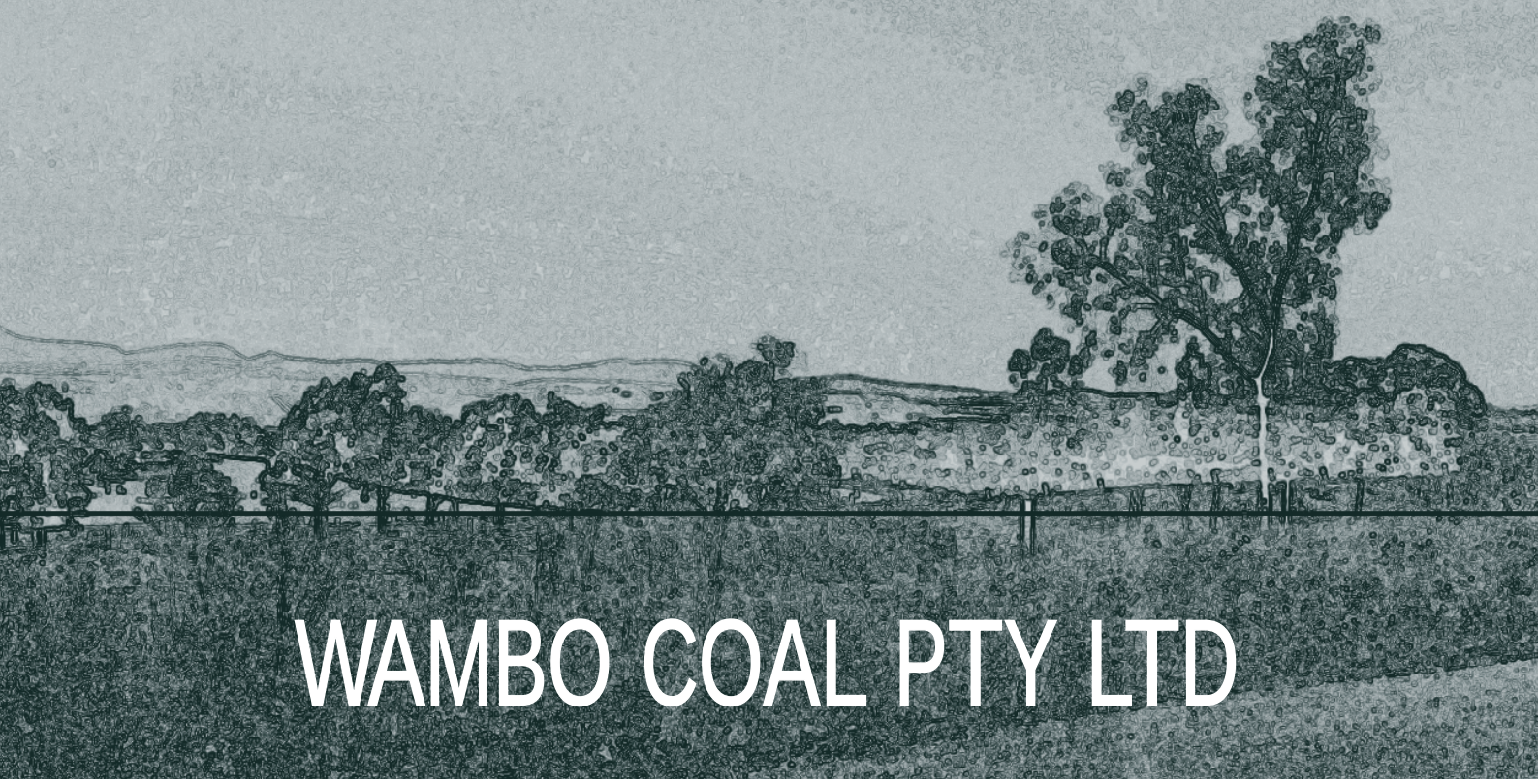

WAMBO COAL PTY LTD

NORTH WAMBO UNDERGROUND MINE
LONGWALL 10A MODIFICATION

ENVIRONMENTAL ASSESSMENT

APPENDIX F

Fauna Assessment

Peabody ENERGY

niche
Environment and Heritage

North Wambo Underground Mine

Longwall 10A Modification – Fauna Assessment

Prepared for Wambo Coal Pty Limited

Document control

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Cover photograph: surface above proposed Longwall 10A.

Executive Summary

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Wambo Coal Pty Limited (WCPL) to conduct a fauna assessment to determine the impact of a proposed Longwall 10A at the North Wambo Underground Mine on biodiversity (i.e. potential impacts of subsidence). The Longwall 10A Modification, which requires a modification of consent (DA 305-7-2003), involves an additional longwall in the Wambo Seam, contiguous with the existing North Wambo Underground Mine.

Method

The results of prior comprehensive fauna surveys and monitoring programs conducted within and adjacent to the study area were reviewed and documented. Supplementary habitat assessments and opportunistic fauna surveys were completed on 10 June 2014 to verify the relevance of prior fauna surveys to this impact assessment. Where necessary a precautionary approach (regarding the potential presence of threatened species) was adopted in the impact assessments where scientific uncertainty was identified.

Results

A total of 30 vertebrate fauna species were recorded during the one day field survey comprising 27 birds, two mammals and one frog. No threatened species were recorded. These observations were from habitats consisting of cleared grazing land, small constructed dams, regenerating and mixed aged woodland, riparian vegetation and ephemeral watercourses.

The study area has been impacted previously through clearing and alterations to natural aquatic habitat. Although the visual condition of aquatic habitats appear disturbed, monitoring conducted in 2013 found aquatic communities within the Wambo Creek (also known as South Wambo Creek) as similar to reference condition (Niche 2014e). The catchment of Wambo Creek is the largest in the Wambo Coal Mine area and of the ephemeral/semi-permanent streams feeding Wollombi Brook, has longer periods of sustained surface water connectivity (Niche 2013). Wambo Creek also contains two species of native fish (Niche 2013).

Impacts

Subsidence impacts to Wollombi Brook and North Wambo Creek are expected to be minimal; however Wambo Creek is predicted to experience greater subsidence. The maximum approved subsidence in Wambo Creek is 1,600 millimetres while the maximum predicted additional subsidence as a result of the Project is 900 millimetres. Subsidence in Wambo Creek may result in increased ponding and stream slope with the latter potentially resulting in increased erosion and downstream sediment deposition. These changes in hydraulic and geomorphic conditions may have an impact on aquatic biodiversity in areas within Wambo Creek subject to potential predicted Longwall 10A subsidence. Impacts may primarily be on aquatic invertebrate communities and commonly occurring fish species via disruption of existing habitat through a reduction in the condition of habitat features such as semi-permanent pools. Further details regarding potential impacts and mitigation measures are provided in Sections 5 and 6 of this report. WCPL has committed to undertake stream mitigation works to address these potential erosion related impacts if monitoring indicates it is required (Evans and Peck, 2014).

Assessment

There is limited habitat for threatened species within the study area. The intensity and extent of subsidence impacts on native vegetation and associated habitats is expected to be minimal when considered in a landscape context, restricted to surface cracking of up to 100 millimetres in diameter and slumping. As such it is considered unlikely that there would be a significant impact on threatened or migratory species listed under the New South Wales *Threatened Species Conservation Act, 1995,* the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and/or the New South Wales *Fisheries Management Act 1994.*

Mitigation and Offsetting

Biodiversity offsetting is considered unnecessary as it is considered unlikely that the proposed longwall and associated subsidence impacts would result in a significant impact on terrestrial and aquatic fauna. Short, medium and long term mitigation measures are recommended to minimise the effects of subsidence on the natural environment (e.g. revegetation of riparian corridor). These strategies should include those adopted for the North Wambo Underground Mine in conjunction with existing stream health initiatives and riparian restoration measures described in the existing riparian and aquatic management plans and monitoring programs.

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1. Introduction

1.1 Background

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Wambo Coal Pty Limited (WCPL) to prepare a fauna and aquatic impact assessment for the proposed Longwall 10A forming part of the approved North Wambo Underground Mine (the Project). The Project is a modification to existing consent DA 305-7-2003 approved in 2004. The Project is to be assessed as a section 75W modification under the repealed Part 3A of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.2 Project Description

The Project is located near the village of Warkworth in the Hunter Valley region of NSW, approximately 15 kilometres (km) west of Singleton, in the Singleton Local Government Area (LGA) (Figure 1). Proposed is an additional longwall panel in the Wambo seam adjacent to the existing North Wambo Underground Mine (Longwall 10A) (Figure 2). Access to the additional longwall panel would be via the existing North Wambo Underground Mine. The Project would use the existing surface infrastructure of North Wambo Underground Mine.

1.3 Objectives

The aim of this fauna and aquatic impact assessment is to determine whether or not the Project is likely to have a significant impact on threatened or migratory species listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act), NSW *Fisheries Management Act 1994* (FM Act) and/or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The assessment has been prepared with reference to relevant NSW guidelines for Part 3A projects to determine if a "maintain or improve" outcome for biodiversity is achieved and to the Federal significant impact criteria guidelines (Commonwealth Department of the Environment [DotE] 2013). Tasks undertaken as part of this assessment are listed below:

- Undertake a background review of relevant literature and a review of relevant databases and mapping;
- Describe the ecological values of the site for fauna;
- Quantify and describe the ecological impacts of the Project on fauna;
- Assess the likelihood of occurrence of fauna species listed as threatened under the TSC Act, FM Act and/or EPBC Act to be informed through a review of previous surveys, assessment of habitat to be impacted and a review of the ecology of individual species;
- Report on the methods and results of the fauna surveys;
- Prepare impact assessments under NSW (i.e. thresholds assessments under the TSC Act) and Commonwealth Significant Impact Criteria under the EPBC Act (DotE 2013) to determine the impacts (if any) from longwall subsidence and clearing of native vegetation for surface infrastructure on threatened fauna; and
- Provide recommendations to avoid, mitigate and/or offset the impacts of the Project on threatened fauna, if required.

1.4 Regional Setting

Typically, the Hunter Valley is characterised as a heavily cleared landscape, this being the result of agriculture and coal mining. The remaining native vegetation is in variable condition with very few areas considered to be in pre-European settlement condition. Conditions within the study area are generally consistent with that found in the wider regional setting, although the effects of agriculture have been lessened by reduced grazing intensity within this area as a result of the Remnant Woodland Enhancement Program (RWEP) which has been in existence for approximately 10 years.

The Wollemi National Park is located to the west of the study area which forms part of the Greater Blue Mountains World Heritage Area. This area is biologically and geologically distinct from the study area, comprising of steep sandstone cliffs and ridges and drier vegetation.

1.5 Definitions

The following definitions are adopted from *Threatened Species Assessment Guidelines: The Assessment of Significance* (NSW Department of Environment and Climate Change [DECC] 2007):

Subject Site: the area to be directly affected by the Project - being Longwall 10A. The Project will result in subsidence impacts to approximately 84 ha of derived grasslands with scattered trees, 7 ha of regenerating woodland and 3 ha of riparian habitat.

Study Area: is the subject site and any additional areas which may potentially be affected by the Project - being the extent of subsidence due to Longwall 10A, and downstream waterways that may experience impacts due to subsidence along creeks within the area of subsidence. The extent of subsidence is depicted in Figure 2.

Direct Impacts: are those that directly affect the habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat. No direct impacts would occur from this Project, due to the Project consisting only of longwall mining. No native vegetation would be removed.

Indirect Impacts: indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas. Indirect impacts for this Project would consist primarily of subsidence from longwall mining.

Local Population: the local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area. The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time.

Locality: the area within 10 km of the study area.

Local Occurrence: the ecological community that occurs within the study area. However, the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated. For the purposes of this assessment, the local occurrence of habitat is considered to be 10 km from the subject site.

1.6 Legislative Context

1.6.1 State

The assessment of the Project will be carried out for determination under section 75W under the repealed Part 3A of the EP&A Act. Threatened biodiversity as listed under the TSC Act and FM Act have been considered in this assessment.

Other NSW legislation which is relevant to biodiversity conservation and assessment includes the NSW *National Parks and Wildlife Act 1974* and *State Environmental Planning Policy No. 44 Koala Habitat Protection* (SEPP 44).

1.6.2 Commonwealth of Australia

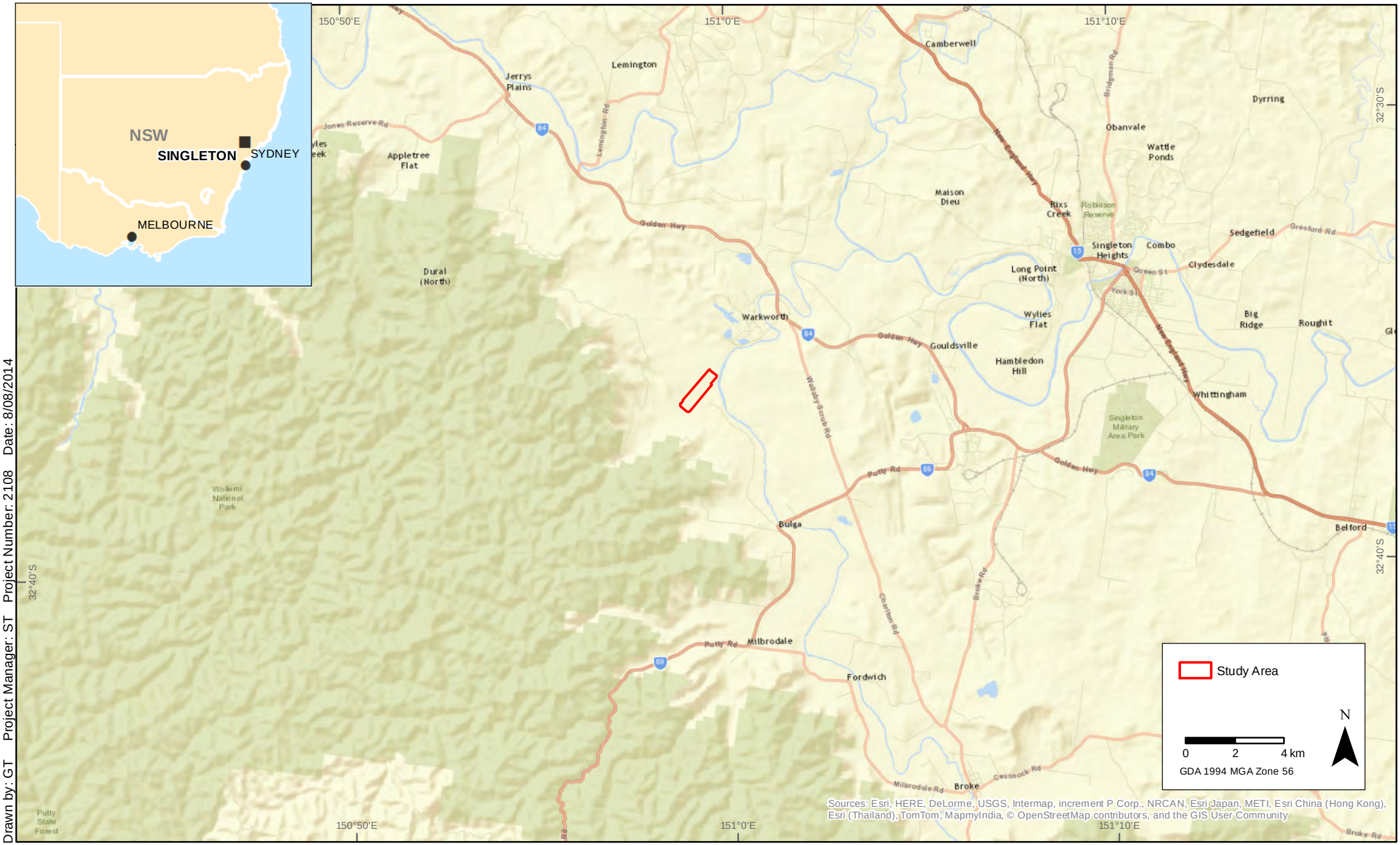
Impact assessments (Assessments of Significance) have been completed for threatened and/or migratory species listed under the EPBC Act with a moderate or greater likelihood of occurrence within the study area. Species considered to have only a low likelihood of occurrence were not assessed because, if individuals are present now or at any time, they would be so few or infrequently occurring such that the development would not have a significant impact on the population.

1.7 Approach to Field Survey and Impact Assessment

The field survey consisted habitat assessments in order to determine the likelihood of occurrence of threatened species. The field survey did not include any targeted or systematic survey techniques for threatened species. Instead, there has been a reliance on prior survey results prepared for the Wambo Coal Mine precinct that has included extensive field survey data collected over the previous 10 years within 2 km of the study area. For example, ultrasonic bat detection or trapping was not undertaken during this study as these techniques have previously been conducted within and immediately adjacent to the study area in May and September 2011 (Niche 2012) and continuously in the RWEP areas since 2006.

The results of the habitat assessments were aligned with prior survey findings to increase the certainty of assessment conclusions. A conservative assessment has been made for threatened fauna species that are cryptic or difficult to detect thereby minimising the potential for an invalid impact assessment.

The aquatic fauna was not specifically sampled for this study. However, recent monitoring data collected in autumn and spring 2013 from sites located within North Wambo Creek and Wambo Creek has been used and is considered sufficient to determine aquatic fauna likely to be present within the streams in the study area and to assess potential subsidence impacts to stream fauna (Niche 2012, 2013).



Drawn by: GT Project Manager: ST Project Number: 2108 Date: 8/08/2014

Regional Project Location

North Wambo Underground Longwall 10a

FIGURE 1

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Path: T:\spatial\projects\a2100\a2108_Wambo_LW10a\Maps\2108_Figure_1_StudyArea.mxd

Drawn by: GT Project Manager: ST Project Number: 2108 Date: 8/08/2014

Study Area

North Wambo Underground Longwall 10a

FIGURE 2

niche Environment and Heritage

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Imagery: (c) Wambo Coal PL

2. Background Information

2.1 The Study Area

2.1.1 Landscape Context

The study area lies within the northern part of the Sydney Basin bioregion. The study area occurs within the Central Hunter Foothills Landscape (Mitchell 2002), which occurs around the base of the escarpment to the west, and the Central Hunter Alluvial Plains Landscape (Mitchell 2002) which occurs around the flatter areas associated with the main drainage features.

2.1.2 Topography and Drainage

Four main watercourses occur within the study area and surrounds, comprising three ephemeral drainage lines generally flowing from west to east that ultimately join into the permanent Wollombi Brook that is located immediately east of the study area. Parts of Stony Creek, Wambo Creek and North Wambo Creek occur along the edge or within the study area and all flow into Wollombi Brook. The catchment of Wambo Creek is the largest in the Wambo Coal Mine area and of the ephemeral streams can be considered semi-permanent as it has considerable periods of surface water connectivity and pool longevity (Niche 2013). Stony Creek, a tributary of Wambo Creek, is often completely dry. North Wambo Creek, Stony Creek and Wambo Creek have been modified by prior underground mining and subsidence. North Wambo Creek has also been modified by stream realignments due to approved surface activities. There are periods of stream connectivity after rain events, however the system is mostly disconnected with few long standing pools.

2.1.3 Geology and Soils

The study area is situated within the Late Permian age coal measures of the Singleton Supergroup which, in addition to coal, comprise mainly shale, sandstone, siltstone, mudstone and conglomerate. Soil mapping by Kovac and Lawrie (1991) identifies the Bulga Soloths Soil Landscape as occurring in the study area.

Bulga Soloths. This Soil Landscape occurs on the lowest elevations of the study area on gently undulating terrain. It is formed in colluvial material derived from the steep slopes of the Lees Pinch Soil Landscape. The underlying geological unit is the Singleton Coal Measures with overlying colluvium from Narrabeen Sandstone. It comprises sandstone, conglomerate, red and green claystone, shale, mudstone and coal. On the study area it occupies the low flat valleys of North Wambo Creek, Wambo Creek and Stony Creek. The soils formed from weathered parent rock and derived colluvium, include soloths on upper slopes, solodic soils on mid slopes and brown earths on lower slopes.

This soil landscape is prone to erosion due to small particle sizes.

2.1.4 Climate

Annual rainfall averages 645 millimetres (mm) at Jerrys Plains, to the north-west of the study area (Bureau of Meteorology [BoM] 2014). While significant rain may occur at any time of the year, on average it is summer dominant, with January being the highest rainfall month. Evaporation is of the order of 1,600 mm per annum, or 2.5 times the annual rainfall, indicating a moderate degree of water stress in Australian terms. Relative humidities are comparatively high and do not vary greatly through the year reflecting the near coastal location of the Project area. In January the 9.00 am and 3.00 pm relative humidities average 67 and 47 percent (%), respectively, while the comparable figures for July are 78 and 51% (BoM 2014).

Summers are warm to hot with mean daily maximum temperatures of 31.7 degrees Celsius (^{o}C) in January, the hottest month. July is the coldest month with a mean minimum temperature of 3.8^{o}C. Frosts are

common in winter; with July having an average lowest minimum temperature -4.5°C and an average of 4.5 days per annum with minimums below 0°C.

Subsequently the study area is one of the driest and warmest parts of the Hunter Valley, with rainfall that is far less than other areas. This is reflected in the type of vegetation that occurs within and adjacent to the study area.

2.1.5 Land Use

Historically the Bulga Warkworth area was subject to a variety of agricultural land uses include livestock grazing, dairy, horse breeding and viticulture. However, the predominant land use are now coal mining and agriculture. Currently, low-density cattle grazing occurs within the study area.

2.1.6 Native Vegetation

The native vegetation of the Hunter Valley floor typically comprises dry sclerophyll shrub/grass woodlands and grassy woodlands in varying condition states. Derived native grasslands and regenerating woodlands represent the bulk of native vegetation cover with patches of higher condition intact native vegetation cover restricted to variously connected and/or fragmented patches of varying size (e.g. less than one hectare to several hundred hectares).

The vegetation of the study area is described in detail in Section 4, but consists mostly of derived native grasslands with small patches of River Oak Riparian Woodland, Forest Red Gum-Grey Gum dry open forest, Grey Box – Narrow-leaved Ironbark Shrubby Woodland, *Melaleuca decora* low forest and Bulloak Forests of the Central Hunter Valley and *Acacia pendula* (FloraSearch 2014).

2.1.7 Fire History

The study area falls under the Singleton Bush Fire Management Committee's Bush Fire Risk Management Plan (Singleton Bush Fire Management Committee, 2011). The bush fire season generally runs from September to March with prevailing winds, high daytime temperatures and low relative humidity (Singleton Bush Fire Management Committee, 2011). The current approved Wambo Coal Mine Bushfire Management Plan 2013 identifies bushfire hazards and assesses fire risks to various land uses and ecological values. The Bushfire Management Plan provides fire prevention, protection and suppression strategies.

2.2 Previous Studies

Ecological studies previously undertaken within and adjacent to the study area are listed below:

- South Wambo Coal Project – Fauna Impact Assessment. Unpublished field survey data prepared for Wambo Coal Pty Ltd (Niche 2014a);
- Montrose Water Storage Modification – Terrestrial Fauna Assessment (Biosphere Environmental Consultants 2012);
- North Wambo Underground Mine Modification Fauna Assessment (Niche 2012);
- Wambo Development Project Environmental Impact Statement Terrestrial Fauna Assessment (Mount King Ecological Surveys 2003);
- Annual ecological monitoring reports (e.g. HLA-Envirosciences Pty Limited 2007 - referred to hereafter as HLA; RPS Harpers Somers O'Sullivan 2007-2013 – referred to hereafter as RPS);
- Annual Sensitive Species Monitoring Program for the Remnant Woodland Enhancement Area (Niche 2014b);

- Annual Flora Monitoring Program for the Remnant Woodland Enhancement Area (Niche 2014c);
- Annual Riparian Monitoring Report: Wambo Remnant Woodland Enhancement Program (Niche 2014d);
- Aquatic and Riparian Management and Monitoring Plan (Niche 2013); and
- Wambo Mine Aquatic Monitoring Report (Niche 2014e).

A summary of the terrestrial fauna and aquatic ecosystems surveys and their results is provided in the following sections.

2.2.1 Terrestrial Fauna

Mount King Ecological Surveys (2003), BioSphere Environmental Consultants (2012) and Niche (2014a) represent the most comprehensive general fauna surveys completed for lands within and adjacent to the study area. The majority of the systematic surveys conducted for these investigations were consistent with the NSW Department of Environment and Conservation (DEC) (2004) survey guidelines.

Annual monitoring surveys have also been conducted for both flora and fauna since 2006 in areas referred to as the RWEP areas. The temporal dataset produced from lands adjacent to the study area is of high value, completed over many years (HLA 2007, RPS 2008, RPS 2009, RPS 2010, RPS 2012, RPS 2013, Niche 2014b, Niche 2014c). Surveys in the RWEP areas have specifically focused on 'sensitive species' such as woodland birds and bats; these being the fauna groups with the most number of prior threatened species observations. However, detailed fauna survey methods have also involved spotlighting and trapping throughout the monitoring period.

Combined, these fauna and flora surveys have consistently reported the occurrence of a diverse woodland bird community comprising many ecosystem predicted threatened species such as the Hooded Robin (*Melanodryas cucullata*), Speckled Warbler (*Chthonicola sagittatus*), Brown Treecreeper (*Climacteris picumnus victoriae*), Varied Sitella (*Daphoenositta chrysoptera*), Diamond Firetail (*Stagonopleura guttata*), Scarlet Robin (*Petroica boodang*), Little Lorikeet (*Glossopsitta pusilla*) and Grey-crowned Babbler (*Pomatostomus temporalis temporalis*).

The Glossy-Black-Cockatoo (*Calyptorhynchus lathami*) has been routinely recorded in consolidated bushland to the west of the study area and occasionally within open areas nearer to the study area (e.g. RPS 2009). Similarly, the Powerful Owl (*Ninox strenua*), Masked Owl (*Tyto novaehollandiae*), Turquoise Parrot (*Neophema pulchella*) and Gang-gang Cockatoo (*Callocephalon fimbriatum*) have been recorded from past survey outside of the study area, occasionally from similar habitat to that of the study area but more typically within more consolidated bushland habitat to the west. All of the above species are likely to concentrate their movements within larger patches of bushland to the west where the availability of prey or foraging resources would be significantly higher than within the study area. Riparian corridors and smaller patches of vegetation with the region such as those within the study area would assist with movement and may occasionally be used for opportunistic foraging.

Less commonly observed species include the Little Eagle (*Hieraaetus morphnoides*) and Square-tailed Kite (*Lophoictinia isura*).

Similar to woodland birds, a diverse woodland micro-bat community is present within the area covered by combined surveys for Wambo Coal Mine associated activities. The following threatened species have been detected via echolocation recordings: Little Bent-wing Bat (*Miniopterus australis*), Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), Eastern False Pipistrelle

(*Falsistrellus tasmaniensis*), Eastern Freetail Bat (*Mormopterus norfolkensis*) and Large-eared Pied Bat (*Chalinolobus dwyeri*). The same suite of species would be expected to occur within the study area although it is unlikely that cave roosting species (Little Bent-wing Bat) would use the study area for breeding or shelter as suitable roosting habitat is absent (i.e. cave or sandstone overhangs). The study area does provide a small area of roosting habitat for tree roosting bat species, within woodland remnants.

In contrast the ground and arboreal mammal community is considered to be relatively depauperate in species richness and abundance. While Brushtailed Possums (*Trichosurus vulpecula*) are regularly observed, there are few recorded occurrences of Ringtail Possums (*Pseudocheirus peregrinus*), Sugar Gliders (*Petaurus breviceps*) or Squirrel Gliders (*Petaurus norfolkensis*). There have been no observations of Greater Gliders (*Petauroides volans*) or Yellow-bellied Gliders (*Petaurus australis*) throughout the foot slopes of the southern escarpment; a result expected to be replicated within the study area where habitat is poorer quality.

The small ground mammal community is largely limited to the exotic Black Rat (*Rattus rattus*) and House Mouse (*Mus musculus*). Despite considerable trapping effort there has been very limited observations of native ground mammal species such as *Antechinus* spp. and Bandicoots. Wombats (*Vombatus ursinus*) and Short-beaked Echidnas (*Tachyglossus aculeatus*) are relatively common throughout.

The large ground mammal community substantially contrasts with the depauperate small ground mammal community as indicated by an abundant occurrence of Eastern Grey Kangaroos (*Macropus giganteus*) on the lower slopes and cleared valley floor. Commonly to frequently encountered in the partially disturbed and undisturbed native woodlands are the Red-necked Wallaby (*Macropus rufogriseus*) and Euro (*Macropus robustus*). The Swamp Wallaby (*Wallabia bicolor*) is uncommonly encountered and is generally restricted to the least disturbed areas. A single possible recording of the threatened Brush-tailed Rock-wallaby (*Petrogale penicillata*) (RPS 2008) was made in the upper catchment of Stony Creek where suitable rocky escarpment habitat for this species is present. However, it is unlikely that the Brush-tailed Rock-wallaby would utilise the study area as it is distant from rocky escarpments (approximately 2 – 3 km north-west) with significant open ground in between. There have been no records of the Spotted-tailed Quoll (*Dasyurus maculatus*) despite the completion of extensive targeted surveys for this species and presence of suitable habitat within and adjacent to the study area.

2.2.2 Aquatic Ecosystems

Niche (2014d) identified riparian condition in Wambo Creek in 2013 has diminished since the prior monitoring period. Reasons for this appear to be strongly related to the January–February 2013 rainfall event where excessive rainfall had resulted in substantive erosion and weed abundance. There was no evidence of mining related deleterious impacts on these streams (Niche 2014b). The annual Ecosystem Function Analysis monitoring program recommended active (i.e. weed control) and passive (i.e. riparian plantings) management actions to increase the resilience of North Wambo, Stony and Wambo Creeks (Niche 2014d). Such management would have wide ranging positive benefits and is also likely to improve riparian resilience in areas that are or may be impacted by mining activity.

Niche (2013) investigated the likely impact of sediment deposition in North Wambo Creek below the Stage 3 diversion following the January 2013 rainfall event. The assessment found the benthic faunal communities of this stream are able to withstand short-term increases in suspended and benthic sediments and that aquatic fauna can recover rapidly from fine particulate material due to human disturbance over short durations. However, continuous high levels of sediment input, generally associated with agriculture and mining activity, are likely to have had substantial influence on the natural faunal assemblage of this

stream, as indicated by comparative investigations with Wambo Creek. Riparian and stream management strategies were recommended to minimise the cumulative effect of disturbance such as ongoing sediment input, or a combination of anthropogenic impacts that can lead to long term stream impairment.

Conversely, the annual monitoring program found pools in Wambo Creek to contain invertebrate communities similar to those predicted by the AUSRIVAS model for a Band A condition stream (i.e. relatively good health compared to the other systems) (Niche 2014e). Also noted was the potential for a change in condition state of such pools should sustained periods of no flow eventuate (Niche 2014e). Monitoring sites within North Wambo Creek near the confluence with Wollombi Brook demonstrated lower quality stream health (i.e. condition Band B), indicating moderate impairment under AUSRIVAS classification. Sites downstream of the diversion in North Wambo Creek and Wambo Creek (near the stream gauge) contained two native fish species (Flat Head Gudgeon [*Philypnodon grandiceps*] and Fire Tailed Gudgeon [*Hypseleotris galii*]) with no threatened species being observed. Re-vegetation and management of the Wambo Creek riparian zone have been recommended (Niche 2014b) to enhance stream health and establish resilience to stream and bank erosion.

2.3 Threatened Fauna Observations

Threatened fauna species recorded at Wambo have been summarised in Table 1 below.

Table 1. Threatened Fauna Species Recorded during Previous Surveys at Wambo Coal Mine

Species	Scientific Name	Studies where Species has been Recorded
Birds		
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	Niche (2014b), Niche (2012), RPS (2009), Mt King (2003)
Little Eagle	*Hieraaetus morphnoides*	Niche (2014b), RPS (2009)
Square-tailed Kite	*Lophoictinia isura*	Mt King (2003)
Gang-gang Cockatoo	*Callocephalon fimbriatum*	RPS (2009)
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	RPS (2009), Mt King (2003)
Diamond Firetail	*Stagonopleura guttata*	RPS (2009), Mt King (2003)
Hooded Robin	*Melanodryas cucullata cucullata*	Mt King (2003)
Masked Owl	*Tyto novaehollandiae*	RPS (2009)
Painted Honeyeater	*Grantiella picta*	RPS (2009)
Spotted Harrier	*Circus assimilis*	Niche (2014b)
Little Lorikeet	*Glossopsitta pusilla*	Niche (2014b), RPS (2009)
Brown Treecreeper	*Climacteris picumnus victoriae*	Niche (2014b), Niche (2012), RPS (2009)
Varied Sittella	*Daphoenositta chrysoptera*	Niche (2014b), RPS (2009)
Specked Warbler	*Chthonicola sagittata*	Niche (2014b), Niche (2012), RPS (2009), Mt King (2003)
Scarlet Robin	*Petroica boodang*	Niche (2014b), Niche (2012), RPS (2009)
Powerful Owl	*Ninox strenua*	RPS (2008, 2011)
Turquoise Parrot	*Neophema pulchella*	Niche (2014b), Mt King (2003)
Mammals		
Squirrel Glider	*Petaurus norfolcensis*	Mt King (2003)
Little Bentwing-bat	*Miniopterus australis*	RPS (2009)
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	RPS (2009)
Greater Broad-nosed Bat	*Scoteanax rueppellii*	RPS (2009)

Species	Scientific Name	Studies where Species has been Recorded
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	RPS (2009)
Eastern Freetail-bat	*Mormopterus norfolkensis*	Niche (2012), RPS (2009)
Large-eared Pied Bat	*Chalinolobus dwyeri*	Niche (2012), RPS (2009)
Brush-tailed Rock Wallaby	*Petrogale penicillata*	RPS (2008)

3. Methods

3.1 Review of Materials

Three broad habitat types were identified within the study area, these being similar and contiguous with those previously described within and around the study area (e.g. Mount King Ecological Surveys 2003, Niche 2012, BioSphere 2012). These are described as follows:

- Grassland with scattered trees and small patches (i.e. < 0.25 ha) of regenerating vegetation;
- Regenerating vegetation dominated by eucalyptus species, including some small patches of vegetation dominated by Bulloak (*Allocasuarina luehmannii*), on low lying and undulating plains; and
- Creek line and riparian habitats.

The literature and database review was used to identify threatened fauna species that may occur in the study area. Database searches using a 10 km radius around the study area were conducted in June 2014 (bounding decimal degrees coordinates of 150.9, -32.7; 150.9, -32.5; 151.1, -32.7; 151.1, -32.5) (Figure 3). The following databases and search tools were used:

- NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife (2014); and
- DotE Protected Matters Search Tool (2014).

3.2 Field Survey

A one-day habitat assessment occurred on 10th June 2014 to compliment the comprehensive prior investigations completed in the study area and adjacent lands. This survey recorded the habitat values observed in the study area and were mapped where relevant (i.e. tree hollows, hollow logs, stags, aquatic habitat features). Opportunistic observations of fauna occurring within the study area were documented. The survey traversed all woodland patches and a 400 metre (m) section of Wollombi Brook, located outside and adjacent to the study area.

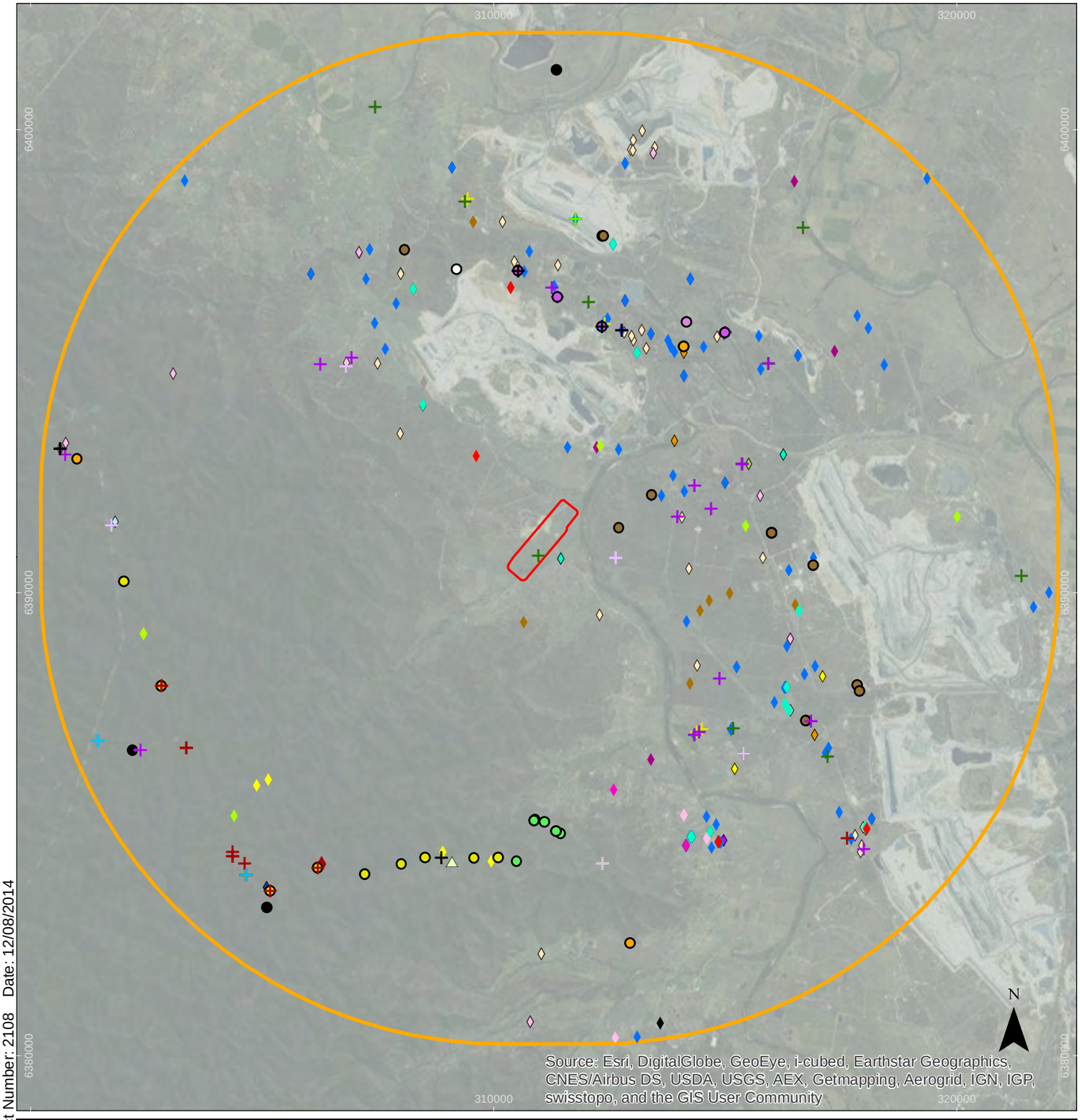
The impact assessment is considered appropriate and sufficiently robust given the extent of previous surveys conducted within and around the study area and the nature of expected impacts from the Project, the reliance on previous survey results and survey of habitat conducted during the one-day habitat assessment. Further justification for this approach is supplied within Section 1.7.

3.3 Likelihood of Occurrence Assessment

A list of fauna that could potentially occur within the study area was determined from available literature and searches of relevant databases (Appendix 1). Further analysis of the likelihood of occurrence of these species within the study area was then undertaken following the field survey.

Five categories for 'likelihood of occurrence' were attributed to species after considering the number and proximity of known records, presence or absence of preferred habitat features, the mobility of the species, results of field surveys and professional judgement. The categories are outlined in Table 2.

Species in the 'Known', 'High' and/or 'Moderate' categories were considered individually to ascertain whether there might be any potential impacts from the Project. Any species would be subject to a formal Assessment of Significance if impacts for the species could reasonably occur from the Project based on potential habitat use within the study area and an understanding of potential impacts from the Project. This process was completed on an individual species basis (Appendix 1).



Project Number: 2108 Date: 12/08/2014

Project Manager: ST

Drawn by: GT

Study Area
10km Search

Threatened Fauna

- Barking Owl
- Black-necked Stork
- Brown Treecreeper (eastern subspecies)
- Brush-tailed Phascogale
- Brush-tailed Rock-wallaby
- Diamond Firetail
- Eastern Bentwing-bat
- Eastern Cave Bat
- Eastern False Pipistrelle
- Eastern Freetail-bat
- Flame Robin
- Gang-gang Cockatoo
- Giant Burrowing Frog
- Glossy Black-Cockatoo
- Greater Broad-nosed Bat
- Grey-crowned Babbler (eastern subspecies)
- Grey-headed Flying-fox
- Hooded Robin (south-eastern form)
- Koala
- Large-eared Pied Bat
- Little Bentwing-bat
- Little Eagle
- Little Lorikeet
- Masked Owl
- New Holland Mouse
- Painted Honeyeater
- Powerful Owl
- Regent Honeyeater
- Scarlet Robin
- Sooty Owl
- Southern Myotis
- Speckled Warbler
- Spotted Harrier
- Spotted-tailed Quoll
- Squirrel Glider
- Swift Parrot
- Turquoise Parrot
- Varied Sittella
- Yellow-bellied Glider
- Yellow-bellied Sheathtail-bat

0 1 2 3 km

GDA 1994 MGA Zone 56

Atlas of NSW Wildlife Threatened Fauna Records within 10 km of the Study Area

North Wambo Underground Longwall 10a

niche Environment and Heritage

Atlas of NSW Wildlife 2014-06-06

FIGURE 3

Path: T:\spatial\projects\a2100\a2108_Wambo_LW10a\Maps\2108_Figure_3_ThreatFauna.mxd

Table 2. Likelihood of Occurrence Criteria – Threatened Fauna

Likelihood rating	Criteria
Known	The species was observed within the study area during recent survey (i.e. since 2003).
High	It is likely that the species inhabits or utilises habitat within the study area based on habitat observations, the biology of the species and/or previous survey records.
Moderate	Potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. There may be one or more recent records within similar habitat around the study area.
Low	It is unlikely that the species inhabits the study area. If present the species would likely be a transient visitor. Habitat or other features of the study area is/are largely unsuitable.
None	The habitat within the study area is unsuitable for the species.

4. Results

4.1 Habitat Assessment

The study area consists of habitat types that have been previously disturbed via clearing for agriculture and associated activities. Habitats primarily constitute lightly to moderately grazed grasslands with scattered mature trees and small stands of regenerating woodland and larger patches of regenerating woodland dominated by eucalyptus species and Bulloak. Ephemeral watercourses also occur within the study area (i.e. Wambo Creek and Stony Creek).

Habitats within the study area are generally in low to moderate condition, due to a lack of native species richness and the absence of older growth habitat components. A moderate level of resilience is apparent due to a relatively intact soil profile and low cover of weeds throughout most areas. Past land management practices have led to low densities of hollow-bearing trees and coarse woody debris and there is little rocky habitat throughout the study area.

A description of each of the three habitats is presented in Sections 4.1.1, 4.1.2 and 4.1.3.

4.1.1 Regenerating Woodland

The more densely vegetated areas of the study area constitute regenerating woodland with occasional large emergent remnant eucalyptus trees (Plate 1). The canopy and midstorey layers comprise eucalyptus species (predominantly Narrow-leaved Ironbark; *Eucalyptus crebra*) and Bulloak, with an average height of approximately 15 metres (m). In some areas, *Melaleuca decora* also occurred. Overall the woodland had a sparse understorey, with large areas of bare soil. Grasses occurred and were predominantly *Austrodanthonia* sp., *Austrostipa* sp. and *Eragrostis* sp. Occasional hollow-bearing trees occurred, however limited logs suitable for use as shelter sites by vertebrate fauna were observed.

Plate 1. Regenerating Woodland

4.1.2 Grassland (mixed native/exotic) with Scattered Trees

The majority of the study area constitutes derived grassland (Plate 2). It consists of a mixture of native and exotic grasses, herbs and sedges. Grassland areas also include low densities of scattered remnant trees

(predominantly Bulloak and Narrow-leaved Ironbark) and these provide limited fauna habitat, for example bird roost sites. Some small constructed dams occur within this area.

Plate 2. Derived Grassland with Scattered Trees within the Study Area

4.1.3 Creekline and Riparian Habitats

Riparian habitats along Wambo Creek vary in habitat structure and quality (Plate 3) including dense stands of *Casuarina cunninghamiana* and small pools of standing water (<5 m across).

Plate 3. Riparian Habitat within the Study Area

4.2 Fauna Observations

Thirty fauna species were recorded during the one-day site visit (June 2014). These included 27 species of birds, two species of mammal and one species of frog (Appendix 2). No threatened species were recorded during the site visit.

4.3 Threatened Species

Database searches revealed previous records (OEH 2014) or potential habitat (DotE 2014) for 49 threatened fauna species listed under the TSC Act, FM Act and/or EPBC Act within a 10 km radius of the study area (Appendix 1). Of the 49 threatened species:

- Sixteen are considered to have a high likelihood of occurring as they have previously been recorded in the vicinity of the study area or due to numerous surrounding records;
- Fourteen are considered to have a moderate chance of occurring; and
- Nineteen are considered to have a low or no chance of occurring.

The high number of threatened species recorded within and adjacent to the study area is due to activities completed for the RWEP areas and in part, reflective of the intensive level of fauna survey within the study area and surrounds over the past decade, mostly due to mining proposals and monitoring programs.

In addition, the study area is next to a large reserve network in Wollemi National Park and the wider Blue Mountains World Heritage Area, and is situated between the coastal plains and escarpment with a high diversity of available habitats and vegetation from grassland to mixed aged forest.

4.4 Critical Habitat

No mapped critical habitat listed under the TSC Act occurs within the study area.

5. Impact Assessment

5.1 Impacts on Terrestrial Fauna

Subsidence impacts have been assessed for the Longwall 10A panel by MSEC (2014). Typically subsidence will be between 1.2 and 2.6 m, with the higher levels of subsidence predicted to occur in the centre of the subject site. Wambo Creek occurs in the south of the study area and will be impacted upon by a predicted 900 mm of subsidence. The potential impacts are expected to be similar to those observed in adjacent longwall panels and include surface cracking (typically less than 100 mm in width) and slumping (MSEC 2014).

The subject site has been previously affected by longwall subsidence in the Whybrow Seam which has caused negligible modification to the terrestrial ecological values of the area (Niche 2014d, Niche 2014e), due to the already disturbed nature of the area. Impacts from the Project are unlikely to substantially alter the ecological values of the subject site and surrounding environment, such that any fauna species would be significantly impacted.

The Project does not involve any surface infrastructure, however vehicle access for monitoring may be required.

5.2 Impacts on Streams

5.2.1 Wollombi Brook

No longwall mining will occur under permanent rivers or streams, namely the Wollombi Brook. Longwall mining will occur under Wambo Creek, which is an ephemeral creek with a number of semi-permanent pools, up to 5 m in width (MSEC 2014). It is unlikely that Wollombi Brook or the associated alluvium would be adversely impacted as a result of the extraction of the proposed Longwall 10A (MSEC 2014). The potential subsidence impacts on the Wollombi Brook and the associated alluvium, due to the extraction of the proposed longwall, are expected to be negligible (MSEC 2014).

The North Wambo Underground Mine Longwall 10A Modification Groundwater Assessment prepared by HydroSimulations (2014) concluded that the additional longwall would have no discernible impact on stream baseflow or natural river flow for Wollombi Brook, beyond the effects of approved mining (HydroSimulations 2014).

5.2.2 North Wambo Creek

The banks of North Wambo Creek are located at distance of 270 m north of the finishing end of Longwall 10A, at their closest point to the proposed longwall. At this distance, this creek is predicted to experience less than 20 mm of vertical subsidence (MSEC 2014). While it is possible that North Wambo Creek could experience very low levels of subsidence, it would not be expected to experience any significant tilts, curvatures or ground strains (MSEC 2014).

HydroSimulations (2014) concluded that the additional longwall would have no discernible impact on stream base flow or natural river flow for North Wambo Creek, beyond the effects of approved mining.

5.2.3 Wambo and Stony Creeks

The extraction of the proposed Longwall 10A could result in increased levels of ponding along Wambo Creek, upstream of the longwall maingate, where the mining induced tilts oppose and are greater than the natural stream gradients that exist before mining (MSEC 2014; Evans and Peck 2014). Mining could also

potentially result in an increased likelihood of scouring of the beds along Wambo and Stony Creeks, downstream of the longwall edges, where the mining induced tilts considerably increase the natural stream gradients that exist before mining (MSEC 2014). Wambo and Stony Creeks have shallow incisions into the surface soils, but have exposed bedrock and isolated outcropping along the lower reaches. Cracking in the beds of the streams would only be visible at the surface where the depths of the surface soils are shallow, or where the bedrock is exposed (MSEC 2014; Evans and Peck 2014).

The North Wambo Underground Mine Longwall 10A Modification Groundwater Assessment concluded that the additional longwall would have no discernible impact on stream baseflow or natural river flow for these streams, beyond the effects of approved mining (HydroSimulations 2014).

5.3. Impacts on Aquatic Ecosystems

5.3.1 Ponding

Increased ponding is expected to occur on Wambo Creek. This is likely to increase the available habitat for fish and benthic macroinvertebrates, although it may also reduce the availability of flowing (lotic) environments. However, since this stream is ephemeral, the impact to flowing habitat is limited to periods of flow after rain. Although there is potential temporal and spatial changes to macroinvertebrate communities, it is not expected that ponding will change macroinvertebrates communities outside the natural variation expected in ephemeral stream pool habitats.

5.3.2 Stream Hydrology

Approved mine layout impacts to the baseflow for Wollombi Brook, North Wambo Creek, Wambo Creek and Stony Creek are increases in the order of 0.3 megalitres per day (ML/day), 0.01 ML/day, 0.05 ML/day and 0.03 ML/day respectively (Heritage Computing 2012). Change to the flow regime may affect flow recessions and size and length of time pools persist after flow. Localised impacts to aquatic fauna such as reduced abundances may occur and likely to be exacerbated by low flow periods.

5.3.3 Erosion/Sedimentation

Increase in stream slope is expected to occur in Wambo Creek (MSEC 2014). This is expected to change local hydraulics and lead to increased stream and bank edge erosion. Stream incision can result, changing the stream geomorphology as well as the habitat available to aquatic fauna. Wambo and Stony Creek are vulnerable to subsidence from the Longwall 10A (i.e. maximum predicted additional subsidence from the Project of 900 mm and 450 mm respectively [MSEC 2014]) and are likely to be particularly susceptible to erosion from high flow events, especially considering the location of the longwall under the confluence of these systems. Erosion from flow events and subsequent sediment deposition has the potential to change habitats downstream altering aquatic communities to those that are tolerant of higher sediment loads. Appropriate mitigation of erosion (Section 6) will alleviate some of this impact.

5.4 Cumulative Impacts

The Hunter Valley floor has a range of current and approved proposals for underground and open cut mines. Within a 10 km radius of the study area, the main projects awaiting approval are the Mt Thorley Continuation Project and the Warkworth Continuation Project.

Agriculture and associated land clearing and cattle grazing have resulted in altered aquatic habitat within streams in the area. The combined effect of agriculture and mining can increase erosion, sedimentation within streams and result in loss of aquatic habitat. The already degraded riparian habitat provides little stream bank resilience to large disturbances. For example high flow events or additional anthropogenic impacts such as mine subsidence can have a cumulative effect on erosion. Long–term cumulative impacts if

not managed appropriately can ultimately lead to an altered aquatic ecosystem, processes, habitat and aquatic fauna.

After the completion of the necessary remediation measures, the long term impacts on Wambo and Stony Creeks, based on the Modified Layout (LW 10a), are expected to be the same as those assessed based on the Approved Layout (MSEC 2014). Therefore, the cumulative impacts from LW10a are expected to be minor.

5.5 Threatened Fauna Species Listed Under the TSC Act

An impact assessment has been conducted (see Appendix 3) considering the Guidelines for Threatened Species Assessment under Part 3A of the EP&A Act (DEC and NSW Department of Primary Industries [DPI] 2005), otherwise known as threshold assessments. The assessments completed in Appendix 3 concluded that it was unlikely that any significant impact would occur as a result of the Project on threatened fauna species listed under the TSC Act.

5.6 Key Threatening Processes

The following key threatening processes are relevant to this development:

- Instream structures and other mechanisms that alter natural flow;
- The degradation of native riparian vegetation along NSW water courses; and
- Alteration of habitat following subsidence due to longwall mining.

The effect of the Project on the above key threatening processes has been assessed in Appendix 3 and mitigation measures are outlined in Section 6.

5.7 Threatened Fauna Species Listed Under the EPBC Act

Assessments of Significance were completed for threatened fauna species listed under the EPBC Act that are likely to be impacted by the Project (Appendix 4). The potential impact of the Project on threatened fauna species includes modification of habitat via surface cracking, slumping and alteration to groundwater hydrology. These assessments concluded that an impact to any of these species was unlikely to occur and, therefore, the Project does not require referral under the EPBC Act.

5.8 SEPP 44 – Koala Habitat Protection

A response to the criteria defining core and potential Koala habitat is provided below.

1. Does the policy apply? Does the subject land occur in a LGA identified in Schedule 1?

The study area occurs within the Singleton LGA, which is listed under Schedule 1 of SEPP 44 and therefore the policy is applicable.

2. Is the landholding to which the DA (the proposed State significant development in this case) *applies greater than 1 hectare in area?*

Yes – approximately 94 hectares.

3. Is the land potential Koala habitat? Does the site contain areas of native vegetation where the trees of types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component?

The study area contains a small area of Forest Red Gum (*Eucalyptus tereticornis*) (approximately 3 ha), a species listed under Schedule 2 of SEPP 44. This small area is considered to be potential Koala habitat.

4. Is the land core Koala habitat?

Core Koala habitat is defined as an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

The Hunter Valley has occasional historical records of Koalas, however with the exception of the Port Stephens LGA, breeding populations are not known to occur. No evidence of Koalas has been recorded at Wambo Mine in over 10 years of monitoring.

Conclusion

The study area is not considered to comprise core Koala habitat and therefore a Koala Plan of Management is not required (albeit that a Koala Plan of Management is not relevant to an application made under section 75W of the EP&A Act).

6. Management Recommendations

Nevertheless, active monitoring programs and revegetation works in vulnerable areas (Evans and Peck 2014) are likely to assist with avoiding some of the sedimentation impacts that could occur after any instability such as slumping. Uncertainties regarding the location and nature of subsidence impacts mean that not all erosional events can be predicted.

Management strategies have previously been developed for the sections of the creeks which have already been directly mined beneath. It is recommended that these existing management strategies be reviewed and revised, where required, to apply to the small section of Wambo Creek within the study area.

6.1 Management

It is recommended that a combination of passive, revegetation and engineered mitigation measures be applied to affected streams. Generally from an ecological perspective, is it recommended that passive and revegetation measures be applied to rehabilitation as engineered solutions can often cause more damage than the initial disturbance thus proposed earthworks to bed and banks would need to be assessed based on their potential long-term benefits and risk avoidance versus short term disruption to vegetation and other features that usually aid in bed and bank stabilisation.

6.1.1 Passive Rehabilitation

It is recommended that the system, where there is resilience to disturbance, be allowed to adjust to the changed stream condition. The system may stabilise naturally and natural processes such as natural infilling of cracks will lead to some self healing or ponding resulting in the establishment of new pool habitat. This can be complimented by revegetation work recommended in Section 6.1.2.

6.1.2 Revegetation of Riparian Zone

The establishment of deep rooted native vegetation in the riparian zone would substantially improve bank stability and integrity prior to future subsidence impacts; a management issue previously identified within the Wambo Coal Mine operations area (pers. comm., Wambo Coal Environmental Team). These works would have substantial cross benefits with terrestrial systems such as the improvement of wildlife connectivity between east and west RWEP areas and improved patch area and hence biological integrity within those patches (e.g. reduced edge length to area ratios for thin tracts of native vegetation). It is therefore recommended to plant native trees and shrubs within and adjacent to the riparian corridors in Wambo Creek to minimise the effects of subsidence on the natural environment (i.e. revegetation of the riparian corridor). This action would help reduce the incidence of bank and channel erosion, thereby improving riparian resilience.

This type of revegetation has likely highly significant value for the conservation of woodland birds and other animals, with plantations having been shown to increase the diversity of birds twofold, over grazing land alone (Lindenmayer and Hobbs 2007). Riparian areas are particularly valuable for wildlife and have the potential to act as a dispersal corridor for particular taxa, especially migratory woodland birds and microbats (Lindenmayer and Hobbs 2007).

6.1.3 Regrading of the River Bed

Engineered mitigation measures should be considered where necessary in response to subsidence impacts such as head-cut development that may cause excessive erosion and sedimentation problems within Wambo Creek (Evans and Peck 2014). This is recommended to: protect the structural integrity of the

stream; arrest erosion/sediment deposition impacts; and to protect aquatic habitat and fauna up and downstream of the impact site.

MSEC (2014) suggest that if the mining induced ponding areas were to result in adverse impacts, these could be remediated by regrading the beds of Wambo and Stony Creeks, so as to re-establish the natural gradients. The creeks have shallow incisions in the natural surface soils and, therefore, it is expected that the mining induced ponding areas could be reduced by excavating the channels downstream of the proposed and future longwalls and by increasing the heights of the banks above the proposed and future longwalls (MSEC 2014).

This management option is recommended to be used in conjunction with bank stabilisation and erosion control measures, if required, with the need for this management determined through the monitoring program and with consideration given to any beneficial or replacement habitat created through additional pooling attributed to subsidence impacts.

6.2 Monitoring

Monitoring of aquatic fauna is conducted annually at the Wambo Coal Mine. It is recommended that the program be maintained and amended to include an additional site on Wambo Creek at the predicted impact location. Sampling must start prior to the commencement of the longwall mining under Wambo Creek to collect baseline data. Frequent visual inspections are recommended after the commencement of mining under Wambo Creek consistent with measures identified in the Subsidence Impacts on Wambo Creek and Stony Creek Assessment (Evans and Peck 2014), to identify the beginnings of any erosion and subsidence features. Aquatic sampling should be undertaken before and after any observed impacts that may affect habitat quality within semi-permanent pools. Monitoring of the impact to Wambo Creek will require an adaptive approach and take into account the degree of impact, other disturbances (high flow events), and mitigation strategies employed.

7. Conclusion

This assessment describes the threatened biodiversity, as listed on the TSC Act, FM Act and EPBC Act that would potentially be affected by the Project. Thirty terrestrial threatened fauna species have the potential to be affected by the Project. Thresholds assessments in accordance with Part 3A impact assessment guidelines (DEC & DPI 2005) were prepared to assess the Project's impact on these species. Significance assessments undertaken in accordance with the Commonwealth guidelines (DotE 2013) were also prepared to assess the Project's impacts on Matters of National Significance.

Due to the small area of potential habitat within the study area (94 ha), the disturbed nature of the habitat, the absence of habitat features that have the potential to be affected by subsidence within the study area (e.g. sandstone caves) and absence of potential habitat for threatened species that are potentially affected by subsidence (e.g. threatened frogs), the Project is considered unlikely to result in a significant effect on any threatened fauna species listed under the TSC Act, FM Act or EPBC Act.

North Wambo Creek and Wollombi Brook are unlikely to be impacted by the Project. The greatest impact will be on Wambo and Stony Creeks through increased ponding, bank and bed scouring, cracking and bank slumping.

It is recommended that mitigation measures include revegetation of the riparian corridor to lessen the risk of subsidence impacts and thereby assist in protection of geomorphic and aquatic habitat values of affected waterways. Where considered advantageous, engineering works (e.g. those discussed in Evans and Peck 2014) should also be considered. Reactive ameliorative measures may also be employed should severe subsidence impacts eventuate. These strategies should include those adopted for the North Wambo Underground Mine in conjunction with stream health initiatives and riparian restoration measures recommended in riparian and aquatic management plans and monitoring programs.

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9. Appendices

Appendix 1: Threatened Species Likelihood of Occurrence Table

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Giant Burrowing Frog *Heleioporus australiacus*	V	V	Prefers hanging swamps on sandstone shelves adjacent to perennial non-flooding creeks. Can also occur within shale outcrops within sandstone formations. In the southern part of its range can occur in wet and dry forests, montane sclerophyll woodland and montane riparian woodland. Individuals can be found around sandy creek banks or foraging along ridge-tops during or directly after heavy rain. Males often call from burrows located in sandy banks next to water.	None – not recorded during current or previous surveys, or within 10 kilometres (km) radius of the study area. Inappropriate habitat.
Giant Barred Frog *Mixophyes iteratus*	E	E	Coast and ranges from south-eastern Queensland to the Hawkesbury River in New South Wales (NSW). The species is also known to occur in north-eastern NSW, particularly the Coffs Harbour-Dorrigo area. The Giant Barred Frog occurs in uplands and lowlands in rainforest and wet sclerophyll forest and can also be found on vegetated streams in farmland.	None – not recorded during current or previous surveys, or within a 10 km radius of the study area. Inappropriate habitat.
Green and Golden Bell Frog *Litoria aurea*	V	E	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are un-shaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available.	Low – not recorded during current or previous surveys, or within 10 km radius of the study area.
Booroolong Frog *Litoria booroolongensis*	E	E	The Booroolong Frog is restricted to NSW and north-eastern Victoria, predominantly along the western-flowing streams of the Great Dividing Range. It has disappeared from much of the Northern Tablelands, however several populations have recently been recorded in the Namoi catchment. Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses.	None – not recorded during current or previous surveys, or within database searches. No western flowing streams of a suitable nature.
Littlejohn's Tree Frog *Litoria littlejohni*	V	V	Occurs in wet and dry sclerophyll forests associated with sandstone outcrops between 280 and 1,000 metres (m) on the eastern slopes of the Great Dividing Range. Can be found breeding in permanent streams, permanent ponds and, sometimes, temporary pools. Forages both in the tree canopy and on the ground, and has been observed sheltering under rocks on high exposed ridges during summer. It is not known from coastal habitats.	None – not recorded during current or previous surveys, or within 10 km radius of the study area. Inappropriate habitat.
Broad-headed Snake *Hoplocephalus bungaroides*	V	E	Mainly occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer.	None – inappropriate habitat.

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Black-necked Stork *Ephippiorhynchus asiaticus*	-	E	Mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sandflats, and mangrove vegetation.	Low – Single record on outskirts of 10 km search area. Not recorded around study area despite previous extensive survey. Poor quality habitat within study area.
Spotted Harrier *Circus assimilis*	-	V	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	**High** – recorded by Niche (2014a) during annual monitoring, adjacent to the study area.
Square-tailed Kite *Lophoictinia isura*	-	V	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by *Eucalyptus longifolia, Corymbia maculata, E. elata or E. smithii*. Individuals appear to occupy large hunting ranges of more than 100km^2. They require large living trees for breeding, particularly near water with surrounding woodland -forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	**Moderate** – recorded around the study area during previous surveys. Some limited potential foraging habitat occurs within the study area which may be used - albeit not commonly. No resources or habitat of particular importance occur within study area.
Little Eagle *Hieraaetus morphnoides*	-	V	Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. May nest in farmland, woodland and forest in tall trees.	**High** – numerous previous records around the study area.
Australian Painted Snipe *Rostratula australis*	E	E	Generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains.	Low – not recorded during current or previous surveys within a 10 km radius of the study area.
Glossy Black-Cockatoo *Calyptorhynchus lathami*	-	V	Inhabits forest with low nutrients, characteristically with key *Allocasuarina* spp. Tends to prefer drier forest types with a middle stratum of allocasuarina below eucalyptus or angophora. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead.	**Moderate** – recorded around the study area during previous surveys. Some limited potential foraging habitat occurs within the study area which may be used - albeit not commonly. No resources or habitat of particular importance occur within study area.
Gang-gang Cockatoo *Callocephalon fimbriatum*	-	V	In summer, the species occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.	**High** – recorded during previous surveys around the study area.

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Little Lorikeet *Glossopsitta pusilla*	-	V	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.	**High** – numerous previous records around study area.
Turquoise Parrot *Neophema pulchella*	-	V	Occurs in open woodlands and eucalypt forests with a ground cover of grasses and under storey of low shrubs. Generally found in the foothills of the Great Divide, including steep rocky ridges and gullies. Nest in hollow-bearing trees, either dead or alive; also in hollows in tree stumps. Prefer to breed in open grassy forests and woodlands, and gullies that are moist.	**High** – numerous previous records around study area.
Swift Parrot *Lathamus discolor*	E	E	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	**Moderate** – not recorded during previous surveys, however potential habitat occurs.
Sooty Owl *Tyto tenebricosa*	-	V	Often found in tall old-growth forests, including temperate and subtropical rainforests. In NSW mostly found on escarpments with a mean altitude less than 500 m. Nests and roosts in hollows of tall emergent trees, mainly eucalypts often located in gullies. Nests have been located in trees 125 to 161 centimetres (cm) in diameter.	Low – not recorded during previous surveys and only one record within 10 km of the study area. Habitat is unsuitable for use by this species.
Masked Owl *Tyto novaehollandiae*	-	V	Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. Nest hollows are usually located within dense forests or woodlands. Masked Owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet.	**Moderate** – recorded around study area during previous surveys. Potential foraging habitat occurs within the study area.
Powerful Owl *Ninox strenua*	-	V	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.	**Moderate** –recorded around study area during previous surveys. Potential foraging habitat occurs within the study area which may be used - albeit not commonly. No resources or habitat of particular importance occur within study area.
Barking Owl *Ninox connivens*	-	V	Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country.	**Moderate** – not recorded during current or previous surveys. Potential foraging habitat occurs within the study area.

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Brown Treecreeper (eastern subspecies) *Climacteris picumnus victoriae*	-	V	Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (*Eucalyptus camaldulensis*). Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses.	**Moderate** – recorded during most previous surveys at Wambo. Potential habitat occurs.
Speckled Warbler *Chthonicola sagittata*	-	V	The Speckled Warbler lives in a wide range of eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	**Moderate** – recorded during most previous surveys at Wambo. Potential habitat occurs.
Regent Honeyeater *Anthochaera phrygia*	E	CE	A semi-nomadic species occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests.	**Moderate** – not recorded during previous surveys. Numerous records within a 10 km radius of the study area. Potential habitat occurs.
Painted Honeyeater *Grantiella picta*	-	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occur on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	**Moderate** – previously recorded during field surveys at Wambo. Potential habitat occurs.
Hooded Robin (south-eastern form) *Melanodryas cucullata cucullata*	-	V	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	**Moderate** – numerous previous records around study area (locally common). Potential habitat occurs.
Flame Robin *Petroica phoenicea*	-	V	Flame Robins are found in a broad coastal band from southern Queensland to just west of the South Australian border. The species is also found in Tasmania. The preferred habitat in summer includes eucalyptus forests and woodland, whilst in winter prefers open woodlands and farmlands. It is considered migratory. The Flame Robin breeds from about August to January.	**Moderate** – limited records within 10 km of study area. Potential habitat occurs.
Scarlet Robin *Petroica boodang*	-	V	The Scarlet Robin's range includes all state capitals. Occurs in forests, woodlands; and heavier vegetation when breeding. During autumn and winter occurs in more open and cleared areas. It has dispersive or locally migratory seasonal movements. Is conspicuous in open and suburban habitats.	**High** – numerous previous records around study area. Potential habitat occurs.
Grey-crowned Babbler (eastern subspecies) *Pomatostomus temporalis temporalis*	-	V	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains.	**High** –previous records around study Area (locally common).

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Varied Sittella *Daphoenositta chrysoptera*	-	V	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature eucalypts with hollows.	**High** – numerous previous records around study area. Potential habitat occurs.
Diamond Firetail *Stagonopleura guttata*	-	V	Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (*Eucalyptus pauciflora*) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities.	**High** – recorded during previous surveys around study Area. Potential habitat occurs within the Project area.
Spotted-tail Quoll (South-east Mainland Population) *Dasyurus maculatus maculatus*	E	V	Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests. Habitat requirements include suitable den sites, including hollow logs, rock crevices and caves, an abundance of food and an area of intact vegetation in which to forage.	Low – not recorded during previous surveys but some records within a 10 km radius of the study area. Habitat is too disturbed for frequent use by Quolls.
Brush-tailed Phascogale *Phascogale tapoatafa*	-	V	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west to the divide. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest.	Low – not recorded during current or previous surveys. Single recent record within 10 km of the study area.
Koala *Phascolarctos cinereus*	V	V	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall.	Low – not previously recorded around Modification area. Sparse feed trees in study area.
Yellow-bellied Glider *Petaurus australis*	-	V	Occurs 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. Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria.	Low – numerous records within a 10 km radius of the study area but all to the west of the study area in more consolidated habitat. Not recorded during previous surveys and unsuitable habitat in the study area.
Squirrel Glider *Petaurus norfolcensis*	-	V	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range. Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias. There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps. Within a suitable vegetation community at least one species should flower heavily in winter and one species of Eucalypt should be smooth barked.	Low – previously recorded at Wambo in 2003, however the species has not been recorded since. Marginal habitat occurs within the study area.
Brush-tailed Rock-wallaby *Petrogale penicillata*	V	E	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves and crevices.	Low – records exist within 10 km of the study area. However, unsuitable habitat within study area particularly given distance from favoured habitat.

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Grey-headed Flying-fox *Pteropus poliocephalus*	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.	**High** – multiple previous records (OEH, 2014). Suitable habitat occurs.
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	-	V	The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn.	**High** – previously recorded during surveys. Potential habitat occurs.
Eastern Freetail-bat *Mormopterus norfolkensis*	-	V	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits.	**High** – multiple previous records. Potential habitat occurs.
Little Bentwing-bat *Miniopterus australis*	-	V	Coastal north-eastern NSW and eastern Queensland. Little Bent-wing Bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel hundreds of kilometres from feeding home ranges to breeding sites. The Little Bentwing-bat has a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects.	**Moderate** – sparse numbers of records in locality. Potential foraging habitat occurs.
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	-	V	Broad range of habitats including rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands. Roost in caves and man-made habitats and under road culverts.	**High** – recorded during previous surveys (OEH, 2014). Potential foraging habitat occurs.
Large-eared Pied Bat *Chalinolobus dwyeri*	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between three and 37 individuals.	**High** – recorded during previous surveys. Potential foraging habitat occurs.
Corben's Long-eared Bat *Nyctophilus corbeni*	V	V	Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species. Inhabits a variety of vegetation types, including mallee, bulloak (*Allocasuarina leuhmanni*) and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark.	Low - not recorded during current or previous surveys, or within 10 km radius of study area. Marginal habitat occurs.

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	-	V	Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20 m high. Two observations have been made of roosts in stem holes of living eucalypts. There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor. This species also appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites.	**Moderate** – previously recorded at Wambo. Potential marginal foraging habitat occurs.
Southern Myotis *Myotis macropus*	-	V	Occurs in most habitat types as long as they are near permanent water bodies, including streams, lakes and reservoirs. Commonly roost in caves, but can also roost in tree hollows, under bridges and in mines.	**High** – records occur within 10km of the study area. Suitable habitat occurs along creeks in the study area.
Greater Broad-nosed Bat *Scoteanax rueppellii*	-	V	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches.	**High** – multiple previous records occur. Potential foraging and roosting habitat occurs.
Eastern Cave Bat *Vespadelus troughtoni*	-	V	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. Cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.	Low – Records well outside of study area and not recorded in current or previous surveys.
New Holland Mouse *Pseudomys novaehollandiae*	V	-	Coastal heath and dry sclerophyll forest and woodland.	Low – Not previously recorded within a 10 km radius of study area.
Hastings River Mouse *Pseudomys oralis*	E	E	A patchy distribution spanning the Great Dividing Range from the Hunter Valley, south of Mt Royal, north to the Bunya Mountains near Kingaroy in south-east Queensland, at elevations between 300 m and 1,100 m. A variety of dry open forest types with dense, low ground cover and a diverse mixture of ferns, grass, sedges and herbs. Access to seepage zones, creeks and gullies is important, as is permanent shelter such as rocky outcrops. Nests may be in either gully areas or ridges and slopes. They eat seeds, leaves, insects and fungi.	Low – Not recorded during current or previous surveys, or within 10 km radius of study area.

Appendix 2: Fauna Recorded during Field Surveys

Common Name	Scientific Name	TSC Act (Y/N)	EPBC Act (Y/N)
Amphibians			
Common Eastern Froglet	*Crinia signifera*	N	N
Birds			
Australian Wood Duck	*Chenonetta jubata*	N	N
Cattle Egret	*Ardea ibis*	N	N
White-faced Heron	*Egretta novaehollandiae*	N	N
Masked Lapwing	*Vanellus miles*	N	N
Crested Pigeon	*Ocyphaps lophotes*	N	N
Galah	*Eolophus roseicapillus*	N	N
Eastern Rosella	*Platycercus eximius*	N	N
Rainbow Lorikeet	*Trichoglossus haematodus*	N	N
Musk Lorikeet	*Glossopsitta concinna*	N	N
Superb Fairy-wren	*Malurus cyaneus*	N	N
Brown Thornbill	*Acanthiza pusilla*	N	N
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	N	N
Yellow-faced Honeyeater	*Lichenostomus chrysops*	N	N
Noisy Miner	*Manorina melanocephala*	N	N
Eastern Yellow Robin	*Eopsaltria australis*	N	N
Red-capped Robin	*Petroica goodenovii*	N	N
Grey Shrike-thrush	*Colluricincla harmonica*	N	N
Magpie-lark	*Grallina cyanoleuca*	N	N
Grey Fantail	*Rhipidura albiscapa*	N	N
Pied Butcherbird	*Cracticus nigrogularis*	N	N
Australian Magpie	*Cracticus tibicen*	N	N
Pied Currawong	*Strepera graculina*	N	N
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	N	N
Australian Raven	*Corvus coronoides*	N	N
Red-browed Finch	*Neochmia temporalis*	N	N
Black-shouldered Kite	*Elanus axillaris*	N	N
Brown Goshawk	*Accipiter fasciatus*	N	N
Mammals			
Eastern Grey Kangaroo	*Macropus giganteus*	N	N
European cattle	*Bos taurus*	N	N

Appendix 3: Thresholds Assessment under NSW Threatened Species Conservation Act 1995 for Part 3A Major Projects under the EP&A Act 1979

Definitions

The following definitions are adopted from the *Threatened Species Assessment Guidelines: The assessment of significance* (DECC 2007):

Subject Site: the area to be directly affected by the Project - being Longwall 10A. The Project will result in subsidence impacts to approximately 84 ha of derived grasslands with scattered trees, 7 ha of regenerating woodland and 3 ha of riparian habitat.

Study Area: is the subject site and any additional areas which may potentially be affected by the Project - being the extent of subsidence due to Longwall 10A. The extent of subsidence is depicted in Figure 2.

Direct Impacts: are those that directly affect the habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat. No direct impacts would occur from this Project, due to the Project consisting only of longwall mining. No native vegetation would be removed.

Indirect Impacts: indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas. Indirect impacts for this Project would consist primarily of subsidence from longwall mining.

Local Population: the local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area. The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time.

Locality: the area within 10 km of the study area.

Local Occurrence: the ecological community that occurs within the study area. However, the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated. For the purposes of this assessment, the local occurrence of habitat is considered to be 10 km from the subject site.

1. **Whether or not the Proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.**

   The proposal will not remove any native vegetation. The proposal is for one longwall panel with an associated predicted subsidence area of 94 hectares, of which the majority is located over derived native grasslands, thus currently contains low biodiversity values. Previous mining in the same area on another coal seam has resulted in a small degree of surface cracking. Streams that have been subjected to undermining still contain small pools of water, thus the impacts of past mining are negligible.

   The proposal is therefore likely to maintain the biodiversity values of the study area.

2. **Whether or not the Proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.**

   Diurnal woodland 'edge' birds (Speckled Warbler, Grey-crowned Babbler, Diamond Firetail Finch, Hooded Robin, Turquoise Parrot, Scarlet Robin, Flame Robin)

   The proposal will affect, via subsidence approximately 7 hectares of woodland habitat, 3 hectares of riparian habitat and 84 hectares of grassland habitat. The subsidence is unlikely to substantially alter the ecological values of the subject site and surrounding environment, such that the long-term viability of a local population would be reduced. Furthermore, due to the occurrence of several thousand hectares of potential habitat adjacent to the subject site, the proposal is unlikely to reduce the long-term viability of the local population of the above woodland 'edge' bird species.

   Diurnal woodland 'interior' birds (Brown Treecreeper, Little Lorikeet, Glossy Black Cockatoo, Gang-gang Cockatoo, Varied Sittella, Painted Honeyeater)

   The proposal will affect, via subsidence approximately 7 hectares of woodland habitat and 3 hectares of riparian habitat for these species. The subsidence is unlikely to substantially alter the ecological values of the subject site and surrounding environment, such that the long-term viability of a local population would be reduced. Furthermore, due to the occurrence of several thousand hectares of potential habitat adjacent to the subject site, the proposal is unlikely to reduce the long-term viability of the local population of the above woodland 'interior' bird species.

   Swift Parrot and Regent Honeyeater

   The proposal will affect, via subsidence approximately 7 hectares of woodland habitat and 3 hectares of riparian habitat for these species. The subsidence is unlikely to substantially alter the ecological values of the subject site and surrounding environment, such that the long-term viability of a local population would be reduced. Furthermore, due to migratory nature of these species and the occurrence of several thousand hectares of potential habitat adjacent to the subject site, the proposal is unlikely to reduce the long-term viability of the local population of the Swift Parrot and Regent Honeyeater.

   Threatened diurnal raptors (Little Eagle, Square-tail Kite, Spotted Harrier)

   The proposal will affect, via subsidence approximately 7 hectares of woodland habitat, 3 hectares of riparian habitat and 84 hectares of grassland habitat. The subsidence is unlikely to substantially alter the ecological values of the subject site and surrounding environment, such that the long-term viability of a local population would be reduced. Due to the large foraging area of raptors (several thousand hectares) and due to the occurrence of several thousand hectares of potential habitat adjacent to the subject site, the proposal is unlikely to reduce the long-term viability of the local population of the above threatened diurnal raptors.

Threatened owls (Barking Owl, Masked Owl, Powerful Owl)

The proposal will affect, via subsidence approximately 7 hectares of woodland habitat and 3 hectares of riparian habitat for these species. The subsidence is unlikely to substantially alter the ecological values of the subject site and surrounding environment, such that the long-term viability of a local population would be reduced. Each of these species has a home range greater than 1,000 hectares, thus the modification of 10 hectares of potential foraging habitat is also insignificant. Furthermore, due to the occurrence of several thousand hectares of potential habitat adjacent to the subject site, the proposal is unlikely to reduce the long-term viability of the local population of the above threatened owl species.

Cave-dependent microbat species (Large-eared Pied Bat, Little Bent-wing Bat, Eastern Bent-wing Bat)

No caves or overhangs will be affected by this proposal. The proposal will affect, via subsidence approximately 7 hectares of woodland foraging habitat, 3 hectares of riparian foraging habitat and 84 hectares of grassland foraging habitat. The subsidence is unlikely to substantially alter the ecological values of the subject site and surrounding environment, such that the long-term viability of a local population would be reduced. Furthermore, due to the occurrence of several thousand hectares of potential habitat adjacent to the subject site and the large distance travelled by these species each night (i.e. >10 kilometres), the proposal is unlikely to reduce the long-term viability of the local population of the above threatened cave dependent microbat species.

Hollow-dependent microbat species (Yellow-bellied Sheathtail Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat, Eastern Freetail Bat)

No tree hollows will be affected by this proposal. The proposal will affect, via subsidence approximately 7 hectares of woodland foraging habitat, 3 hectares of riparian foraging habitat and 84 hectares of grassland foraging habitat. The subsidence is unlikely to substantially alter the ecological values of the subject site and surrounding environment, such that the long-term viability of a local population would be reduced. Furthermore, due to the occurrence of several thousand hectares of potential habitat adjacent to the subject site and the large distance travelled by these species each night (i.e. >1 kilometre), the proposal is unlikely to reduce the long-term viability of the local population of the above threatened hollow-dependent microbat species.

Southern Myotis

The proposal will affect, via subsidence approximately 3 hectares of riparian foraging habitat for the Southern Myotis. The riparian foraging habitat has already been subjected to some longwall subsidence and has retained a number of small (<5 metre) pools which represent potential foraging habitat. Whilst further modification to foraging habitat of the Southern Myotis may occur, due the limited magnitude of such impacts it is unlikely to reduce the long-term viability of the local population of the Southern Myotis.

Grey-headed Flying Fox

No Grey-headed Flying Fox camps occur within or adjacent to the subject site. The closest known Grey-headed Flying Fox camp occurs in Singleton, approximately 25 kilometres to the north-east. The proposal will affect, via subsidence approximately 7 hectares of woodland, and 3 hectares of riparian habitat, which are potential foraging resources for the Grey-headed Flying Fox. The level of predicted subsidence is unlikely to significantly alter the foraging habitat such that the long-term viability of the local population of the Grey-headed Flying Fox.

3. **Whether or not the Proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.**

Diurnal woodland 'edge' birds (Speckled Warbler, Grey-crowned Babbler, Diamond Firetail Finch, Hooded Robin, Turquoise Parrot, Scarlet Robin, Flame Robin)

The proposal will affect, via subsidence approximately 7 hectares of woodland habitat, 3 hectares of riparian habitat and 84 hectares of grassland habitat. However the habitat is unlikely to be affected to the extent that the above species of diurnal woodland 'edge' birds are no longer able to occupy the habitat. Subsequently it is unlikely that the proposal will accelerate the extinction of threatened diurnal woodland 'edge' birds or place them at risk of extinction.

Diurnal woodland 'interior' birds (Brown Treecreeper, Little Lorikeet, Glossy Black Cockatoo, Gang-gang Cockatoo, Varied Sittella, Painted Honeyeater)

The proposal will affect, via subsidence approximately 7 hectares of woodland habitat and approximately 3 hectares of riparian habitat. However, the habitat is unlikely to be affected to the extent that the above species of diurnal woodland 'interior' birds are no longer able to occupy the habitat. Subsequently it is unlikely that the proposal will accelerate the extinction of threatened diurnal woodland 'interior' birds or place them at risk of extinction.

Swift Parrot and Regent Honeyeater

The proposal will affect, via subsidence approximately 7 hectares of woodland habitat and approximately 3 hectares of riparian habitat. However, the habitat is unlikely to be affected to the extent that the above species of diurnal woodland 'interior' birds are no longer able to occupy the habitat. Subsequently it is unlikely that the proposal will accelerate the extinction of the Swift Parrot and Regent Honeyeater or place them at risk of extinction.

Threatened diurnal raptors (Little Eagle, Square-tail Kite, Spotted Harrier)

The proposal will affect, via subsidence approximately 7 hectares of woodland habitat, 3 hectares of riparian habitat and 84 hectares of grassland habitat. However due to the large home range of these species (several thousand hectares) and that the habitat is unlikely to be affected to the extent that prey species are no longer able to occupy the habitat, impacts to threatened diurnal raptors from this proposal are likely to be insignificant. Subsequently it is unlikely that the proposal will accelerate the extinction of threatened diurnal raptors or place them at risk of extinction.

Threatened owls (Barking Owl, Masked Owl, Powerful Owl)

The proposal will affect, via subsidence approximately 7 hectares of woodland habitat and 3 hectares of riparian habitat. However due to the large home range of these species (several thousand hectares) and that the habitat is unlikely to be affected to the extent that prey species are no longer able to occupy the habitat, impacts to threatened owls from this proposal are likely to be insignificant. Subsequently it is unlikely that the proposal will accelerate the extinction of threatened owls or place them at risk of extinction.

Cave-dependent microbat species (Large-eared Pied Bat, Little Bent-wing Bat, Eastern Bent-wing Bat)

No caves or overhangs will be affected by this proposal. The proposal will affect, via subsidence approximately 7 hectares of woodland foraging habitat, 3 hectares of riparian foraging habitat and 84 hectares of grassland foraging habitat. However, as the habitat is unlikely to be affected to the extent that foraging is no longer possible or efficient, impacts to threatened cave-dependent microbat species from this proposal are likely to be insignificant. Subsequently it is unlikely that the proposal will accelerate the extinction of threatened cave-dependent microbat species or place them at risk of extinction.

Hollow-dependent microbat species (Yellow-bellied Sheathtail Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat, Eastern Freetail Bat)

No hollow-bearing trees or roost trees would be removed by this proposal. The proposal will affect, via subsidence approximately 7 hectares of woodland foraging and roosting habitat, 3 hectares of riparian foraging and roosting habitat and 84 hectares of grassland foraging habitat. However, as the habitat is unlikely to be affected to the extent that foraging is no longer possible or efficient, impacts to threatened hollow-dependent microbat species from this proposal are likely to be insignificant. Subsequently it is unlikely that the proposal will accelerate the extinction of threatened hollow-dependent microbat species or place them at risk of extinction.

Southern Myotis

The proposal will affect, via subsidence approximately 3 hectares of riparian foraging However, as the habitat is unlikely to be affected to the extent that foraging is no longer possible or efficient, impacts to the Southern Myotis from this proposal are likely to be insignificant. Subsequently it is unlikely that the proposal will accelerate the extinction of the Southern Myotis or place it at risk of extinction.

Grey-headed Flying Fox

No Grey-headed Flying Fox camps occur within or adjacent to the subject site. The closest known Grey-headed Flying Fox camp occurs in Singleton, approximately 25 kilometres to the north-east. The proposal will affect, via subsidence approximately 7 hectares of woodland and 3 hectares of riparian habitat, which is a potential foraging resource for the Grey-headed Flying Fox. Subsequently it is unlikely that the proposal will accelerate the extinction of the Grey-headed Flying Fox or place it at risk of extinction.

4. Whether or not the Proposal will adversely affect critical habitat.

The NSW Government maintains a register of critical habitat. No critical habitat occurs within or adjacent to the study area.

Grey-headed Flying Fox		
Criteria (Vulnerable species)	**Consideration of Criteria**	**Likelihood**
An action is likely to have a significant impact on an important population of 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	The alteration of approximately ten hectares of potential Grey-headed Flying Fox habitat, via subsidence is unlikely to lead to a long-term decrease in the size of the local population as: • The subsidence is unlikely to alter the habitat to an extent that foraging is no longer possible. • Due to the presence of several thousand hectares of commensurate habitat in the Hunter Valley.	Unlikely
• reduce the area of occupancy of an important population	As no habitat will be removed and the level of habitat alteration to the ten hectares of potential Grey-headed Flying Fox habitat will be minor, the area of occupancy of the Grey-headed Flying Fox is unlikely to be reduced.	Unlikely
• fragment an existing important population into two or more populations	As no habitat will be removed and the level of habitat alteration to the ten hectares of potential Grey-headed Flying Fox habitat will be minor, along with the high dispersal ability of the species, it is unlikely that the proposal will fragment an existing population into two or more populations.	Unlikely
• adversely affect habitat critical to the survival of a species	Grey-headed Flying Fox camps are considered as habitat critical to the survival of the species. No Grey-headed Flying Fox camps are located within or adjacent to the subject site. The closest camp is located at Singleton, approximately 25 kilometres (km) to the north-west.	Unlikely
• disrupt the breeding cycle of an important population	Grey-headed Flying Foxes breed in camps. No Grey-headed Flying Fox camps are located within or adjacent to the subject site. The closest camp is located at Singleton, approximately 25 km to the north-west.	Unlikely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The alteration, via subsidence, of approximately ten hectares of potential Grey-headed Flying Fox habitat is unlikely to cause the Grey-headed Flying Fox to decline.	Unlikely
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposal will not lead to an invasive species becoming established that would lead to a decline in the Grey-headed Flying Fox. Wambo Coal Pty Ltd undertakes regular weed and feral animal control programs within land under their control.	Unlikely
• introduce disease that may cause the species to decline,	The proposal is not expected to cause any increase in the risk or prevalence of diseases that might impact this species.	Unlikely
• interfere substantially with the recovery of the species	The proposal does not interfere with any recovery strategies for this species and does not add to any identified key threatening processes.	Unlikely
CONCLUSION	Due to no removal of Grey-headed Flying Fox habitat and the small extent of habitat modification from subsidence, the proposal is unlikely to affect the Grey-headed Flying Fox population.	

Large-eared Pied Bat		
Criteria (Vulnerable species)	**Consideration of Criteria**	**Likelihood**
An action is likely to have a significant impact on an important population of a vulnerable species if there is a real chance or possibility that it will:		
• lead to a long-term decrease in the size of a population of a species	The alteration of approximately ten hectares of potential Large-eared Pied Bat foraging habitat, via subsidence is unlikely to lead to a long-term decrease in the size of the local population as: • The subsidence is unlikely to alter the habitat to an extent that foraging is no longer possible. • Due to the presence of several thousand hectares of commensurate habitat in the Hunter Valley. • Due to the large nightly foraging patterns of this species (>10 km per night).	Unlikely
• reduce the area of occupancy of a population	As no habitat will be removed, no sandstone overhangs will be affected and the level of habitat alteration to the 94 hectares of potential Large-eared Pied Bat potential habitat will be minor, the area of occupancy of the Large-eared Pied Bat is unlikely to be reduced.	Unlikely
• fragment an existing population into two or more populations	As no habitat will be removed and the level of habitat alteration to the 94 hectares of potential Large-eared Pied Bat habitat will be minor, along with the high dispersal ability of the species, it is unlikely that the proposal will fragment an existing population into two or more populations.	Unlikely
• adversely affect habitat critical to the survival of a species	Large-eared Pied Bat roosts (which occur in caves) are considered as habitat critical to the survival of the species. No potential or known Large-eared Pied Bat roosts are located within or adjacent to the subject site. The nearest potential roosts are located in the sandstone escarpment country, approximately 2 km to the south of the subject site. Thus it is unlikely that the proposal will adversely affect habitat critical to the survival of the Large-eared Pied Bat.	Unlikely
• disrupt the breeding cycle of a population	Large-eared Pied Bats breed in sandstone overhangs/ caves. No potential or known caves/ overhangs are located within or adjacent to the subject site. The closest potential caves/ overhangs that the species may use to breed are located in the escarpment country, approximately 2 km to the south-west of the subject site.	Unlikely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The alteration, via subsidence, of approximately ten hectares of potential Large-eared Pied Bat habitat is unlikely to cause the Large-eared Pied Bat to decline.	Unlikely
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposal will not lead to an invasive species becoming established that would lead to a decline in the Large-eared Pied Bat. Wambo Coal Pty Ltd undertakes regular weed and feral animal control programs within land under their control.	Unlikely
• introduce disease that may cause the species to decline,	The proposal is not expected to cause any increase in the risk or prevalence of diseases that might impact this species.	Unlikely
• interfere substantially with the recovery of the species	The proposal does not interfere with any recovery strategies for this species and does not add to any identified key threatening processes.	Unlikely
CONCLUSION	Due to no removal of Large-eared Pied Bat habitat and the small extent of habitat modification from subsidence, the proposal is unlikely to affect the Large-eared Pied Bat population.	

Regent Honeyeater and Swift Parrot		
Criteria (Endangered species)	**Consideration of Criteria**	**Likelihood**
An action is likely to have a significant impact on an important population of an 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	The alteration of approximately ten hectares of potential Swift Parrot and Regent Honeyeater habitat, via subsidence is unlikely to lead to a long-term decrease in the size of the local population as: • The subsidence is unlikely to alter the habitat to an extent that foraging is no longer possible. • Due to the presence of several thousand hectares of commensurate habitat in the Hunter Valley. • Due to the migratory nature of the Regent Honeyeater and Swift Parrot.	Unlikely
• reduce the area of occupancy of the species	As no habitat will be removed and the level of habitat alteration to the ten hectares of potential Regent Honeyeater and Swift Parrot habitat will be minor, the area of occupancy of the Regent Honeyeater and Swift Parrot is unlikely to be reduced.	Unlikely
• fragment an existing population into two or more populations	As no habitat will be removed and the level of habitat alteration to the ten hectares of potential Regent Honeyeater and Swift Parrot habitat will be minor, along with the high dispersal ability of the species, it is unlikely that the proposal will fragment an existing population into two or more populations.	Unlikely
• adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the Regent Honeyeater are breeding areas and large tracts of forests and woodlands dominated by winter flowering Eucalypts (e.g. Spotted-Gum Ironbark, Box Gum Woodlands). The closest known breeding site for the Regent Honeyeater occurs near Cessnock. The habitat that will be modified by subsidence is a small fragment and does not connect to any larger remnant. Habitat critical to the survival of the Swift Parrot are breeding areas in Tasmania and large tracts of forests and woodlands dominated by winter flowering Eucalypts. The habitat that will be modified by subsidence is a small fragment and does not connect to any larger remnant. Therefore the proposal is unlikely to affect habitat critical to the survival of the Regent Honeyeater and Swift Parrot.	Unlikely
• disrupt the breeding cycle of a population	The closest known breeding site for the Regent Honeyeater is near Cessnock, approximately 30 km to the south-east. The Swift Parrot breeds entirely within Tasmania. Thus the proposal is unlikely to disrupt the breeding cycle of these species.	Unlikely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The alteration, via subsidence, of approximately ten hectares of potential Regent Honeyeater and Swift Parrot habitat is unlikely to cause these species to decline.	Unlikely

Regent Honeyeater and Swift Parrot (Continued)		
Criteria (Endangered species)	**Consideration of Criteria**	**Likelihood**
• result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat	The proposal will not lead to an invasive species becoming established that would lead to a decline in the Regent Honeyeater and Swift Parrot. Wambo Coal Pty Ltd undertake regular weed and feral animal control programs within land under their control.	Unlikely
• introduce disease that may cause the species to decline,	The proposal is not be expected to cause any increase in the risk or prevalence of diseases that might impact this species.	Unlikely
• interfere substantially with the recovery of the species	The proposal does not interfere with any recovery strategies for this species and does not add to any identified key threatening processes.	Unlikely
CONCLUSION	Due to no removal of Swift Parrot and Regent Honeyeater habitat and the small extent of habitat modification from subsidence, the proposal is unlikely to affect the Swift Parrot or Regent Honeyeater population.	

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