not represent naturally occurring vegetation communities.

Commonly recorded species within Disturbed Areas include the weed species lantana (*Lantana camara*), purpletop (*Verbena bonariensis*), cobblers pegs (*Bidens pilosa*) and fleabane (*Conyza* sp.), with native species of adjacent intact vegetation communities commonly occurring.

4.2.17 Aquatic Vegetation

Drainage lines within the continued underground mining area did not contain sufficient aquatic habitat to support aquatic flora species. Aquatic flora was limited to a dam on an ephemeral drainage line in the eastern portion of the continued underground mining area. Aquatic flora species included swamp lily (*Otellia ovalifolia*), frogsmouth (*Philydrum lanuginosum*), cumbungi (*Typha orientalis*), waterlily (*Nymphaea* sp.), *Juncus usitatus, Eleocharis sphacelata, Eleocharis ?equisetina* and *Schoenoplectus mucronata*.

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

4.3.1 Threatened Flora Species

Two threatened flora species were recorded in the continued underground mining area: black-eyed Susan (*Tetratheca juncea*) and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). The locations of records of these species are shown in **Figure 4.2**.

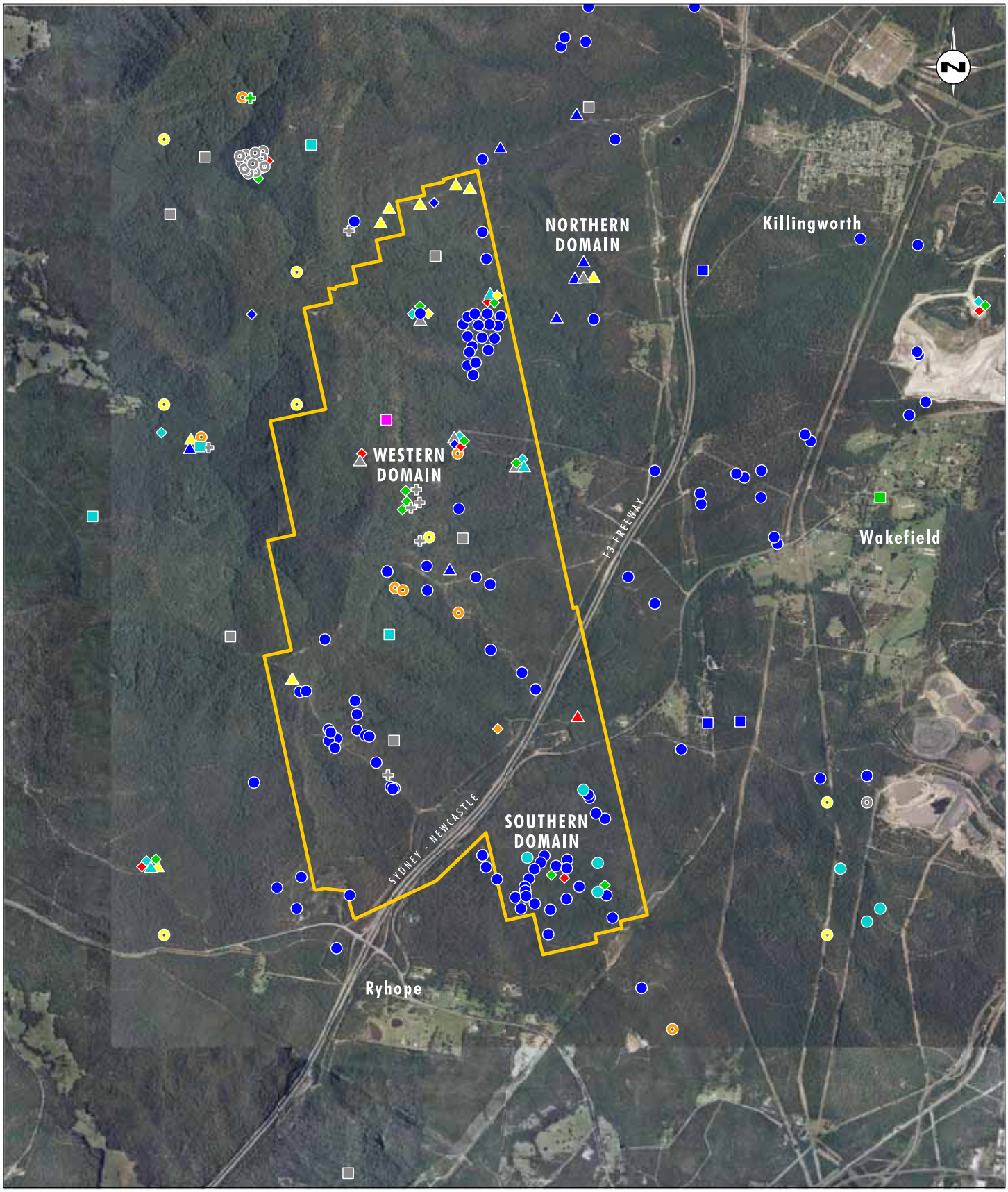
Black-eyed Susan (*Tetratheca juncea*) was recorded widely within the continued underground mining area, however was found to be less common in riparian communities. The species is considered to be one of a number of dominant groundcover species in Freemans Peppermint Apple Bloodwood Forest. A total of 77 locations of this species were mapped however, due to the great abundance of specimens recorded, these mapped locations generally indicate the boundary of populations of this species, rather than a documentation of the total area covered. The actual extent of this species' distribution throughout the continued underground mining area is expected to be greater than that mapped on **Figure 4.2** based on the extent of available habitat and the common nature of the species within flora plots. Bell and Driscoll (2009) regarded the species as common in the Sugarloaf SCA.

The small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) was recorded at four locations in the south-east corner of the continued underground mining area. It is likely that the actual number of individuals of this species occurring in the continued underground mining area would be greater, due to the cryptic nature of the species in the understorey. Bell and Driscoll (2009) regarded the species as abundant on the eastern slopes and ridgetops of the main range and also on the lowlands in the south.

In addition to those threatened flora species recorded, a number of species were assessed for their potential to occur in the continued underground mining area, based on their known distribution and habitat requirements. None of these additional species were recorded during surveys for this project or by extensive surveys undertaken by Bell and Driscoll (2009). These species were identified from database searches, literature review and expert knowledge, and are listed in **Appendix A**. Of the 14 threatened flora species assessed, seven (in addition to the two recorded) were found to have reasonable potential, on the basis of suitable habitat, to occur in the continued underground mining area, and are listed in **Table 4.2** below.

Table 4.2 – Threatened Flora Species with Potential to Occur in the Continued Underground Mining Area

Species	Legal Status
leafless tongue orchid (*Cryptostylis hunteriana*)	V (TSC) V (EPBC)
Bynoes wattle (*Acacia bynoeana*)	E (TSC)
heath wrinklewort (*Rutidosis heterogama*)	V (TSC) V (EPBC)
nettled bottle brush (*Callistemon linearifolius*)	V (TSC)
leafless tongue orchid (*Cryptostylis hunteriana*)	V (TSC)
eastern underground orchid (*Rhizanthella slateri*)	V (TSC)
magenta lilly pilly (*Syzygium paniculatum*)	V (TSC)



Source: OCAL

0 0.5 1.0 2km
1:40 000

Legend

- Continued Underground Mining Area
- *Tetratheca juncea*
- *Grevillea parviflora* subsp *parviflora*
- Yellow-bellied Glider
- Stephens Banded Snake
- Spotted-tailed Quoll
- Speckled Warbler
- Sooty Owl
- Powerful Owl
- Masked Owl
- Little Bentwing-bat
- Large-eared Pied Bat
- Koala
- Grey-headed Flying-fox
- Greater Broad-nosed Bat
- Glossy Black-Cockatoo
- Eastern Freetail-bat
- Eastern False Pipistrelle
- Eastern Bentwing-bat
- Brown Treecreeper
- Large-footed Myotis
- Varied sittella
- Common Planigale
- Scarlet Robin

FIGURE 4.2

Threatened Species Locations

File Name (A4): R05_V1/2553_014.dgn

4.3.2 Endangered Flora Populations

No endangered flora populations were recorded within the continued underground mining area, and none are expected to occur.

4.3.3 Threatened Ecological Communities

Three vegetation communities recorded in the continued underground mining area conform to the description provided by the NSW Scientific Committee of a listed endangered ecological community (EEC). River-flat Eucalypt Forest on Coastal Floodplains was recorded on alluvium associated with Diega and Cockle Creeks, covering an area of approximately 12 hectares. The community has been described as Alluvial Tall Moist Forest and a full floristic description of this community is provided in **Section 4.2.8**.

Swamp Mahogany Paperbark Forest is considered to conform to the description provided by the NSW Scientific Committee for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions EEC. Swamp Mahogany Paperbark Forest is described in **Section 4.2.12** and covers an area of approximately 3 hectares.

Coastal Warm Temperate Rainforest identified in the Bangalow Creek catchment in the western portion of the continued underground mining area is considered to conform to the description provided by the NSW Scientific Committee for Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion EEC. The Coastal Warm Temperate Rainforest occurring in gullies along the eastern slopes of the Sugarloaf range are not considered to conform to the description provided by the Scientific Committee, based on floristic, geomorphological and structural characteristics. Coastal Warm Temperate Rainforest is described in **Section 4.2.10** and covers an area of approximately 2.52 hectares.

No additional TECs were recorded in the continued underground mining area or are considered likely to occur.

4.4 Fauna Results

4.4.1 Database Searches

The threatened fauna species recorded on the DECCW Atlas of NSW Wildlife and DEWHA Protected Matters Database are included in **Appendix A**.

4.4.2 Fauna Species

A total of 112 vertebrate fauna species were recorded within the continued underground mining area, comprising 33 mammal species, 68 bird species, five reptile species and six amphibian species. An outline and discussion of the species recorded within each of the four major vertebrate fauna groups is presented in the following sections. A full list of the fauna species recorded is provided in **Appendix C**.

4.4.2.1 Birds

Sixty-eight bird species from 32 families were recorded during surveys. The most speciose families recorded within the continued underground mining area were Meliphagidae (honeyeaters) with ten species recorded, Acanthizidae (thornbills and scrubwrens) with six species recorded and Cuculidae (cuckoos) with five species recorded.

The most abundant species recorded throughout the continued underground mining area were the spotted pardalote (*Pardalotus punctatus*), white-throated treecreeper (*Corombates leucophaea*), eastern yellow robin (*Eopsaltria australis*) grey fantail (*Rhipidura albiscapa*) and noisy miner (*Manorina melanophrys*). The most abundant species in the drier forest habitat were the yellow-faced honeyeater (*Lichenostomus chrysops*), grey butcher bird (*Cracticus torquatus*) and pied currawong (*Strepera graculina*). The most abundant species in the riparian habitat were the golden whistler (*Pachycephala pectoralis*), Lewin's honeyeater (*Meliphaga lewinii*) and brown gerygone (*Gerygone mouki*). Common nocturnal birds recorded were the southern boobook (*Ninox novaeseelandiae*), tawny frogmouth (*Podargus strigoides*) and Australian owlet nightjar (*Aegotheles cristatus*).

Three threatened bird species listed under the TSC Act were recorded within the continued underground mining area during surveys: the sooty owl (*Tyto tenebricosa*), scarlet robin (*Petroica boodang*) and varied sittella (*Daphoenositta chrysoptera*). A further two TSC Act listed bird species were identified within the continued underground mining area through the DECCW Atlas of NSW Wildlife database search being the powerful owl (*Ninox strenua*) and glossy black-cockatoo (*Calyptorhynchus lathami*).

Four EPBC listed migratory species were recorded in the continued underground mining area during surveys, comprising the white-bellied sea-eagle (*Haliaeetus leucogaster*), black-faced monarch (*Monarcha melanopsis*), satin flycatcher (*Myiagra cyanoleuca*) and rufous fantail (*Rhipidura rufifrons*).

4.4.2.2 Mammals

Thirty-three mammal species from 13 families were recorded within the continued underground mining area. The most speciose families recorded were from Vespertilionidae (evening micro-bats) with 13 species recorded, Dasyuridae (carnivorous marsupials) with four species recorded and Molossidae (freetail micro-bats) with three species recorded.

The most common mammal species recorded were red-necked wallaby (*Macropus rufogriseus*), common brushtail possum (*Trichosurus vulpecula*), Gould's wattled bat (*Chalinolobus gouldii*) and little forest bat (*Vespadelus vulturnus*). These species were recorded in all habitats types throughout the continued underground mining area.

Twelve threatened mammal species listed under the TSC Act were identified within the continued underground mining area, including:

- yellow-bellied glider (*Petaurus australis*);
- spotted-tailed quoll (*Dasyurus maculatus*);
- koala (*Phascolarctos cinereus*);
- common planigale (*Planigale maculata*);
- grey-headed flying-fox (*Pteropus poliocephalus*);
- little bentwing-bat (*Miniopterus australis*);
- large-eared pied bat (*Chalinolobus dwyeri*);
- eastern freetail bat (*Mormopterus norfolkensis*);
- eastern false pipistrelle (*Falsistrellus tasmaniensis*);

- large-footed myotis (*Myotis adversus*);
- greater broad-nosed bat (*Scoteanax ruepellii*); and
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*).

Two of the TSC Act listed mammal species recorded during surveys are also listed under the EPBC Act: the grey-headed flying-fox (*Pteropus poliocephalus*) and the large-eared pied bat (*Chalinolobus dwyeri*).

One species, the spotted-tailed quoll (*Dasyurus maculatus*), listed under the TSC Act and EPBC Act was identified within the continued underground mining area in 2006 on the DECCW Atlas of NSW Wildlife database.

4.4.2.3 Reptiles

Five reptile species from two families were identified within the continued underground mining area during the survey. This result in not expected to be representative of the diversity of reptile species in the continued underground mining area. The most abundant reptile species recorded were the grass skink (*Lampropholis delicata*) and eastern water skink (*Eulamprus quoyii*).

Several other reptile species are expected to occur within the continued underground mining area however many are of a cryptic nature and are often difficult to find. Suitable reptile habitat exists throughout the continued underground mining area for many species of reptiles such as the bandy bandy (*Vermicella annulata*), three-toed skink (*Saiphos equalis*), red-bellied black snake (*Pseudechis porphyriacus*), worm snake (*Ramphotyphlops nigrescens*) and golden-crowned snake (*Cacophis squamulosus*), all of which have been recorded in habitats adjacent to the continued underground mining area during biodiversity monitoring in the northern domain undertaken by Umwelt for WWC (Umwelt 2009).

No threatened reptile species were recorded within the continued underground mining area.

4.4.2.4 Amphibians

Six amphibian species from two families were identified within the continued underground mining area. The most abundant species recorded were from the family Myobatrachidae, comprising the common eastern froglet (*Crinia signifera*), spotted marsh frog (*Limnodynastes tasmaniensis*) and red-backed toadlet (*Pseudophryne coriacea*). Moderate to high quality amphibian habitat occurred within the continued underground mining area and a further four species are known to occur in similar habitats in the northern domain, adjacent to the continued underground mining area (Umwelt 2008). These species include Peron's tree frog (*Litoria peronii*), Tylers' tree frog (*Litoria tyleri*), smooth toadlet (*Uperoleia laevigata*) and the broad-palmed frog (*Litoria latopalmata*).

No threatened amphibian species were recorded within the continued underground mining area during the survey effort.

4.4.2.5 Aquatic Habitat Assessment Results

The results of the aquatic habitat assessment identified no permanent standing water in any drainage lines and therefore potential habitat for threatened species listed under the FM Act was not identified.

One aquatic species, mosquito fish (*Gambusia holbrooki*), was recorded in the farm dam in the eastern portion of the continued underground mining area. Potential habitat was identified in this dam for the eastern snake-necked turtle (*Cheladonia longicollis*) and long-finned eel (*Anguilla reinhardtii*). Additional habitat for native vertebrate species is not expected to occur due to substantial impediments to fish passage and the ephemeral nature of drainage line habitats in the vicinity of the dam.

4.4.3 Fauna Habitat and Condition Assessment Results

Three broad fauna habitat types were identified within the continued underground mining area comprising Dry Forest, Riparian and Mesic and aquatic habitats.

4.4.3.1 Dry Forest Habitats

The dry forest habitat dominates the continued underground mining area covering approximately 885 hectares comprising eight vegetation communities. The dry forest habitat ranges in landscape from ridge-top to sheltered catchments. The general structure is continuous throughout the forest habitat however the heights and composition of each stratum can vary across its range.

The structure of the forest habitats comprises a canopy cover ranging from 15 to 25 metres with less than 30 per cent canopy cover, generally with an open understorey and dense ground cover. The canopy trees provide flowering resources for honeyeaters, parrots and arboreal mammals during most of the year. Mature hollow-bearing trees are common throughout this habitat providing potential nesting resources for large arboreal mammal, owls, micro-bats and other hollow-dependent fauna. The sub-canopy stratum, where it occurs, provides potential foraging recourses for cockatoos (Cacatuidae), including the glossy black-cockatoo (*Calyptorhynchus lathami*) listed as vulnerable under the TSC Act.

The open understorey provides potential foraging habitat for micro-bats, macropods, birds and some limited nesting potential in protected areas for small woodland birds. The ground cover is dense with many small rocks and several fallen hollow branches and trees providing foraging and refuge resources for reptiles and small terrestrial mammals. Water resources are limited within this habitat type.

Small areas of escarpment and rocky-outcropping are present within the dry forest habitat. These areas provide potential habitat for reptile species. The survey effort targeted habitats for micro-bats around the escarpments however no areas of caves large enough to support micro-bats were identified.

4.4.3.2 Riparian and Mesic Habitats

The riparian and mesic habitat covers approximately 160 hectares within the continued underground mining area comprising five vegetation communities: Coastal Wet Gully Forest and Coastal Warm Temperate Rainforest on the upper slopes and Alluvial Tall Moist Forest, Swamp Mahogany Paperbark Forest and Riparian Paperbark Peppermint Forest on the lower slopes and flats.

The structure of the riparian and mesic habitat comprises an open canopy cover, to 30 metres, with a dense sub-canopy stratum comprising wet sclerophyll and rainforest vegetation. The canopy and sub-canopy stratums provide flowering and fruiting resources for honeyeaters, rainforest specialist birds and arboreal mammals during most of the year. Hollow bearing trees are not as common however occasional large eucalypt species provide valuable hollow resources for hollow-dependent fauna.

The understorey and ground cover are generally open providing valuable foraging and nesting resources for small rainforest birds and small mammals. The ground cover provides many small rocks and fallen timber providing valuable foraging and refuge resources for small terrestrial mammal, reptile and amphibian species. The riparian and mesic habitat consists of ephemeral creeklines, providing water resources in medium to high rainfall events.

4.4.3.3 Aquatic Habitat

One constructed dam and one naturally occurring freshwater wetland were recorded within the continued underground mining area. These habitats support a moderate diversity of emergent sedges and rushes and some aquatic species. The dam habitat provides important water resource for native fauna, in particular macropods such as the eastern grey kangaroo (*Macropus giganteus*) and red-necked wallaby (*Macropus rufrogriseus*).

Aquatic habitat within the riparian communities identified in the continued underground mining area is limited to pooled water following medium to high rainfall events. These pools provide an important resource for terrestrial species occurring in adjacent communities however, are not expected to provide a significant aquatic fauna habitat in the local area.

4.4.4 Threatened Fauna Species and Endangered Populations

Seventeen threatened fauna species have been recorded within the continued underground mining area. Recorded threatened species include 12 species of mammal (including seven species of micro-bat and one mega-bat) and five bird species. **Table 4.3** identifies the threatened fauna species recorded in the continued underground mining area, including general locations of the records and method of recording. The results of the DECCW Atlas of NSW Wildlife database search and DEWHA Protected Matters database search identified an additional 33 listed threatened species within ten kilometres of the continued underground mining area.

Table 4.3 – Threatened Fauna Recorded within the Continued Underground Mining Area

Species	Status	Location Recorded	Method of Record
spotted-tailed quoll *Dasyurus maculatus*	V (TSC) E (EPBC)	central Continued Underground Mining Area (CUMA) in 2006	DECCW Atlas of NSW Wildlife database search
common planigale *Planigale maculata*	V (TSC)	central CUMA in 2009	hair analysis
koala *Phascolarctos cinereus*	V (TSC)	central and northern CUMA at three locations in 2009	sighted and heard at three locations
yellow-bellied glider *Petaurus australis*	V (TSC)	central CUMA in 2009	heard
grey-headed flying-fox *Pteropus poliocephalus*	V (TSC) V (EPBC)	northern and western CUMA in 2009	sighted and heard
eastern freetail-bat *Mormopterus norfolkensis*	V (TSC)	northern CUMA in 2009	Anabat echolocation analysis
little bentwing-bat *Miniopterus australis*	V (TSC)	throughout the CUMA in 2009	Anabat echolocation analysis

Table 4.3 – Threatened Fauna Recorded within the Continued Underground Mining Area (cont)

Species	Status	Location Recorded	Method of Record
eastern bentwing-bat *Miniopterus schreibersii oceanensis*	V (TSC)	throughout the CUMA in 2009	Anabat echolocation analysis
large-eared pied bat *Chalinolobus dwyeri*	V (TSC) V (EPBC)	central and northern CUMA in 2009	Anabat echolocation analysis
eastern false pipistrelle *Falsistrellus tasmaniensis*	V (TSC)	northern CUMA in 2009	Anabat echolocation analysis
large-footed myotis *Myotis adversus*	V (TSC)	northern CUMA in 2009	Anabat echolocation analysis
greater broad-nosed bat *Scoteanax rueppellii*	V (TSC)	northern CUMA in 2009	Anabat echolocation analysis
powerful owl *Ninox strenua*	V (TSC)	central CUMA	DECCW Atlas of NSW Wildlife database search
sooty owl *Tyto tenebricosa*	V (TSC)	central CUMA in 2009;	identification of call during call-playback survey; previous DECCW Atlas records
glossy black-cockatoo *Calyptorhynchus lathami*	V (TSC)	central CUMA	DECCW Atlas of NSW Wildlife database search
scarlet robin *Petroica boodang*	V (TSC)	southern CUMA in 2009	sighted
varied sittella *Daphoenositta chrysoptera*	V (TSC)	southern CUMA in 2009	sighted

TSC = *Threatened Species Conservation Act 1995*

EPBC = *Environment Protection and Biodiversity Conservation Act 1999*

E = Endangered

V = Vulnerable

4.4.4.1 Endangered Fauna Populations

No endangered fauna populations were recorded within the continued underground mining area, and none are expected to occur.

4.4.5 SEPP 44

SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provides habitat for koalas (*Phascolarctos cinereus*), to ensure permanent free-living populations over their present range and to reverse the current trend of population decline. Under Part 1 (5) of the Policy (Land to which this Policy Applies), it is stated that the policy does not apply to land dedicated or reserved under the NPW Act, which includes the Sugarloaf SCA.

Approximately 93 hectares of the continued underground mining area occur on private property, and this is subject to the provisions of SEPP 44. An assessment of potential koala habitat undertaken on this land determined that potential koala habitat is limited to approximately 3 hectares of Swamp Mahogany Paperbark Forest which contains swamp

mahogany (*Eucalyptus robusta*) as a dominant species. Grey gum (*Eucalyptus punctata*) was recorded as a minor canopy species in Hunter Valley Moist Spotted Gum Ironbark Forest, however this species does not constitute 15 per cent or more of the canopy species across the community and therefore the community does not comprise potential koala habitat.

Approximately 3 hectares of potential koala habitat, as determined under SEPP 44, was identified in the continued underground mining area.

5.0 Impact Assessment

A total of 1085 hectares of native vegetation occur in the continued underground mining area, providing habitat for 19 threatened species, and 15 hectares of EEC (refer to **Section 4.3.3**).

No direct clearing of native vegetation is required for the project, and predicted subsidence is not expected to impact the structure and floristic composition of vegetation communities, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines), however works will typically be limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels, thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities.

A total of 0.5 hectares of disturbed land adjacent to the F3 Freeway and Wakefield Road will be removed for the construction of proposed mining services facility.

In addition to actions undertaken as part of the project by WWC to avoid and minimise impacts on ecological values (refer to **Sections 1.2** and **5.1**), significant impact mitigation measures have been designed to reduce the potential impact of the project on ecological values (refer to **Section 5.11**).

5.1 Project Changes to Avoid and Minimise Impacts

The ecological values of the continued underground mining area were recognised early in the project, and in previous assessments undertaken in the northern domain (Umwelt 2006; 2007; 2008). WWC has undertaken detailed concept and pre-feasibility studies into the proposed mining operation and as part of this process numerous alternative mine and infrastructure plans were considered. Minimising environmental and community impacts and maximising economic resource recovery have been major considerations in the evaluation of alternative options.

A number of detailed hydrogeological assessments have previously been completed for WWC as part of the SMP process for the northern, southern and western domains. These studies have been used in the mine planning process to define the layout of past and future mine plans. An estimate was made of the likely height of fracturing above the extracted longwall panels, and this was determined to be in the order of 70 metres.

Based on this estimation, all secondary extraction below a depth of cover of 70 metres (being areas with the potential to have significant ground and surface water impacts), have been removed from the conceptual mine plan. This change has been adopted as a means to reduce the likelihood for connective cracking to occur, as this has the potential to have substantial impacts on water resources. This modification has resulted in the sterilisation of approximately 2.4 million tonnes of coal resource and resulted in the removal of approximately 123 hectares of vegetation (particularly riparian communities) from being potentially impacted by subsidence.

5.2 Potential Ecological Impacts of the Project

5.2.1 Potential Subsidence Impacts

5.2.1.1 Vertical and Horizontal Displacement

Subsidence can be generically described as the downward movement of the ground surface in response to the rock layers above the coal extraction area temporarily separating and then interfacing again, each one moving down sequentially to fill the gap created by movement of the layer below. It is noted that subsidence can also result in horizontal ground movements and changes to the slope of the ground surface. These movements are significantly smaller in magnitude in comparison to the vertical component, and are not considered in this assessment.

A comprehensive subsidence assessment was completed for the project by Ditton Geotechnical Services (Appendix 5 of the Environmental Assessment). The report assessed the potential subsidence impacts from the project and determined that the greatest vertical subsidence is likely to occur over the centre of each longwall panel. This vertical subsidence is predicted to typically range from 0.36 metres to 2.61 metres (10 to 58 per cent of mining height).

Subsidence movements will permanently displace the ground surface, with a series of hollows over the centre of each longwall panel and a series of humps over each solid pillar of coal. These will not be uniform either laterally or longitudinally over the longwall panel. This undulating surface profile is usually imperceptible to the naked eye because they are small relative to the large horizontal distances across each longwall panel.

5.2.1.2 Subsidence Cracking

The proposed underground mining operations will result in subsidence above the extracted longwall panels. Subsidence itself does not typically adversely impact ecological values, however it can lead to surface cracking and changes to surface drainage that may impact on ecological values. The subsidence impacts associated with this project are not expected to result in tree failure or death. The predicted impacts utilise measurements recorded for the 37 previously mined longwalls within the existing WWC underground mine, as well as experience in the wider Lake Macquarie Coalfields.

As a result of the predicted vertical subsidence, there is the potential that surface cracking may occur where tensile stresses develop, on the edges of longwall panels and along tops of topographic high points. Cracking may also occur at regular intervals along the centre of the panels and be interspersed with compression humps. Surface cracking and shearing is expected to develop within tensile and compressive strain zones and range in width from 10 millimetres to 550 millimetres at cover depths ranging from 70 metres to 360 metres respectively.

There a several small areas of low depth of cover (70 metres to 100 metres) within the continued underground mining area, as shown in **Figure 5.1**. These areas may be subject to direct hydraulic connection with the underground mine workings. Due to both the potential surface water impacts and potential mine safety issues, these cracks may require immediate remediation. The presence of these cracks will be monitored as part of the subsidence monitoring program. In the event that such cracks are observed, options for re-sealing of the cracks will be assessed and implemented. Where possible access to undertake the remediation works will use existing access tracks, however due to the remote nature of these areas and the extensive vegetation cover, the construction of new access tracks may be required to allow the remediation activities.

Source: OCAL - Aerial Photograph, Longwall Layout
LPI - Drainage Lines

0 0.5 1.0 1.5km
1:30 000

Legend

- Existing West Wallsend Colliery Pit Top Facilities
- Continued Underground Mining Area
- Proposed Underground Workings in the West Borehole Seam
- Longwall Progression as of 1st March 2010
- Former Underground Workings
- Previously Approved Longwall Layout Boundary in Western and Southern Domains
- Drainage Line

Depth of Cover Range (m):

5 - 70	285 - 320
70 - 100	320 - 355
100- 145	355 - 390
145 - 180	
180 - 215	
215 - 250	
250 - 285	

FIGURE 5.1

Depth of Cover

File Name (A4): R05_V1/2553_314.dgn

Previous observations at WWC indicate that surface cracking is evident above longwalls, however this has been minor, and remediation works required have been minimal and generally confined to areas where public safety is paramount such as exposed access tracks. It is not expected that a significant increase in remediation works will be required as a result of the project.

5.2.1.3 Tree Fall

It is expected that the predicted subsidence movements will not cause tree fall or failure. This is supported by observations of the similar previously-mined parts of the continued underground mining area, where tree failure as a result of vertical subsidence has not been observed.

Umwelt has undertaken ecological monitoring at six terrestrial sites and three aquatic sites previously subjected to longwall mining in the WWC mine lease boundary. This monitoring did not reveal any evidence of tree fall related to subsidence in those previously-mined areas.

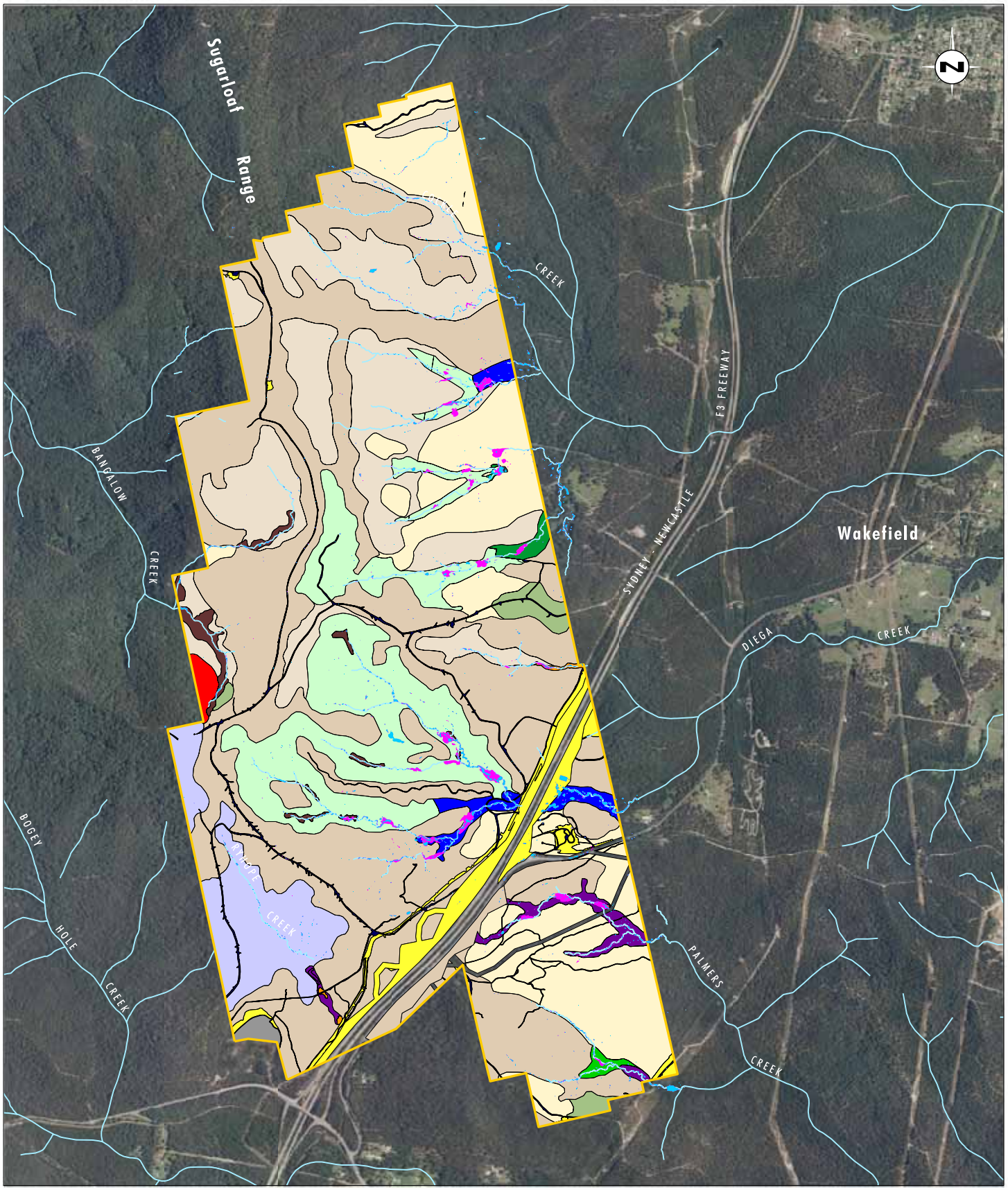
5.2.2 Surface Water Impacts

A number of ephemeral drainage lines occur within the predicted subsidence affectation area, including the upper catchment areas of Cockle Creek, Diega Creek, Palmers Creek and Bangalow Creek.

The surface water assessment has identified locations where there is a potential for surface water ponding to occur. In these areas, the potential surface ponding is expected to be confined to the existing channels and no out-of-channel ponding is expected as a result of the predicted subsidence. Ponding is expected to disperse through evaporation and seepage, however periods of extended ponding may occur during wet periods.

Due to the expected containment of ponding to the existing stream channels, surface water impacts on vegetation communities and fauna habitats are expected to be minimal. In channel environments where there is a higher potential of in-channel ponding occurring (refer to **Figure 5.2**), the channels currently comprise sandy beds with limited in-stream vegetation due to the ephemeral nature of the drainage lines. Riparian vegetation is well adapted to periods of extended wetting, and changes to the structural or floristic diversity of riparian communities as a result of in-channel ponding are not expected. Riparian vegetation has not been shown to be significantly impacted by minor changes to the ponding regime of drainage lines within the northern domain (Umwelt 2006; 2007;2009), and similarly, habitats within the western and southern domains are not expected to be substantially affected due to predicted minor changes in surface water ponding.

A number of surface water monitoring points have been identified where the potential for these impacts to occur is more likely. Any remediation works required to rectify surface cracking or surface water ponding is not expected to be substantial based on previous experience at WWC. Due to the limited remediation works undertaken as part of the existing operations, any future remediation works are expected to also be limited in extent and be able to be undertaken either by hand or small earthmoving equipment, e.g. bobcat, in accessible areas. As such, the remediation works are not likely to significantly impact on the occurrence of riparian or aquatic vegetation within the predicted subsidence affectation zone or in downstream creeklines.



Source: OCAL - Aerial Photograph
LPI - Drainage Lines
Bell & Driscoll 2009 - Vegetation Communities

0 0.5 1.0 1.5km
1:30 000

Legend

- Continued Underground Mining Area
- Drainage Line
- Alluvial Tall Moist Forest
- Cleared Land
- Disturbed - Regrowth
- Swamp Mahogany-Paperbark Forest
- Coastal Wet Gully Forest
- Mesic Paperbark Thicket
- Coastal Foothills Spotted Gum-Ironbark Forest
- Coastal Ranges Dry Blackbutt Forest
- Coastal Ranges Mesic Peppermint Forest
- Coastal Warm Temperate Rainforest
- Freemans Peppermint-Apple-Bloodwood Forest
- Hunter Valley Moist Spotted Gum-Ironbark Forest
- Regenerating Freemans Peppermint-Apple-Bloodwood Forest
- Riparian Paperbark-Peppermint Forest
- Sugarloaf Uplands Smooth-barked Apple Forest
- Sugarloaf Uplands Dry Spotted Gum-Ironbark Forest
- Pre-mining Ponding
- Post-mining Ponding

FIGURE 5.2

Vegetation Communities and Potential Ponding within the Continued Underground Mining area

File Name (A4): R05_V1/2553_289.dgn

5.2.3 Surface Infrastructure

The proposed mining services facility, as shown on **Figure 1.2**, will be developed to provide essential services for the continued operations of WWC. The facility will be a constructed compound, comprising a ballast and concrete borehole, emergency egress borehole, solcenic mixing stations and will include the provision of additional electricity supply. Provision of power to the proposed site will be obtained from the existing power supply in the vicinity of Wakefield Road.

The facility is proposed to be constructed on land previously disturbed by the construction of both Wakefield Road and the F3 freeway. The site is currently composed of disturbed areas adjacent to Wakefield Road and some re-growth vegetation (refer to **Section 4.2.16** for a description of the vegetation at the site). The construction will involve minimal disturbance of an area in the order of 20 metres by 35 metres, with a service road entering the site from Wakefield Road.

In addition, the project may require the construction of a number of surface infrastructure areas, including (potentially):

- ventilation infrastructure; and
- site services including power lines, minor access roads and other minor infrastructure.

The precise location of infrastructure such as ventilation fans, and associated access tracks and power lines will not be known until mining in each area has commenced. The facilities will be located as part of the detailed mine planning process for each set of panels and will consider ecological factors such as the presence of significant vegetation communities and significant ecological features such as threatened species habitat or hollow-bearing trees. The area required for each facility is typically small. Further details regarding the management process for placement of surface facilities are included in **Section 5.11.2**.

Due to the extensive ecological survey conducted within the continued underground mining area, it is considered that these surface infrastructure requirements can be constructed without significant impact on vegetation communities and fauna habitats and threatened species, in accordance with the due diligence process outlined in **Section 5.11.2**.

5.2.4 Subsidence Remediation Works

Based on subsidence predictions and experience from previous mining at WWC, it is expected that subsidence remediation works will be limited to tracks, where there is a potential public risk. It is not expected that subsidence remediation works will be required in areas of intact vegetation.

In the event that subsidence remediation within intact vegetation is required, it would be necessary to remove elements of the canopy, shrub and ground layers to allow for access for earthmoving machinery. The remediation of surface cracking within forest vegetation communities would be managed, however, to reduce the amount of vegetation that would be disturbed or removed as a result of earthworks. In order to achieve this, small earthmoving machinery would be used in these areas as much as possible. The use of small machinery will reduce the potential to require the clearing of small tree, shrub and other vegetation layers. It is considered unlikely that mature trees will need to be cleared to complete the required subsidence remediation; however, in the unlikely circumstances where it is required, clearing would be undertaken in accordance with WWCs detailed pre-clearance procedure.

In forest areas, shrub and ground layers will be the items that would be most significantly impacted by remediation activities. Regular monitoring of remediated woodland areas will be required to ensure that the shrub and ground layers regenerate from the soil seed bank following subsidence remediation works. WWC will facilitate the revegetation of these sites through the planting of native shrub and ground cover species. Species selection will be undertaken to ensure the long term viability of the revegetation works and the preservation of the floristic diversity within this vegetation formation.

5.3 Impact of the Project on Flora Species

In terms of general diversity of flora species, the continued underground mining area is considered to be representative of surrounding areas. Overall, plant species diversity is considered to be moderate, with a total of 264 species recorded during surveys. Of these, 14 species (5 per cent) were not native to the continued underground mining area. A total of 388 taxa have been recorded within the wider Sugarloaf SCA (Bell and Driscoll 2009) and the species diversity of the continued underground mining area is considered to be representative of the diversity in the SCA generally.

The project is not expected to result in the loss of flora species diversity from within the continued underground mining area, due to the very small area of clearing predicted to be required for surface infrastructure and the limited surface remediation works expected to be required to repair potential subsidence impacts.

5.4 Impact of the Project on Vegetation Communities

The vegetation within the continued underground mining area is considered to be of high ecological significance, as 91% of the proposed underground mining area falls within the Sugarloaf State Conservation Area (refer to **Section 2.6**). While subsidence cracking is predicted within native vegetation communities, subsidence remediation works are not predicted to be necessary.

Surface water ponding impacts are expected to occur within approximately 5 hectares of drainage lines, specifically in Diega, Cockle and Central Creeks. Ponding is predicted to be confined to existing channels and no out-of-channel flows are expected as a result of subsidence. Assessment of vegetation communities to be impacted has concluded that approximately 1.8 hectares of Alluvial Tall Moist Forest EEC occurs within the surface water ponding impact zone (refer to **Figure 5.2**), as well as 0.45 hectares of Swamp Mahogany Paperbark Forest. These communities are not expected to be significantly impacted however, as the community is adapted to ‘wet’ conditions and the ponding is expected to be of short duration only due to natural seepage and evaporation.

As disturbance to vegetation communities will only occur where it is necessary to repair areas of severe cracking, clearing of canopy vegetation is unlikely to be required and the majority of vegetation will remain largely undisturbed. Based on subsidence predictions and experience from previous mining at WWC, tree fall is not predicted and subsidence remediation works within intact vegetation are not expected to be required. This predicted impact is not expected to result in a significant loss of floristic diversity or community composition of the continued underground mining area, the Sugarloaf SCA or the region.

The proposed mining services facility will not result in the impact to, or removal of native vegetation communities.

5.5 Impact on Groundwater-dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems which have their species composition and their natural ecological processes determined by groundwater (DLWC 2002). According to the Groundwater Dependent Ecosystem Policy (DLWC 2002), ecosystems which depend on groundwater are:

- wetlands and red gum forests;
- other terrestrial vegetation;
- ecosystems in streams fed by groundwater;
- limestone cave systems;
- springs; and
- hanging valleys and swamps.

Of these ecosystems, those potentially relevant to the project area include other terrestrial vegetation and wetlands. There have been no recordings of significant GDEs such as hanging swamps and limestone cave systems within the continued underground operations area.

Three vegetation communities in the continued underground mining area are considered likely to be dependent on groundwater resources: Alluvial Tall Moist Forest EEC (covering 12 hectares); Swamp Mahogany Paperbark Forest EEC (covering 3 hectares); and Riparian Paperbark Peppermint Forest (covering 10 hectares). A freshwater wetland was also identified in the continued underground mining area. This wetland was extensively investigated as part of the Aboriginal Archaeology Assessment (refer to Appendix 12 of the Environmental Assessment). This wetland is considered to be fed by surface water and is not considered to be groundwater-dependent ecosystem (GDE) (Umwelt 2008b).

Aurecon Pty Ltd was engaged as part of the project to consolidate the available base-line groundwater data from past investigations and to make an assessment of the likely impact of the proposed mining on the groundwater regime. Aurecon Pty Ltd 2009 found that the potential for impact on alluvial deposits identified in the continued underground mining area depends on:

- the depth of cover between the mine and the base of the alluvium; and
- the height of interconnected fracturing in the strata above the extracted longwall panels.

In order to determine the likely impact of the proposed mining on groundwater in the alluvium, the following were undertaken to assist in the assessment of the potential consequences of the proposed mining:

- data relating to the alluvium was gathered from previous field studies;
- a field reconnaissance program was carried out to confirm the location, extent and nature of the alluvial deposits in the continued underground mining area; and
- a broad evaluation was made of the current groundwater usage in and near the affected area.

In order to determine the likelihood of any adverse consequences occurring, an estimate was made of the likely height of fracturing above the extracted longwall panels, which was determined to be in the order of 70 metres.

Based on this estimation, workings below a depth of cover of 70 metres with the potential to have significant ground and surface water impacts have been removed from the conceptual mine plan. This change has been adopted as a means to reduce the likelihood for connective cracking to occur, which may have significant impacts on water resources and groundwater-dependent ecosystems.

The assessment of hydrogeological risk concluded that risks to the groundwater regime in Palmers Creek were negligible, the risks in Diega Creek and Central Creek were low to very low and the risks in Cockle Creek and Ryhope Creek were low, following the modification to the mine plan. A monitoring program has been formulated in order to confirm the assessment outcomes and check for any unexpected adverse impacts. The monitoring program will include:

- continuation of existing monitoring in Cockle Creek;
- establishment of two additional monitoring bores in the Diega Creek alluvium;
- establishment of three monitoring bores in the Ryhope Creek alluvium, outside the continued underground mining area;
- continuation of existing monitoring in the Palmers Creek alluvium, outside the continued underground mining area; and
- inclusion of ecological monitoring locations within GDEs.

The continued underground mining area is not expected to result in an adverse impact on groundwater resources, and similarly alluvial aquifers are not expected to be adversely impacted. The only potential impact on GDEs is from ponding, which is expected to be minimal.

These results indicate that it is unlikely that the project will result in a significant negative impact on identified GDEs such as Alluvial Tall Moist Forest EEC, Swamp Mahogany Paperbark Forest EEC and Riparian Paperbark Peppermint Forest.

5.6 Impact on Cliffline Habitats

The ridgetops and upper slopes of the Sugarloaf Range contain Narrabeen Group sandstone. This sandstone can occur as flat expanses (platforms) and sometimes weathers to create overhangs, cracks and caves in clifflines and under boulders. Such features have the potential to provide habitat for a range of cave-dependent species, particularly micro-bats. Of the threatened micro-bat species recorded from the continued underground mining area (or with the potential to occur), the following are known to utilise caves (or similar structures) for roosting/breeding:

- little bentwing-bat (*Miniopterus australis*);
- large-eared pied bat (*Chalinolobus dwyeri*);
- large-footed myotis (*Myotis adversus*);

- eastern cave bat (*Vespadelus troughtoni*); and
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*).

Of these, the little bentwing-bat (*Miniopterus australis*) and eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) are thought to prefer caves of limestone origin (Churchill 2008), which are not present in the continued underground mining area.

Due to the rugged nature of the continued underground mining area, it was not possible to survey all of the cliffline areas to search for micro-bat roost/maternity caves. Despite this, archaeological surveys did locate a number of 'rockshelters' that could feasibly provide potential habitat for these species. No evidence of micro-bats utilising such features was observed during these surveys.

There is the potential that such habitat features could be impacted as a result of subsidence. The most likely potential impacts from subsidence would be increased cracking in the walls, roof and base of the caves, and possible collapse, depending on the extent of existing cracking. Secondary impacts of the above may manifest in alteration to the microclimate of these caves, resulting from changes to temperature, humidity and light levels. Given the highly specific microclimate requirements exhibited by different micro-bat species, such potential alterations may cause a cave to become unsuitable.

Notwithstanding the above, no evidence of breeding or roosting caves for any micro-bat species has been recorded from surveys completed within the continued underground mining area. Such caves are typically very rare in the landscape, and there is no certainty that they occur in the continued underground mining area. The extensive clifflines of the surrounding area are likely to provide comparable potential for roosting/breeding caves as those within the continued underground mining area. However, the possibility of the presence of such caves cannot be excluded from consideration.

As there is no way to conclusively exclude the potential for breeding and/or roosting of these species in the clifflines of the continued underground mining area, this assessment assumes their potential (if unlikely) presence, and assesses potential impacts accordingly in **Appendices D** and **E**.

Also, it is important to note that the continued underground mining area is not expected to comprise an important population of the large-eared pied bat (*Chalinolobus dwyeri*). A conservative approach has been taken in the assessment to account for uncertainty in relation to impacts on cliffline habitat and the detailed assessment in **Appendix E** has confirmed that this project will not have a significant impact on this species.

5.7 Impact of the Project on Fauna Habitat and Fauna Species

It is unlikely that the project will result in a significant loss or deterioration of fauna habitat within the continued underground mining area. The existing fauna habitat consists broadly of remnant forest vegetation (approximately 82 per cent of the continued underground mining area); with a limited area of riparian and mesic habitat (15 per cent of continued underground mining area); and aquatic habitat (<1 per cent of continued underground mining area). The remaining 2 per cent of the continued underground mining area comprises cleared or disturbed lands.

The project is not expected to result in the loss of fauna species diversity or abundance from within the continued underground mining area, due to the very small area of clearing predicted to be required for surface infrastructure and the limited surface remediation works expected to be required to repair subsidence impacts. This expectation is supported by the

results of previous ecological monitoring conducted by Umwelt in WWC between 2005 and 2008 (Umwelt 2005; 2006; 2007; 2009).

5.8 Impact of the Project on Aquatic Habitat and Species

The surface water assessment completed as part of this assessment has identified potential locations where surface ponding may occur, however a number of monitoring points have been identified where the potential for these impacts to occur is more likely. Any remediation works required to rectify surface cracking, surface ponding or out of channel flows are not expected to be substantial based on previous experience at WWC.

Aquatic flora and fauna species were not identified in the numerous drainage lines and creeks draining the continued underground mining area, due to the ephemeral nature of the systems. Aquatic species were identified in the 'wet soak' however, due to the archaeological significance of the site, mining will not occur beneath the wetland and therefore the site will not be impacted. Aquatic flora species identified in the dam in the eastern portion of the continued underground mining area are similarly not expected to be significantly impacted due to subsidence or connective cracking.

Surveys of the aquatic features of the continued underground mining area have identified that the majority of the drainage lines within the continued underground mining area are ephemeral, and therefore there will be no definitive impact on aquatic species or habitats as a result of the project.

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

The project will result in the loss of a small area of threatened flora and fauna habitat for the construction of surface infrastructure and the potential remediation of surface cracking or ponding. The basic principles of protecting threatened species are to:

- avoid direct impacts and retain habitat;
- minimise impacts wherever possible;
- mitigate or ameliorate impacts; and as a last resort;
- compensate or offset for any unavoidable impacts.

The project will not result in the removal of a substantial area of threatened species habitat, with impacts on vegetation communities and fauna habitats expected to be limited to approximately 2.25 hectares of increased surface water ponding within drainage lines and the limited clearing for the construction of surface facilities. As a result, the project generally avoids direct impacts and retains habitat for all threatened species recorded in the continued underground mining area.

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

As there are no formal assessment guidelines in place for Part 3A projects, the key components of the 'Seven Part Test' were retained for this assessment. To achieve this, the 'Assessment of Significance' used for this project is divided into the following four key components, each with its own specific questions:

- threatened species;
- endangered populations;
- threatened ecological communities; and
- key threatening processes.

An assessment of significance was undertaken using an initial screening process to identify species that have been recorded in the continued underground mining area or may be potentially impacted by the project (Tables 1 and 2 of **Appendix A**). A full assessment of the likely significance of impacts was completed for these species. The Assessment of Significance does not take into account the full range of impact mitigation strategies proposed as part of the project, rather it considers the impacts of the project without mitigation. The Assessment of Significance was completed for the following threatened species and EECs, either due to their recorded presence or the potential for species or TECs to be impacted:

- River-flat Eucalypt Forest on Coastal Floodplains EEC (Alluvial Tall Moist Forest);
- Swamp Sclerophyll Forest on Coastal Floodplains EEC (Swamp Mahogany Paperbark Forest);
- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion EEC;
- black-eyed Susan (*Tetratheca juncea*);
- small-flower grevillea (*Grevillea parviflora* subsp *parviflora*);
- Stephens banded snake (*Hoplocephalus stephensii*);
- yellow-bellied glider (*Petaurus australis*);
- squirrel glider (*Petaurus norfolcensis*);
- spotted-tailed quoll (*Dasyurus maculatus*);
- sooty owl (*Tyto tenebricosa*);
- masked owl (*Tyto novaehollandiae*);
- powerful owl (*Ninox strenua*);
- glossy black-cockatoo (*Calyptorhynchus lathami*);
- gang-gang cockatoo (*Callocephalon fimbriatum*);
- little lorikeet (*Glossopsitta pusilla*);

- swift parrot (*Lathamus discolor*);
- regent honeyeater (*Anthochaera phrygia*);
- varied sittella (*Daphoenositta chrysoptera*);
- scarlet robin (*Petroica boodang*);
- koala (*Phascolarctos cinereus*);
- common planigale (*Planigale maculata*);
- grey-headed flying-fox (*Pteropus poliocephalus*);
- little bentwing-bat (*Miniopterus australis*);
- large-eared pied bat (*Chalinolobus dwyeri*);
- eastern freetail bat (*Mormopterus norfolkensis*);
- eastern false pipistrelle (*Falsistrellus tasmaniensis*);
- large-footed myotis (*Myotis adversus*);
- yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*);
- eastern cave bat (*Vespadelus troughtoni*);
- greater broad-nosed bat (*Scoteanax rueppellii*); and
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*).

The assessment of significance conducted for each of the threatened species recorded in the continued underground mining area or considered likely to be potentially impacted is included in **Appendices D** and **E**. The Assessment of Significance concludes that the project will not have a significant impact on threatened species or TECs known to occur in the continued underground mining area.

An Impact Mitigation Strategy (refer to **Section 5.11**) has been designed to minimise potential impacts of the project on ecological values, including threatened species.

5.9.2 Threatened Species Assessed Under the Fisheries Management Act 1994

Neither the upper catchment of Lake Macquarie, nor the lower catchment of the Hunter River, are known to support any threatened species, endangered populations or EECs listed under the *Fisheries Management Act 1994.* No species, populations or ecological communities listed under the FM Act were recorded in the continued underground mining area; therefore threatened aquatic species, endangered populations, or EECs listed under the FM Act will not be impacted by the project.

5.9.3 SEPP 44 Assessment

Potential habitat under SEPP 44 was identified in approximately 3 hectares of Swamp Mahogany Paperbark Forest, which includes swamp mahogany (*Eucalyptus robusta*) as a dominant canopy species. The project will not result in the clearing of Swamp Mahogany

Paperbark Forest and therefore the swamp mahogany (*Eucalyptus robusta*) will not be directly impacted as a result of the project.

The results of the surface water assessment indicate that surface water ponding may occur within the area mapped as Swamp Mahogany Paperbark Forest. As discussed in **Section 5.2.2**, ponding is expected to be confined to existing channels with no out-of channel ponding predicted. Ponding predictions within Swamp Mahogany Paperbark Forest indicate that current, baseline ponding occurs over an area of approximately 0.06 hectares with a depth generally in the order of 40 centimetres. The post-mining ponding predictions indicate that ponding will be increased to an area of 0.45 hectares, with an increase in depth to approximately one metre.

These surface water impacts are not expected to result in the disturbance of potential koala habitat. Minor alterations to the ponding regime are not expected to result in the alteration of the structural or floristic composition of Swamp Mahogany Paperbark Forest and koala feed trees listed under SEPP 44 are not expected to be lost as a result of the project.

SEPP 44 does not specifically apply to the majority of the continued underground mining area, as this area is a SCA (which is exempt from the provisions of SEPP 44). Despite this, koalas were identified during surveys and therefore the impact of the project on this species has been considered in detail in the Assessment of Significance (refer to **Section 5.9.1** and **Appendix D**). The potential impact on the project on koalas has also been considered in the formulation of the Impact Mitigation Strategy detailed in **Section 5.11**.

The project is not expected to significantly impact on the koala or its habitat and the species is expected to persist in the continued underground mining area in the long term.

As outlined in **Section 3.7**, a Koala Plan of Management (KPoM) is required if core koala habitat is present on privately owned land within an area pertaining to a project application. Therefore a KPoM will be prepared for the Project. This KPoM is applicable only to the privately-owned lands falling within the continued underground mining area, not to the Sugarloaf SCA.

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

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

- listed threatened species and ecological communities;
- migratory species protected under international agreements;
- Ramsar wetlands of international importance;
- the Commonwealth marine environment;
- World Heritage properties;
- National Heritage places;
- Great Barrier Reef Marine Park; and
- nuclear actions.

Four EPBC Act listed vulnerable species were recorded in the continued underground mining area during surveys: black-eyed Susan (*Tetratheca juncea*), small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*), grey-headed flying-fox (*Pteropus poliocephalus*) and the large-eared pied bat (*Chalinolobus dwyeri*). The spotted-tailed quoll (*Dasyurus maculatus*) is listed as endangered under the EPBC Act, and has been previously recorded on one occasion in the central portion of the continued underground mining area (DECCW 2009).

5.9.4.1 Vulnerable Species

When considering the impact of a project on a vulnerable species the impacts are considered in the context of an *important population*. As described by the EPBC Act impact assessment guidelines (DEWHA 2009), an *important population* of a vulnerable species is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

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

The continued underground mining area is not expected to comprise an important population of the vulnerable small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*), grey-headed flying-fox (*Pteropus poliocephalus*) or large-eared pied bat (*Chalinolobus dwyeri*). The continued underground mining area does, however, comprise an important population of black-eyed Susan (*Tetratheca juncea*). The EPBC Act 1999 lists criteria which are used to determine whether an action is likely to have a significant impact on vulnerable species. These criteria are addressed in the Assessment of Significance provided in **Appendix E**. An Assessment of Significance for the vulnerable species concludes that the project will not have a significant impact on vulnerable species known to occur in the continued underground mining area.

The project is not expected to result in a significant impact on vulnerable species and referral to the Commonwealth Minister for the Environmental, Water, Heritage and the Arts is therefore not required.

5.9.4.2 Endangered Species

The continued underground mining area is not expected to contain a population of the endangered spotted-tailed quoll (*Dasyurus maculatus maculatus*) (Southeastern mainland population) as defined by the EPBC Act significant impact guidelines (DEWHA 2009). In relation to an endangered species, a population is defined as, but not limited to:

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

The EPBC Act 1999 lists criteria which are used to determine whether an action is likely to have a significant impact on endangered species. These criteria are addressed in the Assessment of Significance provided in **Appendix E**. An Assessment of Significance for the endangered spotted-tailed quoll (*Dasyurus maculatus maculatus*) (Southeastern mainland population) concludes that the project will not have a significant impact on an endangered species known to occur in the continued underground mining area.

The project is not expected to result in a significant impact on endangered species and referral to the Commonwealth Minister for the Environmental, Water, Heritage and the Arts is therefore not required.

5.9.4.3 Migratory Species

Eighteen EPBC listed migratory species were recorded within the continued underground mining area. These species were considered in an Assessment of Significance provided in **Appendix E**. The continued underground mining area is not considered to provide habitat for an important population of any migratory species, as defined by the EPBC Act impact assessment guidelines, and a significant impact on migratory species is not expected to occur.

The project is not expected to result in a significant impact on migratory species and referral to the Commonwealth Minister for the Environmental, Water, Heritage and the Arts is therefore not required.

5.10 Impact of the Project on Sugarloaf SCA

The project is not expected to have a significant impact on the ecological values of the Sugarloaf SCA. As discussed in **Section 5.2** to **5.10**, the project will not result in a substantial loss of vegetation communities or the floristic composition of vegetation communities; fauna species or habitat; or threatened species, endangered populations and TECs or their habitat.

While subsidence of between 0.36 and 2.61 metres is predicted to occur across the Sugarloaf SCA, subsidence impacts are not expected to compromise the ecological values and integrity of the SCA and a detrimental impact is not expected. The results of ecological monitoring in previously mined areas at WWC indicate that mining has not resulted in significant impacts to ecological values and the impact mitigation strategy and monitoring proposed for the project will ensure that the potential impacts of the project on the Sugarloaf SCA will be adequately managed and monitored as mining progresses.

In the event that unpredicted, adverse impacts on ecological values are identified during management and monitoring of the continued underground mining area, WWC will respond to the issues identified and engage appropriate experts where required. WWC will investigate all appropriate remediation and mitigation requirements, in consultation with the relevant government authorities and in the event that significant impacts on the ecological values of the SCA are identified and cannot be adequately remediated, WWC will engage a suitably qualified and experienced ecologist to prepare a Biodiversity Offset Strategy in consultation with DECCW and DoP.

5.11 Impact Mitigation Strategy

One of the key goals of the impact mitigation strategy is to maintain or improve ecological features and functions within the continued underground mining area, in order to mitigate the impacts associated with underground mining in the continued underground mining area. To achieve this, current management actions that are being employed across the continued underground mining area are described, as well as additional actions that will be adopted as part of this project.

5.11.1 Actions to Improve and Maintain Ecological Value

All Xstrata Coal sites are required to implement the company's Biodiversity and Land Management Standard as a minimum. The purpose of the Standard is 'to develop and implement scientifically-sound technologies and procedures for:

- the effective management and conservation of biodiversity, and
- rehabilitation of disturbed land to a planned post-closure use.' (Section 1, Xstrata Coal NSW 2005).

The implementation of the Standard at Xstrata sites provides a basis for the effective management and maintenance of ecological values of Xstrata sites and the improvement of ecological values where required.

As part of the project, the existing Biodiversity and Land Management Plan (Umwelt 2007) will be updated to include the requirements of the current proposed project to include the impact mitigation strategy outlined in this section. As part of the requirements of this Plan, the following specific control measures are considered to be integral to the protection and preservation of the ecological features of the current and future underground mining areas:

- understanding existing flora and fauna characteristics prior to any new development through the undertaking of baseline studies at feasibility and baseline phases;
- rehabilitation of disturbed and subsided land as soon as practical;
- ensuring appropriate erosion and sediment control systems are in place to prevent damage to flora and fauna from erosion and unnatural flooding events; and
- seasonal monitoring of flora and fauna species and habitats.

Each of these existing control measures result in the maintenance of ecological values and habitat quality across the continued underground mining area.

In addition to the above actions that maintain ecological value, weed and feral animal management is proposed for the continued underground mining area, as needed or identified as part of monitoring recommendations. These works involve targeted weed removal using a variety of techniques and feral animal control in accordance with all relevant government approvals. Targeted weed and feral animal control will result in the improvement in the ecological value of vegetation communities and fauna habitats, particularly in riparian areas where lantana (*Lantana camara*) poses a significant threat to ecological value. Weed and feral animal control is detailed in **Section 5.11.3**.

5.11.2 Management of Potential Surface Infrastructure Construction

As discussed in **Section 5.2.3**, the project may require the construction of various minor surface infrastructure facilities such as ventilation infrastructure and associated services for which the exact locations cannot be known at this stage of the project. It may be necessary to disturb some areas of native vegetation for the construction of these surface facilities. Where this is unavoidable, areas containing significant ecological features such as known threatened species habitat, or hollow-bearing trees will be avoided. Where it will be necessary to disturb areas of native vegetation for these types of infrastructure, the following due diligence processes will be implemented:

- due-diligence inspections will be completed by a suitably qualified ecologist to identify any significant ecological features at identified potential infrastructure sites and to advise of any required management and mitigation measures;

- disturbance to native vegetation communities will be limited to the minimum area required;

- areas of known ecological significance (refer to **Figures 4.1** and **4.2**) will be avoided where possible (that is, areas containing known records of threatened species, endangered populations and TECs. Hollow-bearing trees should be retained, where possible);

- appropriate disturbance setbacks to known or identified significant ecological features will be established where possible; and

- pre-clearance surveys of any sites containing hollow-bearing trees or significant habitat features.

Due diligence inspections will ensure that only the minimum area required for surface infrastructure developments will be cleared and that flora and fauna species (including threatened species), will not be significantly impacted.

As discussed in **Section 5.2.1**, there are several areas within the continued underground mining area that may be susceptible to direct hydraulic connection. A detailed subsidence monitoring program will be undertaken in these areas to identify potential connective cracking issues. In the event that such cracking is observed a due diligence process as outlined above, will be followed in an effort to minimise the potential for impacts upon sensitive ecological features. Where possible existing tracks will be utilised, however due to the extensive vegetation cover and remote nature of the areas, new access tracks may be required. If required, new access tracks will be constructed so as to minimise the potential on ecological features.

In the event that unpredicted, adverse impacts on ecological values are identified during management and monitoring of the continued underground mining area, WWC will respond to the issues identified and engage appropriate experts where required. WWC will investigate all appropriate remediation and mitigation requirements, in consultation with the relevant government authorities and in the event that significant impacts on identified ecological values are identified and cannot be adequately remediated, WWC will engage a suitably qualified and experienced ecologist to prepare a Biodiversity Offset Strategy in consultation with DECCW and DoP.

5.11.3 Weed and Feral Animal Management

5.11.3.1 Weed Control

The presence of weed species has the potential to substantially reduce the ecological value of natural areas. Lantana (*Lantana camara*) was identified as a significant weed in many of the drainage lines occurring in the proposed underground mining area. The species was also identified by Bell and Driscoll (2009) as a significant weed of riparian areas. The presence of weed species within the proposed underground mining area has the potential to significantly decrease the value of vegetation and habitat to native species, particularly threatened species.

Periodic inspections of the drainage lines within the areas affected by proposed underground mining will be undertaken to determine the need for weed control and appropriate weed control methods will be employed.

5.11.3.2 Feral Animal Control

Introduced fauna species such as foxes, rabbits, pigs, wild dogs and feral cats have all been recorded in the proposed underground mining area. In addition to this, a number of introduced herbivores have been recorded within the continued underground mining area, and are likely to be competing with native species and causing damage to vegetation.

Periodic inspections of the areas affected by proposed underground mining will be undertaken to determine the need for feral animal control and appropriate control methods will be employed.

5.12 Cumulative Impact Assessment

The majority of the continued underground mining area consists of the Sugarloaf SCA which is conserved land under the NP&W Act, protecting its ecological values. The remaining 93 hectares of the continued underground mining area is primarily zoned for agricultural use and is substantially vegetated. There are no other known significant development proposals for this area. As discussed in **Section 5.2** to **5.10**, the project is predicted to have minimal impact on the ecological values of the continued underground mining area. Considering the conservation status of the majority of land within the continued underground mining area, the absence of any other significant developments and the minimal impact of this project on ecological values, the project is not expected to result in a significant cumulative impact on local or regional ecological values.

5.13 Summary of Net Ecological Impacts

As a result of the modifications made during mine planning that avoided and minimised impacts on ecological features, and the proposed impact mitigation and monitoring commitments, the project is considered unlikely to significantly impact vegetation communities and fauna species, including identified threatened species and EECs.

WWCs commitment to the implementation of a Biodiversity Offset Strategy in the event that ecological values are significantly impacted beyond those minor impacts predicted in **Sections 5.2** to **5.10** will ensure that the project will not result in a loss of significant vegetation communities and fauna habitats, including threatened species and EECs.

As a result of the implementation of the Impact Mitigation Strategy it is considered likely that there will be no significant impact on threatened species, TECs or their habitats, and that the objective to maintain or improve the biodiversity values of the surrounding region in the medium to long term will be achieved.

6.0 Ecological Monitoring Requirements

OCAL commissioned Umwelt to undertake a program of annual ecological monitoring which commenced in spring 2005 (Umwelt 2005) and ran until November 2008. The ecological monitoring program was to be completed in accordance with the requirements of Xstrata Coal's HSEC STD5.09 Biodiversity and Land Management (Xstrata Coal NSW 2005).

Umwelt recommended detailed ecological monitoring of two sites during 2005 to examine the impact of the mine on native flora and fauna that occur on the surface above current longwall operations. This baseline monitoring included both flora and fauna and focused on identifying structure and floristics, as well as species diversity and abundance at two sites above longwall panels 32 and 33 (refer to **Figure 1.2**).

Additional monitoring sites were established in 2006 above longwall panels 32 and 34. During the 2007 monitoring period, an additional flora and fauna monitoring site was established adjacent to the drainage line above the northern section of longwall panel 35. During the 2008 monitoring period, two additional flora and fauna monitoring sites were established adjacent to creek lines above longwalls 36 and 37. These sites are proposed to be reassessed in 2010.

Refer to **Figure 1.2** for the location of monitored longwall panels.

It is proposed to build on WWC's previous monitoring schedule as mining progresses. Sites will be added to the monitoring schedule with the advancement of mining into each new longwall and sites will be removed from the monitoring schedule once it can be demonstrated that subsidence impacts have resulted in no discernable impact on the vegetation and fauna characteristics of the sites.

Sites will be preferentially located in areas where subsidence impacts are predicted to be greatest, and will be monitored on a regular basis.

6.1 Remnant Vegetation Monitoring

At each of the monitoring locations, a minimum of one 400 square metre (20 x 20 metre) vegetation survey plot will be established and sampled in order to assess flora diversity and abundance. The locations of these vegetation plots will be selected in order to sample each of the vegetation communities identified along the longwall panel. The condition of the vegetation at the site will also be determined.

Each vegetation plot will be marked with a metal star-picket in each corner. A metal tag recording the relevant site details will be attached to each star-picket. The centre of each site will be recorded via GPS to enable accurate location of the vegetation plot, should the star-pickets be removed. This will allow for repeatable surveys over time.

At each site, a botanist will identify all vascular flora species present within the plot. Species within the plot will be assigned a cover-abundance value to reflect their relative cover and abundance in the plot. A modified Braun-Blanquet 6-point scale (see **Table 3.1**) will be used to estimate cover-abundances of all plant species within each plot. Species located outside the plot will be marked as being present, however will not be assigned a cover-abundance value.

Comparison with previous remnant vegetation monitoring will be made and the results evaluated to determine if the mining and subsidence related impacts are detrimentally affecting remnant vegetation communities. As outlined in **Sections 5.9** and **5.11.2**, in the

event that unpredicted, adverse impacts on ecological values are identified during remnant vegetation monitoring WWC will respond to the issues identified and engage appropriate experts where required. WWC will investigate all appropriate remediation, mitigation or offset requirements, in consultation with the relevant government authorities and in the event that significant impacts on remnant vegetation are identified and cannot be adequately remediated, WWC will engage a suitably qualified and experienced ecologist to prepare a Biodiversity Offset Strategy in consultation with DECCW and DoP.

6.2 Fauna Monitoring

During the 2005 monitoring, all vertebrate fauna groups (i.e. birds, mammals, reptiles and amphibians) were surveyed. It was recommended in the 2005 monitoring report that the data collected during subsequent monitoring events should focus on groups of species that could show measurable impacts following disturbance activities relevant to longwall mining. While all species may be impacted by potential subsidence to some degree, species dependent on drainage lines and those with low mobility and small home ranges would be most significantly impacted, such as amphibians and reptiles. Therefore monitoring surveys between 2006 and 2008 included diurnal reptile surveys, nocturnal amphibian surveys and opportunistic recordings of all other species.

A diurnal reptile survey consisting of two person hours over two separate days will be conducted at each of the monitoring points. A nocturnal amphibian survey consisting of two person hours over two separate nights will also be conducted.

6.2.1 Habitat Assessment

A fauna habitat assessment will be undertaken at each of the monitoring locations. The following components of fauna habitat will be recorded and compared to previous monitoring results:

- hollow-bearing trees;
- density of shrub and ground layer;
- canopy cover;
- mistletoe;
- fallen logs and rocks;
- leaf litter;
- decorticating bark;
- winter flowering species; and
- stags.

The results of the monitoring will be analysed and compared to previous survey results to determine general population trends. In the event that negative trends are identified indicating the decline of particular threatened species, appropriate amelioration measures will be developed.

In the event that further threatened species are identified within the monitoring locations the monitoring program will incorporate surveys to adequately assess and monitor these species, where appropriate.

In the event that unpredicted, adverse impacts on fauna species or habitats are identified during fauna monitoring, WWC will respond to the issues identified and engage appropriate experts where required. WWC will investigate all appropriate remediation and mitigation requirements, in consultation with the relevant government authorities and in the event that significant impacts on fauna species and habitats are identified and cannot be adequately remediated, WWC will engage a suitably qualified and experienced ecologist to prepare a Biodiversity Offset Strategy in consultation with DECCW and DoP.

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APPENDIX A

Threatened Species Assessment

Appendix A – Threatened Species Assessment

Threatened species, endangered populations, and threatened ecological communities (TECs) identified within the continued underground mining area are listed in **Tables 1** and **2** below. These tables include the results of the searches of the DECCW Atlas of NSW Wildlife Database and DEWHA Protected Matters Database for a 10 kilometre radius of the continued underground mining area.

Tables 1 and **2** contain the relevant ecological details of each listing (including their habitat requirements, known range and reservation within conservation reserves within the region), as well as an assessment as to whether there may be an impact on any recorded or potentially occurring threatened species, population or TECs as a result of the project. The specific impacts of the project are described in Section 5.0 of the Ecological Assessment. For the purposes of these tables, the 'region' is broadly defined as the lower Hunter region.

Part 3A of the EP&A Act requires an Assessment of Significance relating to the potential impacts of the project on listed threatened species, endangered populations or TECs. As a formal assessment method is yet to be established by the relevant government authorities for Part 3A projects, an assessment that applies the key principles of the Section 5A assessment has been used to assess the potential for the project to impact on threatened species, endangered populations or TECs within the continued underground mining area.

An Assessment of Significance is provided **Appendix D** for those threatened species, endangered populations or TECs recorded in the continued underground mining area or considered to have the potential to be impacted by the project.

An Assessment of Significance for species listed under the Commonwealth EPBC Act, that were recorded in the continued underground mining area or have potential to be impacted by the proposed project is provided in **Appendix E**.

Information on threatened species was sourced from the DECCW web site, Threatened Species Profiles (DECC 2009b). Additional references are cited where required.

Table 1 - Threatened Flora Assessment

Species	Legal Status	Specific Habitat	Distribution in relation to Continued Underground Mining Area	Reservation in the Region	Potential to Occur / Potential for Impact	Assessment of Significance Required?
THREATENED FLORA SPECIES						
Bynoes wattle *Acacia bynoeana*	E (TSC) V (EPBC)	Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches.	This species has been found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra.	Lake Macquarie SCA	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
Charmhaven apple *Angophora inopina*	V (EPBC) V (TSC)	Habitat for this species typically occurs on the shallow sandy soils of the Narrabeen Group, on exposed ridges and slopes with westerly or northerly aspect. It has also been recorded on shallow alluvial soils of this geological type, in upper catchments and in embedded clay soil lenses with sandstone. This species is known to naturally hybridise with *A. floribunda*, particularly around major drainage lines.	This species has a restricted distribution, being confined to the Wyong, Lake Macquarie and Port Stephens Shires of NSW. Pure forms of this species have been recorded from the Wallarah catchment in the south and north to the Toronto area. Disjunct populations have been identified at Karuah.	Lake Macquarie SCA	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
netted bottle brush *Callistemon linearifolius*	V (TSC)	The species typically grows in dry sclerophyll forest on the coast and adjacent ranges.	Occurs chiefly from the Georges River to the Hawkesbury River.	Munmorah SRA Heaton SF	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Continued Underground Mining Area	Reservation in the Region	Potential to Occur / Potential for Impact	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.	Olney SF	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
Camfields stringybark *Eucalyptus camfieldii*	V(TSC) V (EPBC)	Occurs in poor coastal country in shallow sandy soils overlying Hawkesbury sandstone and coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted species of *E. oblonga* (narrow-leaved stringybark), *E. capitellata* (brown stringybark) and *E. haemastoma* (scribbly gum).	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Localised and scattered distribution includes sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal NP.	Lake Macquarie SCA Awabakal NR	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Continued Underground Mining Area	Reservation in the Region	Potential to Occur / Potential for Impact	Assessment of Significance Required?
Parramatta Red Gum *Eucalyptus parramattensis* subsp. *decadens*	V (TSC)	Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant.	There are two separate meta-populations of *E. parramattensis* subsp. decadens. The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Abedare in the south. Large aggregations of the sub-species are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south.	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area however there is limited potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
small-flower grevillea *Grevillea parviflora* subsp. *parviflora*	V (TSC) V (EPBC)	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest and a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	Sporadically distributed throughout the Sydney Basin with the main occurrence centred around Picton, Appin and Bargo (and possibly further south to the Moss Vale area). Separate populations are also known further north from Putty to Wyong and Lake Macquarie on the Central Coast and Cessnock and Kurri Kurri in the Lower Hunter.	Olney SF	This species has been identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Continued Underground Mining Area	Reservation in the Region	Potential to Occur / Potential for Impact	Assessment of Significance Required?
biconvex paperbark *Melaleuca biconvexa*	V (TSC) V (EPBC)	Biconvex paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Scattered and dispersed populations of this species are known to occur in the Karuah Manning and Wyong sub-regions of the Hunter/Central Rivers Catchment	Awaba SF Olney SF	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
eastern underground orchid *Rhizanthella slateri*	V (TSC) E (EPBC)	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed.	Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra.	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
heath wrinklewort *Rutidosis heterogama*	V (TSC) V (EPBC)	Occurs mostly in heath, often along disturbed roadsides, and also in open forest, primarily in coastal districts.	In coastal districts from Maclean to the Hunter Valley and inland to Torrington. It has also been recently recorded at Cooranbong on the Central Coast and extensively around the Cessnock district.	Munmorah SRA	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Continued Underground Mining Area	Reservation in the Region	Potential to Occur / Potential for Impact	Assessment of Significance Required?
coast groundsel *Senecio spathulatus*	E (TSC)	Coast groundsel grows on primary dunes.	Occurs in Nadgee NR (Cape Howe) and between Kurnell in Sydney and Myall Lakes NP (with a possible occurrence at Cudmirrah).	Nadgee NR Myall Lakes NP	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
magenta lilly pilly *Syzygium paniculatum*	V (TSC) V (EPBC)	This species grows in subtropical and littoral rainforests on sandy soils or stabilised dunes near the sea.	Occurs in widely separated localities between Bulahdelah and Jervis Bay.	Pulbah Island NR Munmorah SRA	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
black-eyed Susan *Tetratheca juncea*	V (TSC) V (EPBC)	Usually found in low open forest or woodland with a shrub understorey and grass groundcover on low nutrient soils, however it and has also been found in heathland and moist forest. This species generally prefers well-drained sites and ridges, although it also found on upper and mid-slopes and occasionally in gullies. There appears to be a preference for southerly aspects, although the species will occur on slopes with a variety of aspects.	This species is confined to the Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock LGAs.	Lake Macquarie SCA Wallarah NP Jilliby SCA Awabakal NR Munmorah SCA Glenrock SCA	This species has been identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Continued Underground Mining Area	Reservation in the Region	Potential to Occur / Potential for Impact	Assessment of Significance Required?
Zannichellia palustris	E (TSC)	Grows in fresh or slightly saline stationary or slowly flowing water.	Known to occur in the Hunter, Karuah-Manning and Wyong sub-regions of the Hunter/Central Rivers Catchment	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
ENDANGERED POPULATIONS						
Eucalyptus parramattensis subsp. *paramattensis* in the Wyong and Lake Macquarie LGAs	EP (TSC)	This species is associated with low moist areas alongside drainage lines and adjacent to wetlands. It is often found in woodland on sandy soils. The endangered population occurs on sandy alluvium within a floodplain community which also supports *Eucalyptus robusta* (swamp mahogany), *E. tereticornis* (forest red gum), *E. gummifera* (Sydney bloodwood) as well as *Melaleuca* (paperbark) species.	The species usually occurs from the Goulburn Valley on the Central West slopes to Hill Top on the Central Coast. The endangered population in the Lake Macquarie and Wyong LGA is at the north-eastern limit of the species range and is quite separate from other known populations. The majority of the population occurs within Wyong in the Porter's Creek and the Wallarah Creek catchments.	Lake Macquarie SCA	This population was not recorded in the continued underground mining area and there is low potential for it to occur. There is no potential for an impact on this population.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Continued Underground Mining Area	Reservation in the Region	Potential to Occur / Potential for Impact	Assessment of Significance Required?
THREATENED ECOLOGICAL COMMUNITIES						
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC (TSC)	Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Generally occur below 20 metres elevation on level areas.	Known from along the majority of the NSW coast. There is less than 150 hectares remaining on the Tweed lowlands (estimate in 1985); about 10,600 hectares on the lower Clarence floodplain (in 1982); about 11,200 hectares on the lower Macleay floodplain (in 1983); about 3,500 hectares in the lower Hunter – Central Hunter region (in 1990s); less than 2,700 hectares on the NSW south coast from Sydney to Moruya (in the mid 1990s), including about 660 hectares on the Cumberland Plain (in 1998) and about 100 hectares on the Illawarra Plain (in 2001); and less than 1,000 hectares in the Eden region (in 1990).	Hunter Wetlands NP Pambalong NR	A small (30m x 50m) natural wetland does occur on the mid slope in the north of the continued underground mining area. This wetland occurs greater than 100 metres above sea level and does not comprise the vegetative composition of this EEC. Therefore there is no potential for the EEC to occur. There is no potential for an impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Continued Underground Mining Area	Reservation in the Region	Potential to Occur / Potential for Impact	Assessment of Significance Required?
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC (TSC) CEEC (EPBC)	Occurs on sand dunes and on soil derived from underlying rocks. Stands on headlands exposed to strong wind-action may take the form of dense, wind-pruned thickets. Stands are generally taller in sheltered sites such as hind dunes, although wind-pruning may still occur on their windward sides. Most stands occur within two kilometres of the sea, though are occasionally found further inland within reach of the maritime influence.	Littoral Rainforest occurs only on the coast and is found at locations in the NSW North Coast Bioregion, Sydney Basin Bioregion and South East Corner Bioregion.	Glenrock SCA Lake Macquarie SCA	This EEC was not recorded in the continued underground mining area and there is no potential for it to occur. There is no potential for an impact on this species.	No
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion	EEC (TSC)	May be associated with a range of high-nutrient geological substrates, notably basalts and fine-grained sedimentary rocks, on coastal plains and plateaux, footslopes and foothills. In the north of its range, this EEC is found up to 600 metres above sea level, but in the Sydney Basin bioregion it is limited to elevations below 350 metres. Lowland Rainforest, when optimally developed, has the structural and floristic form of subtropical rainforest, but may be interspersed with stands of dry rainforest as moisture status declines or topographic exposure increases.	The Hawkesbury River notionally marks the southern limit of Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions.	This EEC is not known from any conservation reserves in the region.	Warm Temperate Rainforest in the Bangalow Creek Catchment is considered, in a precautionary context, to conform to this EEC. The remaining Warm Temperate Rainforest on the eastern side of the sugarloaf range is not considered to conform to this EEC. An assessment of significance has been conducted for this EEC.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Continued Underground Mining Area	Reservation in the Region	Potential to Occur / Potential for Impact	Assessment of Significance Required?
Lowland Rainforest on Floodplain in the NSW North Coast Bioregion	EEC (TSC)	This community occurs on fertile soils in lowland river valleys and is a sub-tropical rainforest.	This EEC is bounded to the south by the Hawkesbury River and to the north of this occurs in the Sydney Basin bioregion and NSW North Coast Bioregion.	This EEC is not known from any conservation reserves in the region.	This EEC was not recorded in the continued underground mining area and there is no potential for it to occur. There is no potential for an impact on this species.	No
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC (TSC)	Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Generally occurs below 20 metres (though sometimes up to 50 metres) elevation. The composition of the community is primarily determined by the frequency and duration of waterlogging and the texture, salinity nutrient and moisture content of the soil, and latitude. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.	This community is 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 and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions.	This EEC is not known from any conservation reserves in the region.	This EEC was recorded in the continued underground mining area and there is potential for the community to be impacted by the project. An assessment of significance has been conducted for this EEC.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Continued Underground Mining Area	Reservation in the Region	Potential to Occur / Potential for Impact	Assessment of Significance Required?
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 continued underground mining 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 EEC was recorded in the continued underground mining area and there is potential for the community to be impacted by the project. An assessment of significance has been conducted for this EEC.	Yes
Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion	EEC (TSC)	This EEC occurs in the central to lower Hunter Valley, principally on Permian geology.	The EEC is restricted to a range of approximately 65 kilometres by 35 kilometres centred on the Cessnock – Beresfield area.	This EEC has been recorded in Werakata NP, Werakata SCA and Sugarloaf SCA.	This EEC was not recorded in the continued underground mining area and there is no potential for it to occur. There is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Continued Underground Mining Area	Reservation in the Region	Potential to Occur / Potential for Impact	Assessment of Significance Required?
White Box – Yellow Box – Blakelys Red Gum Woodland	EEC (TSC)	This EEC is characterised by the presence or prior occurrence of white box, yellow box and/or Blakelys red gum. The trees may occur as pure stands, mixtures of the three species or in mixtures with other trees, including wattles. Commonly co-occurring eucalypts include apple box (*E. bridgesiana*), red box (*E. polyanthemos*), candlebark (*E. rubida*), snow gum (*E. pauciflora*), Argyle apple (*E. cinerea*), brittle gum (*E. mannifera*), red stringybark (*E. macrorhyncha*), grey box (*E. microcarpa*), cabbage gum (*E. amplifolia*) and others. The understorey in intact sites is characterised by native grasses and a high diversity of herbs; the most commonly encountered include kangaroo grass (*Themeda australis*) poa tussock (*Poa sieberiana*), wallaby grasses (*Austrodanthonia* sp.) and spear-grasses (*Austrostipa* sp.). Shrubs are generally sparse or absent, though they may be locally common.	This EEC is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW.	Goulburn River NP Manobalai NR Towari NP Wingen Maid NR Wollemi NP	This EEC was not recorded in the continued underground mining area and there is no potential for it to occur. There is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Continued Underground Mining Area	Reservation in the Region	Potential to Occur / Potential for Impact	Assessment of Significance Required?
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CEEC (EPBC)	This EEC can occur as either a woodland or derived grassland (grassy woodland from which trees have been removed). 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. Sites dominated by other tree species that do not have white box, yellow box, or Blakely's red gum as co-dominants are not considered to be part of the community, except in the Nandewar bioregion. In the Nandewar Bioregion, grey box (*E. moluccana* or *E. microcarpa*) may also be dominant or co-dominant in the community.	This EEC is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW.	Goulburn River NP Manobalai NR Towari NP Wingen Maid NR Wollemi NP	This EEC was not recorded in the continued underground mining area and there is no potential for it to occur. There is no potential for an impact on this species.	No

Key:
CE = Critically endangered species
CEEC = Critically Endangered Ecological Community
E = Endangered
EEC = Endangered Ecological Community
EPBC Act = *Environment Protection and Biodiversity Conservation Act* 1999
NP = National Park
NR = Nature Reserve
P = Preliminary Determination
SCA = State Conservation Area
TSC = *Threatened Species Conservation Act* 1995
V = Vulnerable

Table 2 - Threatened Fauna Assessment

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
AMPHIBIANS						
stuttering frog *Mixophyes balbus*	E (TSC) V (EPBC)	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	Occur along the east coast of Australia from southern Queensland to the north-eastern Victoria	Wollemi NP Barrington Tops NP	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No
giant barred frog *Mixophyes iteratus*	E (TSC) E (EPBC)	This species forages and lives amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1,000 metres. They breed around shallow, flowing rocky streams.	Coast and ranges from south-eastern Queensland to the Hawkesbury River in NSW. North-eastern NSW, particularly the Coffs Harbour-Dorrigo area, is now a stronghold.	Watagans NP Jilliby SCA	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No
green and golden bell frog *Litoria aurea*	E (TSC), V (EPBC)	Occurs amongst emergent aquatic or riparian vegetation and amongst vegetation, fallen timber, including grassland, cropland and modified pastures. Breeds in still or slow flowing waterbodies with some vegetation such as *Typha* spp. and *Eleocharis* spp.	NSW North Coast near Brunswick Heads, southwards along the NSW Coast to Victoria where it extends into east Gippsland. The study area is close to the inland limit of this species' known distribution.	Hunter Wetlands NP	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
Littlejohns tree frog *Litoria littlejohni*	V (TSC) V (EPBC)	Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops.	Distribution includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest south to Buchan in Victoria.	Olney SF	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No
REPTILES						
broad-headed snake *Hoplocephalus bungaroides*	E (TSC) V (EPBC)	Nocturnal. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 metres of escarpments in summer.	The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 kilometres of Sydney.	Wollemi NP Yengo NP	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No
Stephens banded snake *Hoplocephalus stephensii*	V (TSC)	Rainforest and eucalypt forests and rocky areas up to 950 metres in altitude.	Coast and ranges from Southern Queensland to Gosford in NSW.	Watagans NP	This species has been identified during ecological surveys within one kilometre of the continued underground mining area. There is little potential for the proposed project to impact on this species however an assessment of significance has been conducted for this species due to its recorded proximity to the continued underground mining area and the identification of potential habitat.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
BIRDS						
magpie goose *Anseranas semipalmata*	V (TSC)	Mainly found in shallow wetlands (less than 1 metre deep) with dense growth of rushes or sedges. Equally at home in aquatic or terrestrial habitats; often seen walking and grazing on land.	Rare in south-eastern Australia, with an increasing number of records in central and northern NSW. Vagrants can follow food sources to south-eastern NSW.	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No
Australasian bittern *Botaurus poiciloptilus*	V (TSC)	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.).	This species may be found over most of the state except for the far north-west.	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No
black bittern *Ixobrychus flavicollis*	V (TSC)	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.	Records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland.	Munmorah SRA	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No
black-necked stork *Ephippiorhynchus asiaticus*	E (TSC)	Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries.	This species is widespread across coastal northern and eastern Australia, becoming uncommon further south into NSW, and rarely found south of Sydney.	Munmorah SRA	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
eastern osprey *Pandion cristatus*	V (TSC)	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes.	Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas.	Munmorah SRA	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an 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.	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No
little eagle *Heiraaetus 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.	Awaba SF	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
comb-crested jacana *Irediparra gallinacea*	V (TSC)	Inhabits permanent wetlands with a good surface cover of floating vegetation, especially water-lilies.	Occurs throughout coastal Australia and well inland in the north from the Kimberley to Sydney. Vagrants occasionally appear further south, possibly in response to unfavourable conditions further north in NSW.	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No
Australian pied oystercatcher *Haematopus longirostris*	V (TSC)	Favours intertidal flats of inlets and bays, open beaches and sandbanks.	This species is thinly scattered along the entire coast of NSW.	Munmorah SRA Lake Macquarie SCA	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No
lesser sand-plover *Charadrius mongolus*	V (TSC)	Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms.	Most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records.	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area and, due to its habitat requirements there is low potential for it to occur. There is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
superb fruit dove *Ptilinopus superbus*	V (TSC)	Inhabits rainforest and similar closed forests where it forages high in the canopy. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	This species occurs principally from north-eastern Queensland to north-eastern NSW. It is much less common further south, where it is largely confined to pockets of suitable habitat as far south as Moruya.	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
wompoo fruit dove *Ptilinopus magnificus*	V (TSC)	Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests.	Occurs along the coast and coastal ranges from the Hunter River in NSW to Cape York Peninsula. It is rare south of Coffs Harbour.	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
rose-crowned fruit dove *Ptilinopus regina*	V (TSC)	Occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful.	Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria.	Lake Macquarie SCA	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
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.	Lake Macquarie SCA Watagans NP Jilliby SCA	This species has been previously identified within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes
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.	Watagans NP Jilliby SCA	This species was not recorded during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the presence of likely habitat an assessment of significance has been conducted for this species.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	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.	Munmorah SCA Olney SF Awaba SF	This species was not recorded during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the presence of likely habitat an assessment of significance has been conducted for this species.	Yes
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 it forages include mugga ironbark, grey box, swamp mahogany, spotted gum, red bloodwood, narrow-leaved red ironbark, forest red gum and yellow box.	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.	Lake Macquarie SCA	This species was not recorded during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the presence of potential habitat an assessment of significance has been conducted for this species.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	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.	Lake Macquarie SCA Wallarah NP Jilliby SCA Awabakal NR	This species has previously been identified within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes
Australian painted snipe *Rostratula australis*	E (TSC)	Favours the fringes of swamps, dams and nearby marsh areas with associated grass, lignum, low-scrub or open-timber vegetation. This species nests amongst tall ground vegetation in created scrapes lined with leaves and grasses. The painted snipe forages in mud-flats and shallow waters.	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.	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	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.	Lake Macquarie SCA Watagans NP Jilliby SCA Awabakal NR	This species has been identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes
sooty owl *Tyto tenebricosa*	V (TSC)	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Nests in very large tree hollows.	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands.	Watagans NP Jilliby SCA Lake Macquarie SCA	This species was identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
brown treecreeper (eastern subsp) *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.	Awaba SF	This species was not recorded in the continued underground mining area and there is little potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
speckled warbler *Chthonicola sagittata*	V (TSC)	The speckled warbler occurs in eucalypt-dominated communities that have a grassy understorey, leaf litter and shrub cover, often on rocky ridges or in gullies.	Patchy distribution throughout south-eastern Queensland, eastern half of NSW and into Victoria, as far west as the Grampians.	Awaba SF	This species was not recorded in the continued underground mining area and there is little potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
regent honeyeater *Anthochaera phrygia*	E (TSC) E (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, its range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland.	Olney SF	This species was not recorded during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the presence of potential habitat an assessment of significance has been conducted for this species.	Yes
black-chinned honeyeater (eastern subspecies) *Melithreptus gularis gularis*	V (TSC)	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially mugga Ironbark (*Eucalyptus sideroxylon*), white box (*Eucalyptus albens*), grey box (*Eucalyptus microcarpa*), yellow box (*Eucalyptus melliodora*) and forest red gum (*Eucalyptus tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees.	The subspecies is widespread, from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond River district. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions.	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area and there is little potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	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.	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. The study area is not at the limit of this species' known distribution.	Munmorah SRA	This species was not recorded in the continued underground mining area and there is little potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
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.	Olney SF Awaba SF	This species has been identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
white-browed woodswallow *Artamus superciliosus*	V (TSC) (PD)	This species breeds in open forests and woodlands (usually eucalypt, acacia, mallee or sheoak) typically between the far western plains and inland slopes. In times of drought they tend to relocate further east to areas nearer to the coast. Their nest s a cup shape made of small twigs and plant fibres, and can be found in either an artificial structure, or a shrub or tree (living or dead) fork, vine, creeper or stump.	This species is distributed across eastern, northern and central Australia.	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area and there is little potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
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.	This species is not known to occur in any reserves in the region.	This species has been identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
flame robin *Petroica phoenicea*	V (TSC)	This species is known to breed in moist eucalypt forests and woodlands. It can usually be seen on ridges and slopes in areas where there is an open understorey layer. This species migrates during the winter to more lowland areas such as grasslands where there are scattered trees, as well as open woodland of the inland slopes and plains.	This robin is located in south-eastern Australia from the Queensland border to Tasmania and into Victoria as well as south-east SA.	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
hooded robin (south east form) *Melanodryas cucullata cucullata*	V (TSC)	This species occupies a range of eucalypt woodlands, acacia shrublands and open forests. In temperate woodlands it favours open areas adjoining large woodland blocks, with areas of dead timber and sparse shrub cover. In semi-arid western NSW, the hooded Robin favours open woodlands of belah, rosewood, mulga and cypress.	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*.	This species is not known to occur in any reserves in the region.	This species was not recorded in the continued underground mining area and there is little potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No
MAMMALS						
common planigale	V (TSC)	Common planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water.	Coastal north-eastern NSW, coastal east Queensland and Arnhem Land. The species reaches its southern distribution limit on the NSW lower north coast.	This species is not known to occur in any reserves in the region.	This species has been previously identified within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
spotted-tailed quoll *Dasyurus 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 including hollow logs, tree hollows, rocky outcrops or caves.	In NSW the spotted-tailed quoll occurs on both sides of the Great Dividing Range, with the highest densities occurring in the north east of the state. It occurs from the coast to the snowline and inland to the Murray River.	Lake Macquarie SCA Olney SF Watagans NP Heaton SF Awaba SF	This species has been previously identified within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes
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. It 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 bask 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. Its distribution roughly followed the Great Dividing Range for 2,500 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 Manobolai NR Barrington Tops NP	This species was not recorded in the continued underground mining area and, due to its habitat requirements, there is no potential for it to occur. There is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
koala *Phascolarctos cinereus*	V (TSC)	This species inhabits eucalypt forest and woodland, with suitability influenced by tree species and age, soil fertility, climate, rainfall and fragmentation patterns. The species is known to feed on a large number of eucalypt and non-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.	The koala 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. It is known to occur along inland rivers on the western side of the Great Dividing Range.	Lake Macquarie SCA Watagans NP Jilliby SCA	This species was identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes
long-nosed potoroo (SE mainland) *Potorous tridactylus tridactylus*	V (TSC) V (EPBC)	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.	This species is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range.	Mt Royal NP Barrington Tops NP	This species was not recorded in the continued underground mining area however there is potential for this species to occur. Considering the minimal disturbance to the continued underground mining area, there is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
yellow-bellied glider *Petaurus australis*	V (TSC)	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.	The yellow-bellied glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria.	Watagans NP Jilliby SCA	This species was identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes
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.	Lake Macquarie SCA Wallarah NP	This species was not recorded during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the presence of likely habitat an assessment of significance has been conducted for this species.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	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.	Grey-headed flying-foxes are found within 200 kilometres of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria.	Lake Macquarie SCA	This species was identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes
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.	This species is not known to occur in any reserves in the region.	This species was not recorded during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the presence of likely habitat an assessment of significance has been conducted for this species.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
eastern 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.	Munmorah SCA Olney SF Awaba SF	This species was identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes
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.	Lake Macquarie SCA	This species has been identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
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 centred 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.	Lake Macquarie SCA	This species was identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes
large-eared pied bat *Chalinolobus dwyeri*	V (TSC) V (EPBC)	The large-eared pied bat is generally found in a variety of drier habitats, including dry sclerophyll forests and woodlands, however, it probably tolerates a wide range of habitats. It 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.	Watagans NP	This species was identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	Assessment of Significance Required?
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.	Lake Macquarie SCA	This species was identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes
large-footed myotis *Myotis adversus*	V (TSC)	This species generally roosts in groups of 10-15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage. It forages over streams and pools catching insects and small fish by raking its feet across the water surface.	The large-footed myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 kilometres inland, except along major rivers.	Olney SF	This species was identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Potential to Occur / Potential for Impact?	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.	Munmorah SCA Olney SF Awaba SF	This species was identified during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	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 is not known to occur in any reserves in the region.	This species was not recorded during ecological surveys within the continued underground mining area. There is little potential for the proposed project to impact on this species however due to the presence of likely habitat an assessment of significance has been conducted for this species.	Yes

Key E = endangered
EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*
NP = National Park
NR = Nature Reserve
SCA = State Conservation Area
TSC = *Threatened Species Conservation Act 1995*
V = vulnerable
PD= Preliminary Determination

Based on the preliminary assessment provided in **Tables 1** and **2**; those species requiring further assessment are listed below.

Threatened Flora Species

- black-eyed Susan *Tetratheca juncea*
- small-flower grevillea *Grevillea parviflora* subsp. *parviflora*

Endangered Ecological Communities

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions
- River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions
- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion

Reptile Species

- Stephens banded snake *Hoplocephalus stephensii*

Bird Species

- glossy black-cockatoo *Calyptorhynchus lathami*
- gang-gang cockatoo *Callocephalon fimbriatum*
- little lorikeet *Glossopsitta pusilla*
- swift parrot *Lathamus discolor*
- powerful owl *Ninox strenua*
- masked owl *Tyto novaehollandiae*
- sooty owl *Tyto tenebricosa*
- regent honeyeater *Anthochaera phrygia*
- varied sittella *Daphoenositta chrysoptera*
- scarlet robin *Petroica boodang*

Mammal Species

- spotted-tailed quoll *Dasyurus maculatus*
- yellow-bellied glider *Petaurus australis*
- squirrel glider *Petaurus norfolcensis*
- koala *Phascolarctos cinereus*
- common planigale *Planigale maculata*

Mega-bat Species

- grey-headed flying-fox *Pteropus poliocephalus*

Micro-bat Species

- yellow-bellied sheathtail bat *Saccolaimus flaviventris*
- eastern freetail-bat *Mormopterus norfolkensis*
- little bentwing-bat *Miniopterus australis*
- eastern bentwing-bat *Miniopterus schreibersii oceanensis*
- large-eared pied bat *Chalinolobus dwyeri*
- eastern false pipistrelle *Falsistrellus tasmaniensis*
- large-footed myotis *Myotis adversus*
- greater broad-nosed bat *Scoteanax rueppellii*
- eastern cave bat *Vespadelus troughtoni*

APPENDIX B

Flora Species List

Appendix B – Flora Species

This Appendix lists all flora species recorded within the West Wallsend Colliery continued underground mining area during field surveys undertaken from December 2008 to March 2009. Details of the flora survey methodologies undertaken are provided in Section 3.3 of the main report. Not all species are readily detected at any one time of the year, and therefore the list will not necessarily include all plant species likely to occur in the continued underground mining area. 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;
- prob. specimens for which identification was considered highly likely but not definite; and
- poss. specimens for which identification was considered likely but not definite.

The following abbreviations or symbols are used in the list:

- asterisk (*) denotes species not indigenous to the continued underground mining area;
- subsp. subspecies; and
- var. variety.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler et al. (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2009), 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.

Family/Subfamily	Scientific Name	Common Name
Cycadopsida (Cycads)		
Zamiaceae	*Macrozamia communis*	burrawang
Filicopsida (Ferns)		
Adiantaceae	*Adiantum aethiopicum*	common maidenhair
Adiantaceae	*Adiantum formosum*	giant maidenhair
Adiantaceae	*Adiantum hispidulum*	rough maidenhair
Adiantaceae	*Cheilanthes* sp.	
Aspleniaceae	*Asplenium australasicum*	birds nest fern
Blechnaceae	*Blechnum indicum*	swamp water fern
Blechnaceae	*Blechnum* sp.	
Blechnaceae	*Doodia aspera*	prickly rasp fern
Davalliaceae	*Nephrolepsis cordifolia*	fishbone fern
Dennstaedtiaceae	*Hypolepis muelleri*	harsh ground fern
Dennstaedtiaceae	*Pteridium esculentum*	bracken

Family/Subfamily	Scientific Name	Common Name
Dicksoniaceae	*Calochlaena dubia*	common ground fern
Lindsaeaceae	*Lindsaea microphylla*	lacy wedge fern
Magnoliopsida (Flowering Plants) – Liliidae (Monocots)		
Anthericaceae	*Caesia parviflora*	pale grass-lily
Anthericaceae	*Thysanotus tuberosus*	common fringe lily
Anthericaceae	*Tricoryne elatior*	yellow autumn-lily
Araceae	*Gymnostachys anceps*	settlers flax
Asteliaceae	*Cordyline stricta*	narrow-leaved palm lily
Commelinaceae	*Commelina cyanea*	native wandering Jew
Cyperaceae	*Carex appressa*	tall sedge
Cyperaceae	*Cyperus* sp.	
Cyperaceae	*Gahnia clarkei*	tall saw-sedge
Cyperaceae	*Gahnia sieberiana*	red-fruit saw-sedge
Cyperaceae	*Gahnia* sp.	
Cyperaceae	*Lepidosperma laterale*	
Cyperaceae	*Ptilothrix deusta*	
Dioscoreaceae	*Dioscorea transversa*	native yam
Doryanthaceae	*Doryanthes excelsa*	gymea lily
Hypoxidaceae	*Hypoxis* sp.	
Iridaceae	*Patersonia sericea*	silky purple-flag
Juncaceae	*Juncus* sp.	
Lomandraceae	*Lomandra confertifolia*	mat-rush
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*	wattle mat-rush
Lomandraceae	*Lomandra longifolia*	spiny-headed mat-rush
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	many-flowered mat-rush
Lomandraceae	*Lomandra obliqua*	
Luzuriagaceae	*Eustrephus latifolius*	wombat berry
Luzuriagaceae	*Geitonoplesium cymosum*	scrambling lily
Orchidaceae	*Calochilus* sp.	
Orchidaceae	*Cymbidium suave*	snake orchid
Orchidaceae	*Dipodium variegatum*	
Phormiaceae	*Dianella caerulea* var. *producta*	blue-flax lily
Poaceae	*Andropogon virginicus*	whiskey grass
Poaceae	*Aristida* spp.	
Poaceae	*Austrodanthonia fulva*	wallaby grass
Poaceae	*Cynodon dactylon*	couch
Poaceae	*Echinopogon caespitosus*	bushy hedgehog-grass
Poaceae	*Echinopogon* sp.	
Poaceae	*Entolasia marginata*	bordered panic
Poaceae	*Entolasia stricta*	wiry panic
Poaceae	*Entolasia* sp.	
Poaceae	**Hyparrhenia hirta*	coolatai grass
Poaceae	*Imperata cylindrica*	blady grass
Poaceae	*Imperata cylindrica* var. *major*	blady grass
Poaceae	*Microlaena stipoides*	weeping grass
Poaceae	*Oplismenus aemulus*	basket grass
Poaceae	*Oplismenus imbecillis*	

Family/Subfamily	Scientific Name	Common Name
Poaceae	*Oplismenus* sp.	
Poaceae	*Panicum simile*	two-colour panic
Poaceae	*Poa affinis*	
Poaceae	*Poa labillardieri*	tussock
Poaceae	*Poa* sp.	
Poaceae	*Themeda australis*	kangaroo grass
Smilacaceae	*Smilax australis*	sarsaparilla
Smilacaceae	*Smilax glyciphylla*	sweet sarsaparilla
Xanthorrhoeaceae	*Xanthorrhoea* sp.	
Zingiberaceae	*Alpinia caerulea*	native ginger
Magnoliopsida (Flowering Plants) – Magnoliidae (Dicots)		
Acanthaceae	*Brunoniella australis*	blue trumpet
Anthericaceae	*Thysanotus sp.*	
Acanthaceae	*Pseuderanthemum variabile*	pastel flower
Apiaceae	*Hydrocotyle geranifolia*	forest pennywort
Apiaceae	*Hydrocotyle laxiflora*	stinking pennywort
Apiaceae	*Hydrocotyle* sp.	
Apiaceae	*Platysace ericoides*	
Apiaceae	*Platysace lanceolata*	shrubby platysace
Apocynaceae	*Parsonsia straminea*	common silkpod
Apocynaceae	*Parsonsia velutina*	
Araliaceae	*Polyscias sambucifolia*	elderberry panax
Asclepiadaceae	*Marsdenia* sp.	
Asparagaceae	**Asparagus aethiopicus*	asparagus fern
Asteraceae	**Ageratina adenophora*	crofton weed
Asteraceae	**Bidens pilosa*	cobblers pegs
Asteraceae	*Conyza* sp.	
Asteraceae	*Ozothamnus diosmifolius*	white dogwood
Asteraceae	*Senecio amygdalifolius*	
Asteraceae	*Senecio madagascariensis*	fireweed
Bignoniaceae	*Pandorea pandorana*	wonga wonga vine
Casuarinaceae	*Allocasuarina littoralis*	black sheoak
Casuarinaceae	*Allocasuarina torulosa*	forest oak
Celastraceae	*Maytenus silvestris*	narrow-leaved orangebark
Convolvulaceae	*Dichondra repens*	kidney weed
Convolvulaceae	*Polymeria calycina*	
Cunoniaceae	*Callicoma serratifolia*	black wattle
Cunoniaceae	*Ceratopetalum apetalum*	coachwood
Dilleniaceae	*Hibbertia aspera*	rough guinea flower
Dilleniaceae	*Hibbertia dentata*	twining guinea flower
Dilleniaceae	*Hibbertia scandens*	climbing guinea flower
Ebenaceae	*Diospyros australis*	black plum
Elaeocarpaceae	*Elaeocarpus obovatus*	hard quandong
Elaeocarpaceae	*Elaeocarpus reticulatus*	blueberry ash
Epacridaceae	*Acrotriche divaricata*	
Epacridaceae	*Epacris pulchella*	wallum heath
Epacridaceae	*Epacris* spp.	

Family/Subfamily	Scientific Name	Common Name
Epacridaceae	*Leucopogon appressus*	
Epacridaceae	*Leucopogon ericoides*	pink beard-heath
Epacridaceae	*Leucopogon lanceolatus*	
Epacridaceae	*Styphelia triflora*	pink five-corners
Epacridaceae	*Trochocarpa laurina*	tree heath
Euphorbiaceae	*Breynia oblongifolia*	coffee bush
Euphorbiaceae	*Claoxylon australe*	brittlewood
Euphorbiaceae	*Croton verreauxii*	native cascarilla
Euphorbiaceae	*Glochidion ferdinandi*	cheese tree
Euphorbiaceae	*Homalanthus populifolius*	
Euphorbiaceae	*Phyllanthus hirtellus*	
Euphorbiaceae	*Phyllanthus* sp.	
Eupomatiaceae	*Eupomatia laurina*	bolwarra
Fabaceae (Caesalpinioideae)	**Senna pendula*	cassia
Fabaceae (Faboideae)	*Bossiaea obcordata*	spiny bossiaea
Fabaceae (Faboideae)	*Daviesia genistifolia*	broom bitter pea
Fabaceae (Faboideae)	*Daviesia squarrosa*	
Fabaceae (Faboideae)	*Daviesia ulicifolia*	gorse bitter pea
Fabaceae (Faboideae)	*Desmodium gunnii*	slender tick trefoil
Fabaceae (Faboideae)	*Desmodium rhytidophyllum*	
Fabaceae (Faboideae)	*Dillwynia retorta*	
Fabaceae (Faboideae)	*Glycine clandestina*	
Fabaceae (Faboideae)	*Glycine* sp.	
Fabaceae (Faboideae)	*Glycine tabacina*	
Fabaceae (Faboideae)	*Gompholobium latifolium*	golden glory pea
Fabaceae (Faboideae)	*Gompholobium pinnatum*	pinnate wedge pea
Fabaceae (Faboideae)	*Hardenbergia violacea*	false sarsaparilla
Fabaceae (Faboideae)	*Hovea linearis*	
Fabaceae (Faboideae)	*Jacksonia scoparia*	dogwood
Fabaceae (Faboideae)	*Kennedia rubicunda*	red kennedy pea
Fabaceae (Faboideae)	*Mirbelia speciosa*	
Fabaceae (Faboideae)	*Podolobium ilicifolium*	prickly shaggy pea
Fabaceae (Faboideae)	*Pultenaea euchila*	bush-pea
Fabaceae (Faboideae)	*Pultenaea retusa*	notched bush-pea
Fabaceae (Faboideae)	*Pultenaea rosmarinifolia*	
Fabaceae (Faboideae)	*Pultenaea* sp.	
Fabaceae (Faboideae)	*Pultenaea tuberculata*	wreath bush-pea
Fabaceae (Faboideae)	*Pultenaea villosa*	hairy bush-pea
Fabaceae (Mimosoideae)	*Acacia binervata*	two-veined hickory
Fabaceae (Mimosoideae)	*Acacia falcata*	sickle wattle
Fabaceae (Mimosoideae)	*Acacia filicifolia*	fern-leaved wattle
Fabaceae (Mimosoideae)	*Acacia floribunda*	white sally
Fabaceae (Mimosoideae)	*Acacia irrorata*	green wattle
Fabaceae (Mimosoideae)	*Acacia linifolia*	white wattle
Fabaceae (Mimosoideae)	*Acacia longifolia*	Sydney golden wattle
Fabaceae (Mimosoideae)	*Acacia myrtifolia*	red-stemmed wattle

Family/Subfamily	Scientific Name	Common Name
Fabaceae (Mimosoideae)	*Acacia* sp.	
Fabaceae (Mimosoideae)	*Acacia terminalis*	sunshine wattle
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	prickly Moses wattle
Flacourtiaceae	*Scolopia braunii*	flintwood
Goodeniaceae	*Dampiera stricta*	
Goodeniaceae	*Goodenia heterophylla*	
Goodeniaceae	*Goodenia ovata*	hop goodenia
Goodeniaceae	*Goodenia* sp.	
Haloragaceae	*Gonocarpus tetragynus*	
Haloragaceae	*Gonocarpus teucrioides*	raspwort
Lamiaceae	*Plectranthus parviflorus*	
Lamiaceae	*Prostanthera incana*	velvet mint-bush
Lauraceae	*Cassytha pubescens*	
Lauraceae	*Cassytha* spp.	
Lauraceae	**Cinnamomum camphora*	camphor laurel
Lauraceae	*Cryptocarya microneura*	murrogun
Lauraceae	*Cryptocarya rigida*	forest maple
Lauraceae	*Neolitsea dealbata*	white bolly gum
Lobeliaceae	*Pratia purpurascens*	whiteroot
Meliaceae	*Synoum glandulosum*	scentless rosewood
Menispermaceae	*Sarcopetalum harveyanum*	pearl vine
Menispermaceae	*Stephania japonica*	snake vine
Moraceae	*Ficus coronata*	creek sandpaper fig
Moraceae	*Ficus rubiginosa*	Port Jackson fig, rusty fig
Myrsinaceae	*Embelia australiana*	
Myrsinaceae	*Rapanea howittiana*	brush muttonwood
Myrsinaceae	*Rapanea variabilis*	muttonwood
Myrtaceae	*Acmena smithii*	lilly pilly
Myrtaceae	*Angophora costata*	smooth-barked apple
Myrtaceae	*Backhousia myrtifolia*	grey myrtle
Myrtaceae	*Callistemon salignus*	willow bottlebrush
Myrtaceae	*Corymbia gummifera*	red bloodwood
Myrtaceae	*Corymbia maculata*	spotted gum
Myrtaceae	*Eucalyptus acmenoides*	white mahogany
Myrtaceae	*Eucalyptus capitellata*	brown stringybark
Myrtaceae	*Eucalyptus microcorys*	tallowwood
Myrtaceae	*Eucalyptus paniculata*	grey ironbark
Myrtaceae	*Eucalyptus pilularis*	blackbutt
Myrtaceae	*Eucalyptus piperita*	Sydney peppermint
Myrtaceae	*Eucalyptus punctata*	grey gum
Myrtaceae	*Eucalyptus resinifera*	red mahogany
Myrtaceae	*Eucalyptus robusta*	swamp mahogany
Myrtaceae	*Eucalyptus saligna*	Sydney blue gum
Myrtaceae	*Eucalyptus umbra*	broad-leaved white mahogany
Myrtaceae	*Leptospermum polygalifolium*	lemon-scented tea tree
Myrtaceae	*Leptospermum trinervium*	paperbark tea tree

Family/Subfamily	Scientific Name	Common Name
Myrtaceae	*Melaleuca linarifolia*	snow in summer
Myrtaceae	*Melaleuca styphelioides*	prickly-leaved tea tree
Myrtaceae	*Rhodamnia rubescens*	scrub turpentine
Myrtaceae	*Syncarpia glomulifera*	turpentine
Ochnaceae	**Ochna serrulata*	Mickey Mouse plant
Oleaceae	*Notelaea longifolia*	large mock-olive
Oleaceae	*Notelaea longifolia* forma *longifolia*	large mock-olive
Oxalidaceae	*Oxalis perennans*	
Pittosporaceae	*Billardiera scandens*	appleberry
Pittosporaceae	*Bursaria spinosa*	native blackthorn
Pittosporaceae	*Pittosporum multiflorum*	orange thorn
Pittosporaceae	*Pittosporum revolutum*	rough fruit pittosporum
Pittosporaceae	*Pittosporum undulatum*	sweet pittosporum
Plantaginaceae	**Plantago lanceolata*	lambs tongues
Polygalaceae	*Comesperma ericinum*	pyramid flower
Proteaceae	*Banksia oblongifolia*	fern-leaved banksia
Proteaceae	*Bansia spinulosa*	hairpin banksia
Proteaceae	*Banksia spinulosa* var. *collina*	hairpin banksia
Proteaceae	***Grevillea parviflora* subsp. *parviflora***	**small flowered grevillea**
Proteaceae	*Hakea dactyloides*	broad-leaved hakea
Proteaceae	*Hakea salicifolia*	willow-leaved hakea
Proteaceae	*Hakea sericea*	needlebush
Proteaceae	*Lambertia formosa*	mountain devil
Proteaceae	*Persoonia levis*	broad-leaved geebung
Proteaceae	*Persoonia linearis*	narrow-leaved geebung
Proteaceae	*Xylomelum pyriforme*	woody pear
Ranunculaceae	*Clematis aristata*	old mans beard
Ranunculaceae	*Clematis glycinoides*	headache vine
Ranunculaceae	*Ranunculus* sp.	
Rhamnaceae	*Alphitonia excelsa*	red ash
Rosaceae	*Rubus moluccanus*	molucca bramble
Rosaceae	*Rubus parvifolius*	native raspberry
Rosaceae	*Rubus* sp.	
Rubiaceae	*Morinda jasminoides*	sweet morinda
Rubiaceae	*Pomax umbellata*	
Rubiaceae	*Psychotria loniceroides*	hairy psychotria
Rutaceae	*Correa reflexa*	native fuschia
Rutaceae	*Melicope micrococca*	hairy-leaved doughwood
Rutaceae	*Phebalium squamulosum*	scaly phebalium
Santalaceae	*Exocarpos cupressiformis*	native cherry
Sapindaceae	*Alectryon subcinereus*	wild quince
Sapindaceae	*Dodonaea triquetra*	large-leaf hop-bush
Sapindaceae	*Guioa semiglauca*	guioa
Sapotaceae	*Planchonella australis*	black apple
Scrophulariaceae	*Veronica plebeia*	trailing speedwell
Solanaceae	*Solanum brownii*	violet nightshade

Family/Subfamily	Scientific Name	Common Name
Solanaceae	**Solanum mauritianum*	wild tobacco bush
Sterculiaceae	*Brachychiton populneus*	kurrajong
Sterculiaceae	*Commersonia fraseri*	brush kurrajong
Thymelaeaceae	*Pimelea linifolia*	slender rice flower
Tremandraceae	*Tetratheca ericifolia*	
Tremandraceae	***Tetratheca juncea***	**black-eyed Susan**
Verbenaceae	*Clerodendrum tomentosum*	hairy clerodendrum
Verbenaceae	**Lantana camara*	lantana
Verbenaceae	**Verbena bonariensis*	purpletop
Violaceae	*Hybanthus monopetalus*	slender violet-bush
Violaceae	*Viola betonicifolia*	native violet
Violaceae	*Viola hederacea*	ivy-leaved violet
Vitaceae	*Cayratia clematidea*	slender grape
Vitaceae	*Cissus antarctica*	water vine
Vitaceae	*Cissus hypoglauca*	giant water vine

APPENDIX C

Fauna Species List

Appendix C – Fauna Species List

This Appendix lists all fauna species recorded within the West Wallsend Colliery continued underground mining area during field surveys undertaken from December 2008 to March 2009. Details of the fauna survey methodologies undertaken are provided in Sections 3.5 and 3.6 of the main report.

The following abbreviations or symbols are used in the list:

asterisk (*) denotes species not indigenous to the continued underground mining area;

MAR Listed marine species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);

MIG Listed migratory species under the EPBC Act;

V Vulnerable under the *Threatened Species Conservation Act 1995* (TSC Act) or EPBC Act; and

E Endangered under the TSC Act or EPBC Act.

Birds recorded were identified using descriptions in Slater et al. (2003) and the scientific and common name nomenclature and taxonomy adopted by Birds Australia. Reptiles recorded were identified using keys and descriptions in Cogger (2000), Swan et al. (2004), Weigel (1990) and Wilson & Swan (2003) and the scientific and common name nomenclature and taxonomy adopted by Cogger (2000).

Amphibians recorded were identified using keys and descriptions in Cogger (2000), Robinson (1998), Anstis (2002) and Barker et al. (1995) and the scientific and common name nomenclature of Cogger (2000). Mammals recorded were identified using keys and descriptions in Strahan (2002), Churchill (1998) and Menkhorst & Knight (2004) and the scientific and common name nomenclature of Strahan (2002) for non-bat species and Churchill (1998) for bats.

Scientific Name	Common Name	Conservation Status		Source		
		TSC Act	EPBC Act	Atlas Database Searches	DEWHA Protected Matters Search	Umwelt Surveys
MAMMALS						
Tachyglossidae						
Tachyglossus aculeatus	short-beaked echidna					✓
Dasyuridae						
Dasyurus maculatus	**spotted-tailed quoll**	**V**	**E**	✓	✓	
Antechinus stuartii	brown antechinus					✓
Planigale maculata	**common planigale**	**V**		✓		✓
Sminthopsis murina	common dunnart					✓
Phascolarctidae						

Scientific Name	Common Name	Conservation Status		Source		
		TSC Act	EPBC Act	Atlas Database Searches	DEWHA Protected Matters Search	Umwelt Surveys
Phascolarctos cinereus	**koala**	**V**		✓		✓
Petauridae						
Petaurus australis	**yellow-bellied glider**	**V**		✓		✓
Petaurus breviceps	sugar glider					✓
Petaurus norfolcensis	**squirrel glider**	**V**		✓		
Pseudocheiridae						
Petauroides volans	greater glider					✓
Pseudocheirus peregrinus	common ringtail possum					✓
Phalangeridae						
Trichosurus vulpecula	common brushtail possum					✓
Potoroidae						
Potorous tridactylus	**long-nosed potoroo**	**V**	**V**		✓	
Macropodidae						
Macropus robustus	common wallaroo					✓
Wallabia bicolor	swamp wallaby					✓
Petrogale penicillata	**brush-tailed rock-wallaby**	**E**	**V**	✓		
Pteropodidae						
Pteropus poliocephalus	**grey-headed flying-fox**	**V**	**V**	✓	✓	✓
Rhinolophidae						
Rhinolophus megaphyllus	eastern horseshoe-bat					✓
Emballonuridae						
Saccolaimus flaviventris	**yellow-bellied sheathtail-bat**	**V**		✓		
Molossidae						
Mormopterus norfolkensis	**eastern freetail-bat**	**V**		✓		✓
Mormopterus sp.2	freetail bat					✓
Nyctinomus australis	white-striped freetail-bat					✓
Vespertilionidae						
Miniopterus australis	**little bentwing-bat**	**V**		✓		✓
Miniopterus schreibersii oceanensis	**eastern bentwing-bat**	**V**		✓		✓
Nyctophilus geoffroyi	lesser long-eared bat					✓

Scientific Name	Common Name	Conservation Status		Source		
		TSC Act	EPBC Act	Atlas Database Searches	DEWHA Protected Matters Search	Umwelt Surveys
Nyctophilus gouldi	Goulds long-eared bat					✓
Chalinolobus dwyeri	**large-eared pied bat**	**V**	**V**	✓	✓	✓
Chalinolobus gouldii	Goulds wattled bat					✓
Chalinolobus morio	chocolate wattled bat					✓
Falsistrellus tasmaniensis	**eastern false pipistrelle**	**V**		✓		✓
Myotis adversus	**large-footed myotis**	**V**		✓		✓
Scoteanax rueppellii	**greater broad-nosed bat**	**V**		✓		✓
Scotorepens orion	eastern broad-nosed bat					✓
Vespadelus pumilus	eastern forest bat					✓
Vespadelus troughtoni	**eastern cave bat**	**V**		✓		
Vespadelus vulturnus	little forest bat					✓
Muridae						
Rattus fuscipes	bush rat					✓
Rattus lutreolus	swamp rat					✓
Canidae						
*Vulpes vulpes**	fox					✓
BIRDS						
Phasianidae						
Coturnix ypsilophora	brown quail					✓
Anseranatidae						
Anseranas semipalmata	**magpie goose**	**V**	**MAR**	✓		
Columbidae						
Macropygia amboinensis	brown cuckoo-dove					✓
Leucosarcia melanoleuca	wonga pigeon					✓
Ptilinopus magnificus	**wompoo fruit-dove**	**V**		✓		
Ptilinopus superbus	**superb fruit-dove**	**V**	**MAR**	✓		
Ptilinopus regina	**rose-crowned fruit-dove**	**V**		✓		
Podargidae						
Podargus strigoides	tawny frogmouth					✓
Eurostopodidae						
Eurostopodus mystacalis	white-throated nightjar		MAR			✓

Scientific Name	Common Name	Conservation Status		Source		
		TSC Act	EPBC Act	Atlas Database Searches	DEWHA Protected Matters Search	Umwelt Surveys
Aegothelidae						
Aegotheles cristatus	Australian owlet-nightjar					✓
Ciconiidae						
Ephippiorhynchus asiaticus	**black-necked stork**	**E**		✓		
Ardeidae						
Botaurus poiciloptilus	**Australasian bittern**	**V**		✓		
Ixobrychus flavicollis	**black bittern**	**V**		✓		
Accipitridae						
Pandion cristatus	**Eastern osprey**	**V**	**MAR & MIG**	✓		
Haliaeetus leucogaster	white-bellied sea-eagle		MAR & MIG			✓
Aquila audax	wedge-tailed eagle		MIG			✓
Hieraaetus morphnoides	**little eagle**	**V**	**MIG**	✓		
Falconidae						
Falco peregrinus	peregrine falcon		MIG			✓
Haematopodidae						
Haematopus longirostris	**Australian pied oystercatcher**	**E**		✓		
Charadriidae						
Charadrius mongolus	**lesser sand-plover**	**V**	**MAR & MIG**	✓		
Jacanidae						
Irediparra gallinacea	**comb-crested jacana**	**V**		✓		
Rostratulidae						
Rostratula australis	**Australian painted snipe**	**E**	**MAR**	✓	✓	
Cacatuidae						
Calyptorhynchus lathami	**glossy black-cockatoo**	**V**		✓		
Callocephalon fimbriatum	**gang-gang cockatoo**	**V**		✓		
Psittacidae						
Trichoglossus haematodus	rainbow lorikeet					✓
Glossopsitta concinna	musk lorikeet					✓
Platycercus elegans	crimson rosella					✓
Platycercus eximius	eastern rosella					✓

Scientific Name	Common Name	Conservation Status		Source		
		TSC Act	EPBC Act	Atlas Database Searches	DEWHA Protected Matters Search	Umwelt Surveys
Lathamus discolor	**swift parrot**	**E**	**MAR & E**	✓	✓	
Cuculidae						
Eudynamis scolopaceus	Asian koel		MAR			✓
Scythrops novaehollandiae	channel-billed cuckoo		MAR			✓
Cacomantis pallidus	pallid cuckoo		MAR			✓
Cacomantis flabelliformis	fan-tailed cuckoo		MAR			✓
Cacomantis variolosus	brush cuckoo					✓
Strigidae						
Ninox strenua	**powerful owl**	**V**		✓		
Ninox novaeseelandiae	southern boobook		MAR/MIG			✓
Tytonidae						
Tyto tenebricosa	**sooty owl**	**V**		✓		✓
Tyto novaehollandiae	**masked owl**	**V**		✓		
Halcyonidae						
Dacelo novaeguineae	laughing kookaburra					✓
Todiramphus macleayii	forest kingfisher		MAR			✓
Coraciidae						
Eurystomus orientalis	dollarbird		MAR			✓
Menuridae						
Menura novaehollandiae	superb lyrebird					✓
Climacteridae						
Corombates leucophaea	white-throated treecreeper					✓
Climacteris picumnus victoriae	**brown treecreeper (eastern subsp.)**	**V**		✓		
Ptilonorhynchidae						
Ailuroedus crassirostris	green catbird					✓
Ptilonorhynchus violaceus	satin bowerbird					✓
Maluridae						
Malurus cyaneus	superb fairy-wren					✓
Malurus lamberti	variegated fairy-wren					✓
Stipiturus malachurus	southern emu-wren					✓

Scientific Name	Common Name	Conservation Status		Source		
		TSC Act	EPBC Act	Atlas Database Searches	DEWHA Protected Matters Search	Umwelt Surveys
Acanthizidae						
Sericornis citreogularis	yellow-throated scrubwren					✓
Sericornis frontalis	white-browed scrubwren					✓
Gerygone mouki	brown gerygone					✓
Chthonicola sagittata	**speckled warbler**	**V**		✓		
Acanthiza nana	yellow thornbill					✓
Acanthiza reguloides	buff-rumped thornbill					✓
Acanthiza pusilla	brown thornbill					✓
Pardalotidae						
Pardalotus punctatus	spotted pardalote					✓
Pardalotus striatus	striated pardalote					✓
Meliphagidae						
Acanthorhynchus tenuirostris	eastern spinebill					✓
Meliphaga lewinii	Lewins honeyeater					✓
Lichenostomus chrysops	yellow-faced honeyeater					✓
Manorina melanophrys	bell miner		MIG			✓
Ephthianura albifrons	**white-fronted chat**	**V**		✓		
Anthochaera phrygia	**regent honeyeater**	**E**	MIG & E	✓	✓	
Myzomela sanguinolenta	scarlet honeyeater					✓
Phylidonyris niger	white-cheeked honeyeater					✓
Melithreptus albogularis	white-throated honeyeater					✓
Melithreptus gularis gularis	**black-chinned honeyeater (eastern subsp.)**	**V**		✓		
Philemon corniculatus	noisy friarbird					✓
Cinclosoma punctatum	spotted quail-thrush					✓
Psophodes olivaceus	eastern whipbird					✓
Pomatostomidae						
Pomatostomus temporalis temporalis	**grey-crowned babbler (eastern subsp.)**	**V**		✓		

Scientific Name	Common Name	Conservation Status		Source		
		TSC Act	EPBC Act	Atlas Database Searches	DEWHA Protected Matters Search	Umwelt Surveys
Neosittidae						
Daphoenositta chrysoptera	**varied sittella**	**V**		✓		✓
Campephagidae						
Coracina novaehollandiae	black-faced cuckoo-shrike		MAR			✓
Pachycephalidae						
Falcunculus frontatus	crested shrike-tit		MIG			✓
Pachycephala pectoralis	golden whistler					✓
Pachycephala rufiventris	rufous whistler					✓
Colluricincla harmonica	grey shrike-thrush					✓
Oriolidae						
Oriolus sagittatus	olive-backed oriole					✓
Artamidae						
Artamus superciliosus	**white-browed woodswallow**	**PD V**		✓		
Cracticus torquatus	grey butcherbird					✓
Gymnorhina tibicen	Australian magpie					✓
Strepera graculina	pied currawong					✓
Rhipiduridae						
Rhipidura rufifrons	rufous fantail		MAR			✓
Rhipidura albiscapa	grey fantail					✓
Corvidae						
Corvus coronoides	Australian raven					✓
Monarchidae						
Myiagra cyanoleuca	satin flycatcher		MAR			✓
Monarcha melanopsis	black-faced monarch		MAR			✓
Petroicidae						
Petroica boodang	**scarlet robin**	**V**		✓		✓
Melanodryas cucullata cucullata	**hooded robin (south-eastern form)**	**V**		✓		
Eopsaltria australis	eastern yellow robin					✓
Timaliidae						
Zosterops lateralis	silvereye		MAR			✓
Nectariniidae						
Dicaeum hirundinaceum	mistletoebird					✓

Scientific Name	Common Name	Conservation Status		Source		
		TSC Act	EPBC Act	Atlas Database Searches	DEWHA Protected Matters Search	Umwelt Surveys
Estrildidae						
Neochmia temporalis	red-browed finch					✓
REPTILES						
Cheloniidae						
Chelonia mydas	**green turtle**	**V**	MAR/MIG & V	✓		
Agamidae						
Amphibolurus muricatus	jacky lizard					✓
Scincidae						
Egernia cunninghami	Cunninghams skink					✓
Eulamprus quoyii	eastern water skink					✓
Lampropholis delicata	grass skink					✓
Lampropholis guichenoti	garden skink					✓
Elapidae						
Hoplocephalus bungaroides	**broad-headed snake**	**E**	**V**		✓	
Hoplocephalus stephensii	**Stephens banded snake**	**V**		✓		
AMPHIBIANS						
Myobatrachidae						
Crinia signifera	brown froglet					✓
Limnodynastes peronii	striped marsh frog					✓
Limnodynastes tasmaniensis	spotted marsh frog					✓
Mixophyes balbus	**stuttering frog**	**E**	**V**		✓	
Mixophyes iteratus	**giant barred frog**	**E**	**E**		✓	
Pseudophryne coriacea	red-backed toadlet					✓
Hylidae						
Litoria aurea	**green & golden bell frog**	**E**	**V**		✓	
Litoria fallax	dwarf tree frog					✓
Litoria littlejohni	**Littlejohns tree frog**	**V**	**V**		✓	
Litoria verreauxii	Verreauxs tree frog					✓

TSC = *Threatened Species Conservation Act 1995*

EPBC = *Environment Protection and Biodiversity Conservation Act 1999*

E = Endangered

V = Vulnerable

PD = Preliminary Determination

APPENDIX D

EP&A Act Assessment of Significance

Appendix D - Assessment of Significance
Environmental Planning & Assessment Act 1979

Part 3A of the EP&A Act requires an assessment of significance relating to the potential impacts of project on listed threatened species, endangered populations or TECs. As a formal assessment method is yet to be established by the relevant government authorities for Part 3A projects, an assessment that applies the key principles of the Section 5A assessment is used here to assess the potential for the project to impact on threatened species, endangered populations or TECs within the continued underground mining area.

An assessment of significance is provided below for those identified threatened species or TECs recorded in the continued underground mining area or considered likely to occur based on the identification of suitable habitat (within Tables 1 and 2 of **Appendix A**). The following species are assessed:

Threatened Flora Species

- black-eyed Susan *Tetratheca juncea;*
- small-flower grevillea *Grevillea parviflora* subsp. *parviflora;*

Endangered Ecological Communities

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion;

Reptile Species

- Stephens banded snake *Hoplocephalus stephensii;*

Bird Species

- glossy black-cockatoo *Calyptorhynchus lathami;*
- gang-gang cockatoo *Callocephalon fimbriatum;*
- little lorikeet *Glossopsitta pusilla;*
- swift parrot *Lathamus discolor;*
- powerful owl *Ninox strenua;*
- masked owl *Tyto novaehollandiae;*
- sooty owl *Tyto tenebricosa;*
- regent honeyeater *Anthochaera phrygia;*

- varied sittella *Daphoenositta chrysoptera;*
- scarlet robin *Petroica boodang;*

Mammal Species

- spotted-tailed quoll *Dasyurus maculatus;*
- yellow-bellied glider *Petaurus australis;*
- squirrel glider *Petaurus norfolcensis;*
- koala *Phascolarctos cinereus*;
- common planigale *Planigale maculata;*

Mega-bat Species

- grey-headed flying-fox *Pteropus poliocephalus;*

Micro-bat Species

- yellow-bellied sheathtail bat *Saccolaimus flaviventris;*
- eastern freetail-bat *Mormopterus norfolkensis;*
- little bentwing-bat *Miniopterus australis;*
- eastern bentwing-bat *Miniopterus schreibersii oceanensis;*
- large-eared pied bat *Chalinolobus dwyeri;*
- eastern false pipistrelle *Falsistrellus tasmaniensis;*
- large-footed myotis *Myotis adversus;*
- greater broad-nosed bat *Scoteanax rueppellii; and*
- eastern cave bat *Vespadelus troughtoni.*

Assessment of Significance under EP&A Act

Threatened Species

Black-eyed Susan *Tetratheca juncea*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water

ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of black-eyed Susan, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for black-eyed Susan will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species is known to occur in Lake Macquarie SCA, Wallarah NP, Jilliby SCA and Awabakal NR. The species is not considered to be adequately reserved in the region.

d) Whether the species is at the limit of its known distribution.

The geographically restricted black-eyed Susan is considered to be at the western limit of its distribution in the continued underground mining area.

Small-flower grevillea *Grevillea parviflora* subsp. *parviflora*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities or fauna habitat, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of small-flower grevillea, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for small-flower grevillea will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species is known to occur in Olney SF. The species is not considered to be adequately reserved in the region.

d) Whether the species is at the limit of its known distribution.

The small-flower grevillea is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix A**).

Stephen's banded snake *Hoplocephalus stephensii*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of any potentially occurring Stephen's banded snake, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of potential habitat for Stephen's banded snake will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Watagans NP. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The Stephen's banded snake is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix A**).

Glossy black-cockatoo *Calyptorhynchus lathami*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of glossy black-cockatoo, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for glossy black-cockatoo will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Lake Macquarie SCA, Watagans NP and Jilliby SCA. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The glossy black-cockatoo is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix A**).

Gang-gang cockatoo *Callocephalon fimbriatum*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of any potentially occurring gang-gang cockatoo, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of potential habitat for the gang-gang cockatoo will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Watagans NP and Jilliby SCA. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The gang-gang cockatoo is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix A**).

Little lorikeet *Glossopsitta pusilla*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of any potentially occurring little lorikeet, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of potential habitat for the little lorikeet will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Munmorah SCA, Olney SF and Awaba SF. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The little lorikeet is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Swift parrot *Lathamus discolor*

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of any potentially occurring swift parrot, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of potential habitat for the swift parrot will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Lake Macquarie SCA. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The swift parrot is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Powerful owl *Ninox strenua*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the powerful owl, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for the powerful owl will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Lake Macquarie SCA, Wallarah NP, Jilliby SCA and Awabakal NR. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The powerful owl is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Masked owl *Tyto novaehollandiae*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the masked owl, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for the masked owl will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Lake Macquarie SCA, Watagans NP, Jilliby SCA and Awabakal NR. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The masked owl is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Sooty owl *Tyto tenebricosa*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the sooty owl, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for the sooty owl will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Lake Macquarie SCA, Watagans NP and Jilliby SCA. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The sooty owl is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Regent honeyeater *Anthochaera phrygia*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g.

vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of any potentially occurring regent honeyeater, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of potential habitat for the regent honeyeater will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Olney SF. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The regent honeyeater is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Varied sittella *Daphoenositta chrysoptera*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the varied sittella, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for the varied sittella will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Olney SF and Awaba SF. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The varied sittella is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Scarlet robin *Petroica boodang*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the scarlet robin, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for the scarlet robin will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

This species is not known to occur in any reserves in the region. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The scarlet robin is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Spotted-tailed quoll *Dasyurus maculatus*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the spotted-tailed quoll, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for the spotted-tailed quoll will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Lake Macquarie SCA, Olney SF, Watagans NP, Heaton SF and Awaba SF. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The spotted-tailed quoll is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Yellow-bellied glider *Petaurus australis*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the yellow-bellied glider, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for the yellow-bellied glider will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Watagans NP and Jilliby SCA. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The yellow-bellied glider is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Squirrel glider *Petaurus norfolcensis*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the squirrel glider, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for the squirrel glider will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Lake Macquarie SCA and Wallarah NP. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The squirrel glider is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Koala *Phascolarctos cinereus*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the koala, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for the koala will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Lake Macquarie SCA, Watagans NP and Jilliby SCA. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The koala is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Common planigale *Planigale maculata*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of

adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the common planigale, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for the common planigale will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has not been recorded in conservation reserves in the region. The species is not considered to be adequately represented in conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The common planigale is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Grey-headed flying-fox *Pteropus poliocephalus*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the grey-headed flying-fox, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for grey-headed flying-fox will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The grey-headed flying-fox is known to occur in Wallaroo NR, Karuah NR, Lake Macquarie SCA, Glenrock SCA and Munmorah SCA. The species is not considered to be adequately conserved in the region.

d) Whether the species is at the limit of its known distribution.

The grey-headed flying fox is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Eastern bentwing-bat *Miniopterus schreibersii oceanensis*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. While there is the potential that this species could be roosting/breeding within the clifflines of the continued underground mining area, the potential for breeding is considered to be low, given the preference for limestone clifflines displayed by this species. There is the potential that subsidence impacts could impact on roosting/breeding habitat for this species, however no evidence of roosting or breeding was recorded during surveys for this project. Therefore, the project is considered unlikely to affect the life cycle of the eastern bentwing-bat, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

No direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities. Potential subsidence impacts on potential roosting/breeding habitat for this species are likely to be minor, given the extent of similar habitat in the region. A significant area of known habitat for the eastern bentwing-bat will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Wallaroo NR, Hunter Estuary NP, Lake Macquarie SCA and Munmorah SCA. The species is not considered to be adequately conserved in the region.

d) Whether the species is at the limit of its known distribution.

The eastern bentwing-bat is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Little Bentwing-bat *Miniopterus australis*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. While there is the potential that this species could be roosting/breeding within the clifflines of the continued underground mining area, the potential for breeding is considered to be low, given the preference for limestone clifflines displayed by this species. There is the potential that subsidence impacts could impact on roosting/breeding habitat for this species, however no evidence of roosting or breeding was recorded during surveys for this project. Therefore, the project is considered unlikely to affect the life cycle of the little bentwing-bat, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

No direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities. Potential subsidence impacts on potential roosting/breeding habitat for this species are likely to be minor, given the extent of similar habitat in the region. A significant area of known habitat for the little bentwing-bat will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species has been recorded in Werakata NP and Lake Macquarie SCA. The species is not considered to be adequately conserved in the region.

d) Whether the species is at the limit of its known distribution.

The little bentwing-bat is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Eastern Freetail Bat *Mormopterus norfolkensis*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be

required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the eastern freetail bat, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for the eastern freetail bat will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The eastern freetail bat is known to occur in Munmorah SCA, Olney SF, Awaba SF and Tomaree NP, however the species is unlikely to be adequately conserved in the region.

d) Whether the species is at the limit of its known distribution.

The eastern freetail bat is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Yellow-bellied sheathtail bat *Saccolaimus flaviventris*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of any potentially occurring yellow-bellied sheathtail bats, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of potential habitat for the yellow-bellied sheathtail bat will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The yellow-bellied sheathtail bat is known to occur in Wollemi NP and Manobalai NR, however the species is unlikely to be adequately conserved in the region.

d) Whether the species is at the limit of its known distribution.

The yellow-bellied sheathtail bat is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Eastern false pipistrelle *Falsistrellus tasmaniensis*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the eastern false pipistrelle, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for the eastern false pipistrelle will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The eastern false pipistrelle is known to occur in Wollemi NP, Yengo NP and Barrington Tops NP however the species is unlikely to be adequately conserved in the region.

d) Whether the species is at the limit of its known distribution.

The eastern false pipistrelle is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Greater broad-nosed bat *Scoteanax rueppellii*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. Therefore, the project is considered unlikely to affect the life cycle of the greater broad-nosed bat, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

As no direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities, a significant area of known habitat for the greater broad-nosed bat will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The greater broad-nosed bat is known to occur in Munmorah SCA, Olney SF, Awaba SF, Wollemi NP, Yengo NP and Barrington Tops NP. The species is unlikely to be adequately conserved in the region.

d) Whether the species is at the limit of its known distribution.

The greater broad-nosed bat is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Eastern cave bat *Vespadelus troughtoni*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. While there is the potential that this species could be roosting/breeding within the clifflines of the continued underground mining area, the potential for breeding is considered to be low, given the rarity of roosting/breeding caves within the landscape. There is the potential that subsidence impacts could impact on roosting/breeding habitat for this

species, however no evidence of roosting or breeding was recorded during surveys for this project. Therefore, the project is considered unlikely to affect the life cycle of any potentially occurring eastern cave bats, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

No direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities. Potential subsidence impacts on potential roosting/breeding habitat for this species are likely to be minor, given the extent of similar habitat in the region. A significant area of potential habitat for the eastern cave bat will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The eastern cave bat is known to occur in Wollemi NP, Manobalai NR and Yengo NP however the species is unlikely to be adequately conserved in the region.

d) Whether the species is at the limit of its known distribution.

The eastern cave bat is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Large-eared pied bat *Chalinolobus dwyeri*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. While there is the potential that this species could be roosting/breeding within the clifflines of the continued underground mining area, the potential for breeding is considered to be low, given the rarity of roosting/breeding caves within the landscape. There is the potential that subsidence impacts could impact on roosting/breeding habitat for this species, however no evidence of roosting or breeding was recorded during surveys for this project. Therefore, the project is considered unlikely to affect the life cycle of the large-eared pied bat, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

No direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities. Potential subsidence impacts on potential roosting/breeding habitat for this species are likely to be minor, given the extent of similar habitat in the region. A significant

area of known habitat for the large-eared pied bat will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The large-eared pied bat is known to occur in Watagans NP, however the species is unlikely to be adequately conserved in the region.

d) Whether the species is at the limit of its known distribution.

The large-eared pied bat is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Large-footed myotis *Myotis adversus*

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

No direct clearing of native vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. While there is the potential that this species could be roosting/breeding within the clifflines of the continued underground mining area, the potential for breeding is considered to be low, given the rarity of roosting/breeding caves within the landscape. There is the potential that subsidence impacts could impact on roosting/breeding habitat for this species, however no evidence of roosting or breeding was recorded during surveys for this project.Therefore, the project is considered unlikely to affect the life cycle of the large-footed myotis, such that the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

No direct clearing of native vegetation is required for the project, and subsidence management works and surface water ponding are not expected to impact the structure and floristic composition of vegetation communities. Potential subsidence impacts on potential roosting/breeding habitat for this species are likely to be minor, given the extent of similar habitat in the region. A significant area of known habitat for the large-footed myotis will not be modified or removed, or isolated from currently interconnecting or proximate areas in a regional context.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The large-footed myotis is known from Olney SF and the species is unlikely to be adequately conserved in the region.

d) Whether the species is at the limit of its known distribution.

The large-footed myotis is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Endangered Ecological Communities

Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

a) In relation to the regional distribution of the habitat of the endangered ecological community, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

Swamp Mahogany Paperbark Forest is considered to conform to the description provided by the NSW Scientific Committee for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions Endangered Ecological Community (EEC). Swamp Mahogany Paperbark Forest is described in **Section 4.2.12** and covers an area of approximately 3 hectares.

No direct clearing of Swamp Mahogany Paperbark Forest is required for the project, with subsidence not expected to impact the structure and floristic composition of the vegetation community, although subsidence cracking may occur. The surface water assessment has identified locations where there is a potential for surface water ponding to occur. In these areas the potential surface ponding is expected to be confined to the existing channels and no out-of-channel ponding is expected as a result of the predicted subsidence. Ponding is expected to disperse through evaporation and seepage, however periods of extended ponding may occur during wet periods. Surface water ponding in Swamp Mahogany Paperbark Forest is expected to increase from 0.06 hectares, representing the current baseline conditions, to approximately 0.45 hectares. Surface water ponding resulting from subsidence is not predicted to substantially affect the floristic or structural characteristics of Swamp Mahogany Paperbark Forest. Therefore, the project is considered unlikely to result in a significant area of known habitat being modified in a regional context.

b) Whether the endangered ecological community, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

This EEC is not known from any conservation reserves in the region. The community is not considered to be adequately represented in conservation reserves in the region.

c) Whether the endangered ecological community is at the limit of its known distribution.

The community is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

River-flat Eucalypt Forest on Coastal Floodplains

a) In relation to the regional distribution of the habitat of the endangered ecological community, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

River-flat Eucalypt Forest on Coastal Floodplains was recorded on alluvium associated with Diega and Cockle Creeks, covering an area of approximately 12 hectares. The community has been described as Alluvial Tall Moist Forest and a full floristic description of this community is provided in **Section 4.2.8**.

No direct clearing of Alluvial Tall Moist Forest is required for the project, with subsidence not expected to impact the structure and floristic composition of the vegetation community, although subsidence cracking may occur. The surface water assessment has identified locations where there is a potential for surface water ponding to occur. In these areas the potential surface ponding is expected to be confined to the existing channels and no out-of-channel ponding is expected as a result of the predicted subsidence. Ponding is expected to disperse through evaporation and seepage, however periods of extended ponding may occur during wet periods. Surface water ponding in Alluvial Tall Moist Forest is expected to increase from 0.087 hectares, representing the current baseline conditions, to approximately 1.4 hectares. Surface water ponding resulting from subsidence is not predicted to substantially affect the floristic or structural characteristics of Alluvial Tall Moist Forest. Therefore, the project is considered unlikely to result in a significant area of known habitat being modified in a regional context.

b) Whether the endangered ecological community, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

There are no known occurrences of this EEC within the conservation reserves of the region. The community is not considered to be adequately represented in conservation reserves.

c) Whether the endangered ecological community is at the limit of its known distribution.

The community is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion

a) In relation to the regional distribution of the habitat of the endangered ecological community, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

Coastal Warm Temperate Rainforest within Bangalow Creek catchment is considered to conform to the description provided by the NSW Scientific Committee for Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion Endangered Ecological Community (EEC). Coastal Warm Temperate Rainforest is described in **Section 4.2.10.**

No direct clearing of Coastal Warm Temperate Rainforest is required for the project, with subsidence not expected to impact the structure and floristic composition of the vegetation community, although subsidence cracking may occur. The surface water assessment has identified locations where there is a potential for surface water ponding to occur. In these areas the potential surface ponding is expected to be confined to the existing channels and no out-of-channel ponding is expected as a result of the predicted subsidence. Ponding is expected to disperse through evaporation and seepage, however periods of extended ponding may occur during wet periods. The Surface Water Assessment (refer to **Appendix 8**) indicates that there will be no discernable difference in Surface water ponding in Coastal Warm Temperate Rainforest in the Bangalow Creek catchment following mining. Therefore, surface water ponding resulting from subsidence is not predicted to affect the floristic or structural characteristics of Coastal Warm Temperate Rainforest. Therefore, the project is considered unlikely to result in a significant area of known habitat being modified in a regional context.

b) Whether the endangered ecological community, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

There are no known occurrences of this EEC within the conservation reserves of the region. The community is not considered to be adequately represented in conservation reserves.

c) Whether the endangered ecological community is at the limit of its known distribution.

The community is not at the limit of its distribution in the continued underground mining area (refer to **Table 2** of **Appendix B**).

Key Threatening Processes

a) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

There are currently 31 key threatening processes (KTPs) listed under the Schedules of the TSC Act, as well as seven listed under the Schedules of the *Fisheries Management Act 1994*. Those KTPs with the potential to increase/be exacerbated by the project are discussed below.

- **Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands** – the project involves the likely subsidence of ephemeral drainage lines which may result in changes to surface water ponding. The surface water assessment has identified locations where there is a potential for surface water ponding to occur. In these areas the potential surface ponding is expected to be confined to the existing channels and no out-of-channel ponding is expected as a result of the predicted subsidence. Ponding is expected to disperse through evaporation and seepage, however periods of extended ponding may occur during wet periods. Changes to surface water ponding as a result of the project are not expected to detrimentally affect the flow regimes or quality of aquatic habitat within the continued underground mining area.

- **Clearing of native vegetation –** No direct clearing of vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities.

- **Ecological consequences of high frequency fires** – the project is not likely to increase the incidence of high frequency fires within the continued underground mining area.

- **Human-caused climate change** – A detailed greenhouse gas and energy assessment for the project has been undertaken. This has included an assessment of the energy and greenhouse gas emissions from the project in accordance with recognised assessment guidelines, calculation of energy consumption and greenhouse gas emissions at various operational stages, and identification of relevant management controls that can be utilised to minimise energy use and greenhouse gas emissions.

- **Loss of hollow-bearing trees** – No direct clearing of vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks).

- **Removal of dead wood and dead trees –** the project will not result in the removal dead wood and dead trees.

- **The degradation of native riparian vegetation along New South Wales water courses –** the project will not result in the direct clearing of riparian vegetation and the project aims to improve the ecological value of the riparian zone through a dedicated weed control program.

The project will not result in an increase of this KTP in the continued underground mining area.

- **Instream structures and other mechanisms that alter natural flow** – the project involves the subsidence of ephemeral drainage lines which may result in changes to surface water ponding. The surface water assessment has identified locations where there is a potential for surface water ponding to occur. In these areas the potential surface ponding is expected to be confined to the existing channels and no out-of-channel ponding is expected as a result of the predicted subsidence. Ponding is expected to disperse through evaporation and seepage, however periods of extended ponding may occur during wet periods. Changes to surface water ponding as a result of the project are not expected to detrimentally affect the natural flow regimes or quality of aquatic habitat within the continued underground mining area.

- **Alteration of habitat following subsidence due to longwall mining** – No direct clearing of vegetation is required for the project, with subsidence not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. The subsidence related impacts, including changes to the ponding regimes within drainage lines are not expected to result in the substantial alteration to habitat such that native flora and fauna species are significantly impacted.

- **Invasion and establishment of exotic vines and scramblers** – the project will not result in the in the invasion and establishment of exotic vines and scramblers as disturbance and degradation of native vegetation communities is not expected to occur as a result of the project.

- **Invasion, establishment and spread of *Lantana camara*** - the project will not result in the in the further invasion and spread of Lantana camara, which is known to occur as a significant weed in riparian and ecotone communities within the continued underground mining area. The Ecological Assessment proposes that annual weed monitoring of the continued underground mining area be undertaken, with a focus on Lantana camara. Annual monitoring and control of this species will ensure that the spread of Lantana camara is restricted throughout the continued underground mining area.

- **Invasion of native plant communities by *Chrysanthemoides monilifera* (bitou bush and boneseed)** - the project will not result in the in the invasion of native plant communities by *Chrysanthemoides monilifera* as disturbance and degradation of native vegetation communities is not expected to occur as a result of the project and annual weed monitoring will be undertaken.

Critical Habitat

a) Will critical habitat be affected?

The following listings are currently present on the critical habitat register:

- Critical habitat declaration – final
  - Gould's Petrel;
  - Little penguin population in Sydney's North Harbour;
  - Mitchell's Rainforest Snail in Stotts Island Nature Reserve; and
  - Wollemi Pine.

- Critical habitat recommendation - pending finalisation
  - *Bomaderry zieria* within the Bomaderry bushland;
  - Eastern Suburbs Banksia Scrub Endangered Ecological Community; and
  - *Wollemia nobilis* (the Wollemi pine).

Critical habitat will not be affected by the project.

Conclusion

The project is not expected to have a significant impact on threatened species or EECs. No direct clearing of vegetation is required for the project, and subsidence is not expected to impact the structure and floristic composition of vegetation communities and fauna habitats, although some subsidence cracking is likely to occur. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would not be required in areas of intact vegetation with works typically limited to public access areas (e.g. vehicle tracks). Surface water ponding resulting from subsidence is expected to be confined to channels thus is not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities. The subsidence related impacts, including changes to the ponding regimes within drainage lines are not expected to result in the substantial alteration to habitat such that threatened flora and fauna species, populations or EECs are significantly impacted.

APPENDIX E

EPBC Act Assessment of Significance

Appendix E – Assessment of Significance under the *Environment Protection and Biodiversity Conservation Act 1999*

A search of the Department of the Environment, Heritage, Water and the Arts (DEWHA) Protected Matters Database (22 April 2010) identified (discounting fishes, marine and migratory wetland species) 21 EPBC Act listed threatened species, seven migratory species and one threatened ecological community (TEC) known to occur or considered likely to occur, on the basis of habitat modelling, within 10 kilometres of the continued underground mining area.

Of the 21 threatened species identified from the DEWHA database search, 11 were found to have potential to occur within the continued underground mining area, being: regent honeyeater (*Anthochaera phrygia*), swift parrot (*Lathamus discolour*), large-eared pied bat (*Chalinolobus dwyeri*), spotted-tailed quoll (*Dasyurus maculatus maculatus*) (SE mainland form), long-nosed potoroo (SE mainland) (*Potorous tridactylus tridactylus*), grey-headed flying-fox (*Pteropus poliocephalus*), leafless tongue-orchid (*Cryptostylis hunteriana*), small flowered grevillea (*Grevillea parviflora* subsp. *parviflora*), eastern underground orchid (*Rhizanthella slateri*), magenta lilly pilly (*Syzygium paniculatum*), black-eyed Susan (*Tetratheca juncea*).

All seven migratory species identified from the DEWHA database search were found to have moderate to high potential to occur within the continued underground mining area, four of these species were recorded within the continued underground mining area during the field surveys. These were the white bellied sea eagle (*Haliaeetus leucogaster*), black-faced monarch (*Monarcha melanopsis*), satin flycatcher (*Myiagra cyanoleuca*) and rufous fantail (*Rhipidura rufifrons*). The remaining three species have potential to occur within the continued underground mining area, being; the white-throated needletail (*Hirundapus caudacutus*), rainbow bee-eater (*Merops ornatus*) and regent honeyeater (*Anthochaera phrygia*).

The one TEC identified from the DEWHA database search, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, was not considered to have potential to occur and therefore was not assessed.

An assessment of the potential impacts of the proposed development is provided below for threatened and migratory species identified from the DEWHA database search. The assessment is based on the disturbance of five hectares disturbed habitat and the potential of long term impacts from subsidence within the continued underground mining area.

The aim of this assessment is to determine whether the proposed underground mining operation at West Wallsend Colliery is likely to have a significant impact on EPBC Act matters of national environmental significance (MNES). In this instance, MNES with potential to occur within the continued underground mining area include:

- listed threatened species (including endangered and vulnerable species); and
- listed migratory species.

Each category is addressed separately below.

Endangered Species

The following EPBC Act listed endangered species are considered in this assessment:

- eastern underground orchid (*Rhizanthella slateri*);
- spotted-tailed quoll (*Dasyurus maculatus maculatus*) (SE mainland form);
- swift parrot (*Lathamus discolor*); and
- regent honeyeater (*Anthochaera phrygia*).

An assessment in accordance with the DEWHA principal significant impact guidelines is provided below for these species.

In this case, a *population* means:

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

The proposed underground mining project will result in the disturbance of approximately five hectares of potential habitat for the above listed species. Based on the known habitats within the continued underground mining area, and ecological knowledge of the local area, these potentially occurring species are not likely to comprise a *population* according to the above criterion. One of the four species listed above was recorded in the continued underground mining area, being the spotted-tailed quoll (*Dasyurus maculatus maculatus*) (SE mainland form). The other three species have potential habitat within the continued underground mining area, and are known to occur in the locality. The continued underground mining area does not contain a geographically distinct regional population, or collection of local populations of these species, and does not contain a regional population, or collection of local populations of this species that occur within the Sydney Basin bioregion.

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

- **lead to a long-term decrease in the size of a *population*; or**

The spotted-tailed quoll (*Dasyurus maculatus maculatus*) (SE mainland form) was recorded in the continued underground mining area, most recently in 2006. The other three species have potential habitat within the continued underground mining area, and are known to occur in the locality. Given the small area of impact and the large amounts of similar habitat adjacent to the continued underground mining area, the proposed underground mining project is not likely to result in a long-term decrease in a *population* of the endangered species listed above.

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

The proposed underground mining project will reduce a small area (approximately five hectares) of potential habitat for these endangered species, however this reduction is not considered to be significant. Substantial areas of similar potential habitats for these species are protected within the adjacent Sugarloaf State Conservation Area.

Given the relatively small area of the disturbance and the large areas of similar habitats protected within the adjacent Sugarloaf State Conservation Area, the proposed underground mining project is not likely to substantially reduce the area of occupancy of a *population* of these species.

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

The proposed underground mining project is not likely to fragment an existing population of these endangered species into two or more populations. Substantial areas of similar potential habitats for these species are protected within the adjacent Sugarloaf State Conservation Area.

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

Considering the small area of disturbance (approximately five hectares), the proposed underground mining project is not likely to adversely affect habitat critical to the survival of these endangered species.

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

Considering the small area of disturbance (approximately five hectares), the proposed underground mining project is not likely to disrupt the breeding cycle of a population of these endangered species.

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

Considering the small area of disturbance (approximately five hectares), the proposed underground mining project is not likely to modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that these endangered species is likely to decline.

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

Low numbers of invasive species occur within the continued underground mining area and surrounding Sugarloaf State Conservation Area. The species of most potential to become invasive is lantana (*Lantana camara*). The proposed underground mining project is not likely to result in significant increase in the extent this species. Recommendations have been made to undertake weed monitoring as part of an annual monitoring program (refer to **Section 5.10.3** and **Section 6.0** of this report) to ensure that no invasive species become established to the detriment of endangered species.

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

Considering the small area of disturbance (approximately five hectares), the proposed underground mining project is not likely to interfere with the recovery of these species.

Vulnerable Species

The following EPBC Act listed vulnerable species are considered in this assessment:

- black-eyed Susan (*Tetratheca juncea*);
- small flowered grevillea (*Grevillea parviflora* subsp. *parviflora*);
- leafless tongue orchid (*Cryptostylis hunteriana*);
- magenta lilly pilly (*Syzygium paniculatum*);
- long-nosed potoroo (SE mainland) (*Potorous tridactylus tridactylus*);
- grey-headed flying-fox (*Pteropus poliocephalus*); and
- large-eared pied bat (*Chalinolobus dwyeri*).

An assessment in accordance with the DEWHA principal significant impact guidelines is provided below for these species.

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

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

Of the above-listed vulnerable species, black-eyed Susan, small flowered grevillea, grey-headed flying-fox and large-eared pied bat were recorded within the continued underground mining area. The other species were found to have potential to occur, based on suitable habitat and/or local records. The records of the small flowered grevillea, grey-headed flying-fox and large-eared pied bat are not considered to comprise part of an *important population* (according to the above criterion) within the continued underground mining area, as all of the recorded species are known to occur broadly within similar habitats across the lower Hunter Valley region.

Black-eyed Susan, however has a restricted distribution and the continued underground mining area is considered to be nearing the western limit of the species' distribution. Therefore, the population of black-eyed Susan in the proposed underground mining area is considered to comprise an *important population*.

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

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

The proposed underground mining project will result in the disturbance of approximately five hectares of known habitat for the black-eyed Susan, small flowered grevillea, grey-headed flying-fox and large-eared pied bat, as well as potential habitat for leafless tongue orchid, magenta lilly pilly and long-nosed potoroo (SE mainland).

Both the black-eyed Susan and small flowered grevillea are recorded widely in the lower Hunter region. The small area of direct impact, and predicted minimal impacts from subsidence are not likely to result in a long-term decrease in an *important population* of these species.

No records of roosting/breeding camps of the grey-headed flying-fox were recorded from the continued underground mining area. As such, the project only has the potential to directly impact on foraging habitats for this species. The small area of impact, and predicted minimal impacts from subsidence are not likely to result in a long-term decrease in an *important population* of this species.

The large-eared pied bat was recorded via call detection from two locations in the northern parts of the continued underground mining area. This species has the potential to be roosting/breeding within the clifflines of the area, however no evidence of this has been recorded during surveys. The small area of impact will only affect a small amount of disturbed foraging habitat for this species. The predicted impacts from subsidence may cause an impact to potential roosting/breeding habitat within clifflines, however this is not likely to result in a long-term decrease in an *important population* of this species.

Substantial areas of similar potential habitats for these species are protected within the adjacent Sugarloaf State Conservation Area. Given the large adjacent area of similar habitat adjacent the continued underground mining area to the north and west the proposed underground mining project will not result in a long-term decrease in an *important population* of these vulnerable species.

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

The proposed underground mining project will result in the disturbance of approximately five hectares of potential or known habitat for the above-listed species. Given the relatively small area of the disturbance and the large areas of similar habitats protected within the adjacent Sugarloaf State Conservation Area, the proposed underground mining project is not likely to reduce the area of occupancy of an *important population* of the black-eyed Susan, small flowered grevillea, grey-headed flying-fox or large-eared pied bat.

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

Due to the small size of the proposed disturbance (approximately five hectares), and the substantial size of the adjacent remnant comprising Sugarloaf State Conservation Area, the proposed underground mining project is not likely to fragment an existing *important population* of black-eyed Susan, small flowered grevillea, grey-headed flying-fox or large-eared pied bat into two or more populations.

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

The continued underground mining area does not contain habitats that are critical to the survival of the black-eyed Susan, small flowered grevillea, grey-headed flying-fox or large-eared pied bat. The adjacent Sugarloaf State Conservation Area protects a large area of similar habitats to those present within the continued underground mining area.

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

The proposed underground mining project does not comprise actions that would disrupt the breeding cycle of the black-eyed Susan, small flowered grevillea or the grey-headed flying-fox. If the large-eared pied bat was shown to be breeding in the clifflines of the continued underground mining area, the potential subsidence could impact on a breeding cave directly

by way of cracking (and associated impacts), or indirectly by alterations to microclimate. No evidence of breeding or roosting of this species has been observed during surveys for this project. The potential for breeding would be the same as for the adjoining cliffline habitats of the broader region.

The continued underground mining area does not support an *important population* for these species.

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

The proposed underground mining project does not comprise actions that would be likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat for black-eyed Susan, small flowered grevillea or the grey-headed flying-fox to the extent that they are likely to decline. If the large-eared pied bat was shown to be breeding in the clifflines of the continued underground mining area, the potential subsidence could impact on a breeding cave directly by way of cracking (and associated impacts), or indirectly by alterations to microclimate. If this was to happen, it is not likely that this would cause the species, as a whole, to decline. No evidence of breeding or roosting of this species has been observed during surveys for this project. The potential for breeding would be the same as for the adjoining cliffline habitats of the broader region.

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

Low numbers of invasive species occur within the continued underground mining area and surrounding Sugarloaf State Conservation Area. The species of most potential to become invasive is lantana (*Lantana camara*). The proposed underground mining project is not likely to result in significant increase in the extent this species. Recommendations have been made to undertake weed monitoring as part of an annual monitoring program (refer to **Section 5.10.3** of this report) to ensure that no invasive species become established to the detriment of black-eyed Susan, small flowered grevillea, grey-headed flying-fox or large-eared pied bat.

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

The disturbance of a relatively small area of habitat as a result of the proposed underground mining project will not interfere substantially with the recovery of the black-eyed Susan, small flowered grevillea, grey-headed flying-fox or large-eared pied bat.

Migratory Species

The following EPBC Act listed migratory species are considered in this assessment:

- white-bellied sea-eagle (*Haliaeetus leucogaster*);
- black-faced monarch (*Monarcha melanopsis*);
- satin flycatcher (*Myiagra cyanoleuca*);
- rufous fantail (*Rhipidura ruffifrons*);
- white-throated needletail (*Hirundapus caudacutus*);

- rainbow bee-eater (*Merops ornatus*); and

- regent honeyeater (*Anthochaera phrygia*).

An assessment in accordance with the DEWHA principal significant impact guidelines is provided below for these species.

An area of *important habitat* is:

- **habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or**

- **habitat that is of critical importance to the species at particular life-cycle stages; and/or**

- **habitat utilised by a migratory species which is at the limit of the species range; and/or**

- **habitat within an area where the species is declining.**

Four of the above-listed species were recorded within the continued underground mining area during the field surveys; the white bellied sea eagle (*Haliaeetus leucogaster*), black-faced monarch (*Monarcha melanopsis*), satin flycatcher (*Myiagra cyanoleuca*) and rufous fantail (*Rhipidura rufifrons*). The remaining three species have potential to occur within the continued underground mining area. The continued underground mining area is not considered to comprise *important habitat* for the listed migratory species, based on the DEWHA criteria described above.

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

- **substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of *important habitat* for a migratory species;**

The proposed underground mining project will require disturbance of a small area of potential habitat for migratory species, approximately five hectares. Large areas of similar habitats are protected within the adjoining Sugarloaf State Conservation Area.

Given the small area of potential habitat to be removed, the highly mobile nature of these species, and the significant area of habitat conserved within the locality, the proposed underground mining project would not substantially modify, destroy or isolate an area of *important habitat* for a migratory species.

- **result in an invasive species that is harmful to the migratory species becoming established in an area of *important habitat* for the migratory species; or**

There are very low numbers of invasive species within the continued underground mining area and surrounding Sugarloaf State Conservation Area. The species of most potential to become invasive is lantana (*Lantana camara*). The proposed underground mining project is not likely to result in significant increase in the extent this species. Recommendations have been made to undertake weed monitoring as part of an annual monitoring program (refer to

Section 9.1 of this report) to ensure that no invasive species become established to the detriment of vulnerable species. The continued underground mining area is not considered to comprise *important habitat* for the listed migratory species.

- **seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species**

The proposed underground mining project will require the disturbance of a small area of potential migratory species habitat, approximately five hectares. The continued underground mining area is not considered to comprise *important habitat* for the listed migratory species. The disturbance of the relatively small area of habitat will not interfere substantially with the lifecycle of an ecologically significant proportion of the population of these migratory species.

Conclusion

The proposed underground mining project will not result in a significant impact on recorded or potential EPBC Act listed threatened species or migratory species.