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Environment and Heritage

# Tahmoor North Longwalls 31 to 37

## Terrestrial Ecology Assessment

**Prepared for Tahmoor Coal**

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*Cover photograph:* Stone Quarry Creek

# Table of Contents

## List of Figures



## List of Tables

# 1. Executive summary

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Tahmoor Coal to undertake a terrestrial flora and fauna assessment of the potential subsidence impacts associated with the proposed mining of Longwalls 31 to 37 at Tahmoor Colliery.

This document constitutes the terrestrial ecological assessment to accompany and inform the Subsidence Management Plan (SMP). Specifically this report assesses whether the proposal is likely to have a significant impact on threatened biodiversity listed on the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

**Results of the terrestrial ecological assessment**

Vegetation in the study area has been mapped as part of Tozer (2006) Native vegetation of southeast NSW. Vegetation mapped in the study area includes the following vegetation units (following the nomenclature of Tozer 2006): Coastal Sandstone Ridgetop Woodland, Hinterland Sandstone Gully Forest, Sydney Hinterland Transition Woodland, Cumberland Shale Sandstone Transition Forest, Cumberland Shale Hills Woodland, Cumberland Shale Plains Woodland, Cumberland River Flat Forest, Grey Myrtle Dry Rainforest and Cumberland Moist Shale Woodland.

Based on the vegetation mapping, four Threatened Ecological Communities (TECs) are likely to occur in the study area:

- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest.
- Shale Sandstone Transition Forest.
- Moist Shale Woodland in the Sydney Basin Bioregion.
- River-flat Eucalypt Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregion.

No threatened flora species were recorded during the current survey. However the study area has potential habitat for the following threatened flora: *Acacia pubescens, Epacris purpurascens var. purpurascens, Grevillea parviflora subsp. parviflora, Leucopogon exolasius, Persoonia bargoensis, Pimelea spicata, Pomaderris brunnea, Pterostylis saxicola and Tetratheca glandulosa.*

One threatened fauna species was recorded by Niche in the study area: Varied Sittella. The Cumberland Plain Land Snail has also been previously recorded by Niche to the immediate west the study area. The species is therefore likely to occur in the study area.

After considering the habitat present in the study area and the results of the field survey, 34 of these threatened fauna were considered to have a moderate to high likelihood of occurrence study area. These species include:

- Amphibians: Red-crowned Toadlet.
- Birds: Regent Honeyeater, Fork-tailed Swift, Great Egret, Bush Stone-curlew, Gang-gang Cockatoo, Glossy Black-Cockatoo, Brown Treecreeper (eastern subspecies), Varied Sittella, Little Eagle, White-throated Needletail, Swift Parrot, Square-tailed Kite, Hooded Robin (south-eastern form), Black-chinned Honeyeater (eastern subspecies), Rainbow Bee-eater, Black-faced Monarch, Satin Flycatcher, Turquoise Parrot, Barking Owl, Powerful Owl, Scarlet Robin, Speckled Warbler, Rufous Fantail, Masked Owl.
- Invertebrates: Cumberland Plain Land Snail.
- Mammals: Large-eared Pied Bat, Little Bentwing-bat, Eastern Bentwing-bat, Eastern Freetail-bat, Southern Myotis, Koala, Grey-headed Flying-fox, Greater Broad-nosed Bat.

**Subsidence impacts to vegetation**

Subsidence predictions for Longwalls 31 to 37 were investigated and reported by MSEC (2014). A flood impact study was also conducted for the project by WRM Water & Environment Pty Ltd (WRM). An assessment of the impacts to water quality associated with the proposal was investigated and reported by GeoTerra (2014).

Based on previous assessments in the Southern Coalfield and MSEC (2014), it has been concluded that the majority of vegetation within the study area would not be impacted by subsidence due to underground mining but that limited impacts may potentially occur for riparian vegetation. Riparian vegetation potentially impacted by subsidence is generally not mapped as discrete vegetation communities, rather these areas display structural and floristic variation within their composite community in response to more frequent contact with the local water table.

MSEC (2014) states that it is likely that gas emissions will occur as a result of the mining of the longwalls. It is possible for gas emissions at the surface to cause localised vegetation die-back. This is a rare event and has only occurred previously on one occasion at Tower Mine, over small areas in the base of the Cataract Gorge that had been directly mined beneath. These impacts were limited to small areas of vegetation, local to the points of emission, and when the gas emissions declined, the affected areas were successfully restored. It is therefore likely, that should any gas emissions occur these may only result in localised short-term impacts to riparian vegetation.

Woodland and ridgeline vegetation communities within the study area are unlikely to be impacted by subsidence. It is possible that cracking may occur within these communities, however cracking is unlikely to cause any significant impact, as these communities occur in drier soils and are not ultimately reliant upon groundwater.

**Impacts to threatened biodiversity**

Threatened species reliant upon watercourses, riparian vegetation and overhangs may be potentially impacted by subsidence as a result of the proposal.

Impacts associated with subsidence have the potential to impact threatened amphibians and those species reliant upon overhangs and riparian vegetation.

Assessments of Significance under the TSC and EPBC Acts were carried out for the following species potentially impacted by subsidence:

- Flora: *Pomaderris brunnea, Epacris purpurascens* var. *purpurascens*;
- Amphibians: Red-crowned Toadlet;
- Mammals: Large-eared Pied Bat, Eastern False Pipistrelle, Eastern Bent-wing Bat, Eastern Freetail Bat, Large-footed Myotis, and Eastern Cave Bat.

The Assessments of Significance conducted for these species concluded that the proposal is unlikely to have a significant impact on any threatened biodiversity.

**The report recommends**

- All remediation works that are undertaken near waterways, must take appropriate measures to minimise environmental impacts. This includes avoiding the spread of Chytrid Fungus following the NPWS guidelines and the removal of areas of riparian vegetation to provide access for plant and equipment to the waterways.

- Any subsidence impacts from the proposal on terrestrial ecological values should be assessed at the completion of each longwall panel to ensure any remediation (if required) is undertaken in a timely manner. This will also assist in increasing the accuracy of predictions of impacts from future longwall mining in the area. The condition of plant communities and habitats should be assessed at sample sites that were assessed prior to the commencement of longwall mining to gain further information regarding possible changes to the habitats due to mining related subsidence.
- In the unlikely event that gas release related die-off is observed, actions should be taken to monitor the extent of and recovery of any such vegetation impacts.

Neither a Species Impact Statement nor a Referral to the Commonwealth Minister for the Environment in relation to threatened biodiversity are recommended for any threatened biodiversity.

## 2. Glossary and abbreviations

| | |
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| **Flora and fauna of conservation significance** | Threatened species or populations listed on the schedules of the TSC Act and/or listed as Matters of National Environmental Significance (MNES) under the EPBC Act |
| **Local population** | The population of a particular threatened species that occurs in the locality |
| **Locality** | The area within 10 km of the study area |
| **Local occurrence** | Refers to the distribution of an ecological community within the study area and continuous with it |
| **MNES** | Matters of National Environmental Significance listed on the EPBC Act |
| **OEH** | The NSW Office of Environment and Heritage |
| **TEC** | Threatened Ecological Community as listed on the TSC Act and or EPBC Act. TEC is a collective term to describe vulnerable, endangered and critically endangered ecological communities |
| **Threatened biodiversity** | Threatened species, populations and ecological communities as listed on the TSC and or EPBC Acts |
| **TSC Act** | NSW *Threatened Species Conservation Act 1995* |
| **EPBC Act** | Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* |
| **EP&A Act** | NSW *Environmental Planning and Assessment Act 1979* |
| **SEPP** | State Environment Planning Policy |
| **SMP** | Subsidence Management Plan |

# 3. Introduction

## 3.1 Background

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Tahmoor Coal Pty Ltd (Tahmoor Coal) to undertake a terrestrial flora and fauna assessment of the potential subsidence impacts on terrestrial ecological values associated with the proposed mining of Longwalls 31 to 37 at Tahmoor Colliery (Figure 1).

This document constitutes the terrestrial ecological assessment to accompany and inform the Subsidence Management Plan (SMP) for the project. This terrestrial ecological report has been prepared to meet the relevant sections of the NSW Department of Primary Industries (DPI) Guideline for Applications for Subsidence Management Plan (SMP) Approvals December 2003.Project context

Tahmoor Coal seeks approval to extract coal from Longwalls 31 to 37. Extraction of the coal will be undertaken using longwall mining methods which will cause subsidence of the lands surface. The mine is subject to two difference development consents and associated leases as follows:

- The majority of the northern section of the mine received development consent in 1994 from the Land and Environment Court (DA57/93). This section is covered by Mining Lease Number 1376, and
- Sections beneath urban areas and the railway line that received development consent in 1999 from the Minister for Urban Affairs and Planning (DA67/98) and which is covered by Mining Lease Number 1539.

## 3.2 Purpose and objectives

The primary objective of this report is to describe and assess ecological values within the study area and surrounds and determine whether the proposal is likely to have a significant impact on threatened biodiversity. A description of likely impacts from the development and consideration of mitigation measures is also provided.

The approach of this assessment includes the following:

- Undertake a background review of relevant literature, mapping and databases.
- Conduct a field survey using recognised methods to assess the ecological values of the site.
- Describe the ecological values of the site in regard to flora, fauna and vegetation communities.
- Determine the impact of the proposal on threatened biodiversity and habitat, and undertake formal assessments under relevant legislation where required.
- Provide recommendations and options on how to conserve and enhance the ecological and biodiversity features of the subject area.

## 3.3 Study area

The study area includes the SMP area and the surrounding aquatic environment (Figure 1). The study area occurs within the boundaries of Wollondilly Local Government Area (LGA) and is located approximately 80 kilometres south west of Sydney, in the vicinity of the townships of Picton, Thirlmere and Tahmoor (Figure 2). The study area is located in the Southern Coalfield and is encompassed by CCL 747 and CCL 716 and situated on the south western edge of the Sydney Basin.

The study area is approximately 1043.6 hectares in size. Most of the study area comprises of rural land, with industrial and residential land toward the centre and south-east portion.

Topography varies within the study area, however most of the study area is located on gently undulating flats. The far northern section of the study area contains steep, incised gullies with exposed Hawkesbury Sandstone along Matthews Creek, Stonequarry Creek and Cedar creeks. Redbank Creek occurs toward the northern portions of Longwalls 31 to 32 and is also located within an incised gully.

### 3.3.1 Rivers and creeks

Vegetated land is concentrated along the riparian zones of watercourses, namely Redbank Creek, Stonequarry Creek, Matthews Creek and Cedar creek. These watercourses and the vegetation associated with them are the main natural features within the study area.

The watercourses within the study area provide habitat connectivity eventually joining the Bargo River approximately one kilometre to the south of the study area.

### 3.3.2 Cliffs and rock outcrops

A total of 11 cliffs have been identified within the study area, of which two are located directly above Longwall 35 (MSEC 2014). There are cliffs located along Cedar Creek to the north of the proposed Longwalls 35 to 37; and along Matthews Creek above Longwall 35, and to the north and west of Longwalls 36 and 37.

A number of rock outcrops have been identified within the study area. Rock outcrops are located along Matthews Creek and Cedar Creek. There is also one rock outcrop identified within the study area above Longwall 29 at Redbank Creek.

### 3.3.3 Swamps and wetlands

No swamps or wetlands have been identified within the study area.

### 3.3.4 National Parks and Conservation Reserves

No National Parks or conservation reserves occur within the study area. Thirlmere Lakes National Park is located approximately 3.7 kilometres from the proposed longwalls. It is outside the limits of predicted subsidence.

## 3.4 Mine subsidence predictions

Subsidence predictions for Longwalls 31 to 37 were investigated and reported by MSEC (2014). A flood impact study was also conducted for the project by WRM Water & Environment Pty Ltd (WRM). An assessment of the impacts to water quality associated with the proposal was investigated and reported by GeoTerra (2014).

The natural surface features which are sensitive to subsidence movements have been identified by MSEC and include the following: Redbank Creek, Stone Quarry Creek, Matthews Creek and Cedar Creek, other drainage lines, creeks, rock outcrops, and cliffs.

These features provide important habitat for terrestrial ecological values and therefore a detailed consideration of the potential effects of subsidence on these features is warranted in order to accurately assess any potential impacts and consequences.

A summary of the predicted impacts (MSEC 2014, GeoTerra 2014 and WRM 2014) that the proposal will have on these features is described below.

***Creeks***

- The streams, which are located directly above the proposed longwalls, could experience the full range of predicted subsidence movements (MSEC 2014).
- A reduction in grade is predicted to occur on the downstream edge of Longwall 32 and this may result in localised ponding (MSEC 2014).
- It is possible that there could be localised areas along the streams which could experience small increases in the levels of ponding. Any localised changes in ponding are expected to be minor and not result in adverse impacts on these streams (MSEC 2014).
- The potential for increased scouring is not expected to be substantial (MSEC 2014).
- Where the longwalls mine directly beneath the streams it is considered likely that fracturing could result in surface water flow diversions (MSEC 2014).
- Upsidence and compressive strains due to valley closure are expected to be of sufficient magnitude to cause the underlying strata to buckle and induce cracking at the surface at some locations. This can lead to the diversion of water from the stream beds into the dilated strata beneath it. It is unlikely, however, that there would be any net loss of water from the catchment since any redirected flow would not intercept any flow path that would allow the water to be diverted into deeper strata or the mine (MSEC 2014).
- If substantial fracturing were to occur, partial or complete diversion of surface water and drainage of pools could occur at locations and times where the rate of flow diversion is greater than the rate of incoming surface water (MSEC 2014).
- The majority of the streams are ephemeral and so water typically flows during and for a period of time after each rain event. In times of heavy rainfall, the majority of the runoff would flow over the beds of the streams and would not be completely diverted into the dilated strata below the stream beds. In times of low flow or prolonged periods of dry weather, however, some or all of the water could be diverted into the strata below the stream beds for those sections of the streams that are located over the mined panels (MSEC 2014).
- While much of the channel beds are exposed bedrock, sediments were also commonly found in the creek beds throughout the study area. Where such loose materials occur, it is possible that fracturing in the bedrock would not be seen at the surface. In the event that fracturing of the bedrock occurs in these locations within the alignments of the streams, the fractures may be filled with soil during subsequent flow events reducing the flow through the fractures (MSEC 2014).
- Based on the previous experience of mining beneath streams at Tahmoor Colliery, it is likely that fracturing and surface flow diversions will occur in the sandstone bedrock along the streams, particularly for streams that are located directly above the proposed longwalls. In some of these locations, the fracturing could impact the holding capacity of the standing pools, particularly those located directly above the proposed longwalls. It is unlikely, however, that there would be any net loss of water from the catchment (MSEC 2014).
- Where there are substantial sediment accumulations upstream of these areas, it is expected that some of the fractures would be naturally filled over time with sediment during subsequent flow events, as was observed in the Bargo River and Dog Trap Creek. Where little sediment is present, the impacts are likely to remain for longer periods of time and remediation may be required after the completion of mining, which could include sealing these fractures and voids with grout (MSEC 2014).
- With respect to streams or sections of streams located away from the proposed longwalls, the likelihood of fracturing and surface flow diversions reduces substantially compared to stream sections located directly above the proposed longwalls (MSEC 2014).
- Based on observation of subsided reaches in Myrtle and Redbank Creeks over Longwalls 22 to 28, it is anticipated that no observable adverse effect on stream bed or bank stability will occur in Redbank, Matthews, Cedar or Stonequarry Creeks, even though significant cracking of outcropping sandstone stream bed and rock bars is likely (GeoTerra 2014).

- Due to the high vegetation cover, the urbanisation of the catchment and the minimal predicted development of surface cracking in the SMP area streams, it is not anticipated that significant erosion or channel incision will be observed due to subsidence (GeoTerra 2014).

***Potential gas emissions and water quality***

- It is likely that gas emissions will occur as a result of the mining of the longwalls. Gas is often released into rivers and streams as these areas form topographical low points in the landscape. Where these gas releases occur into the water column there is insufficient time for any substantial amount of gas to dissolve into the water. The majority of the gas is released into the atmosphere and is unlikely to have an adverse impact on water quality (MSEC 2014).
- It is possible for substantial gas emissions at the surface to cause localised vegetation die-back. This is a rare event and has only been observed to occur previously on one occasion at Tower Colliery, over small areas in the base of the Cataract Gorge that had been directly mined beneath by two Longwalls. These impacts were limited to small areas of vegetation, local to the points of emission, and when the gas emissions declined, the affected areas were successfully restored (MSEC 2014).
- Based on the observed chemistry changes in Redbank Creek over Longwalls 22 to 28 and the anticipated subsidence impacts on the stream, it is anticipated that iron, manganese, zinc and nickel could increase in Redbank Creek over and downstream of Longwall 31 associated with increased iron hydroxide precipitation over Longwalls 31 and 32 due to enhanced groundwater seepage into the creek (GeoTerra 2014).
- Based on the similarity in the water chemistry of Myrtle Creek and Matthews Creek and the lack of iron hydroxide precipitation indicating limited or no groundwater seepage, as well as the predicted subsidence impacts on the stream, it is anticipated that no significant change in water quality will occur in Matthews Creek (GeoTerra 2014).
- Based on its similarity to Redbank Creek water chemistry and the anticipated subsidence impacts on the stream, it is anticipated that iron, manganese, zinc and nickel could increase in Cedar Creek over and downstream of the junction with Matthews Creek, adjacent to Longwall 35 associated with increased iron hydroxide precipitation due to enhanced groundwater seepage into the creek (GeoTerra 2014).
- Based on the similarity in the water chemistry of Stonequarry Creek and Myrtle Creek and the lack of iron hydroxide precipitation indicating limited or no groundwater seepage, as well as the predicted subsidence impacts on the stream, it is anticipated that no significant change in water quality will occur in Stonequarry Creek (GeoTerra 2014).

***Cliffs and rock outcrops***

- Given that the proposed longwalls will mine directly beneath and adjacent to cliffs near the junction of Cedar and Matthews Creeks, it is possible that rockfalls could occur in this location (MSEC 2014).
- Studies of mining directly beneath cliffs located along the Nepean, Cataract and Bargo Rivers, suggests that the extent of impact is between 2 % and 5 % of the cliff line located directly above the extracted longwalls (MSEC 2014).
- The extraction of the proposed longwalls is likely to result in some fracturing of the rock outcrops and, where the rock is marginally stable, could then result in instabilities. Previous experience in the Southern Coalfield indicates that the percentage of rock outcrops that are likely to be impacted by mining is very small (MSEC 2014).
- The case studies show that although very minor rock falls have been observed over solid coal outside the extracted goaf areas of longwall mining in the Southern Coalfield, there have been no recorded large cliff instabilities outside the extracted goaf areas of longwall mining in the Southern Coalfield (MSEC 2014).

- Based on the previous experience of mining at Appin and Tower Collieries, it is possible that isolated rock falls could occur as a result of the extraction of the proposed longwalls for the cliffs and rock outcrops within the study area that are not directly above the proposed longwalls. It is also unlikely that any large cliff instabilities would occur as a result of mining, as the longwalls are not proposed to be extracted directly beneath the cliffs (MSEC 2014).


Drawn by: GT Project Manager: MR Project Number: 2276 Date: 4/12/2014

Project Location

Tahmoor North Subsidence Management Plan - Terrestrial Ecology Assessment

**FIGURE 1**

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Drawn by: GT Project Manager: MR Project Number: 2276 Date: 4/12/2014

Site map

Tahmoor North Subsidence Management Plan - Terrestrial Ecology Assessment

**FIGURE 2**

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# 4. Literature review

## 4.1 Database and literature sources

Databases reviewed as part of this study include:

- DECC (2008) Threatened Species Profiles Database, NSW Department of Environment and Climate Change (now OEH).
- OEH Atlas of NSW Wildlife (accessed November 2014, 10 km radius search area).
- The EPBC Act Protected Matters Search Tool (accessed November 2014; 10 km radius search area).

Literature and data sources reviewed included:

- MSEC (2014) Subsidence predications and impact assessments for Longwalls 31 to 37, Prepared for Tahmoor Coal.
- GeoTerra (2014) Glencore Coal - Tahmoor Colliery Longwall Panels 31 to 37 streams, dams & groundwater assessment Tahmoor, NSW. Prepared for Tahmoor Coal.
- WRM (2014) Tahmoor Coal Flood Impact Assessment: LW31 to 37, Prepared for Tahmoor Coal.
- DOP (2008) Impacts of Underground Coal Mining on Natural Features in the Southern Coalfields - Strategic Review. State of NSW through the Department of Planning, 2008 (commonly referred Commission, 2009).
- NPWS (2002) The native vegetation of the Cumberland Plain, Western Sydney.
- PAC (2009) The Metropolitan Coal Project Review Report. State of NSW through the NSW Planning Assessment.
- PAC (2010) Review of the Bulli Seam Operations Project. State of New South Wales through the NSW Planning Assessment Commission, 2010.
- Biosis Research (2009) Tahmoor Colliery – Longwalls 27-30 Impacts of Subsidence on Terrestrial Flora and Fauna Prepared for Tahmoor Coal.
- Tozer (2006) Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands.

## 4.2 Review of previous studies

The following studies and reviews have been taken into consideration for the current assessment.

### 4.2.1 Tahmoor Colliery – Longwalls 27-30 impacts of subsidence on terrestrial flora and fauna prepared for Tahmoor Coal

A previous assessment commissioned by Tahmoor Coal to undertake a terrestrial flora and fauna impact assessment for potential subsidence impacts predicted for proposed longwall mining at Tahmoor Colliery, specifically Longwalls 27-30 was reviewed in detail (Biosis Research 2009). The study area of the current assessment is directly adjacent to the study area of the previous assessment.

Key findings include:

- Four Endangered Ecological Communities (EECs) were recorded: Cumberland Plain Woodland, Shale Sandstone Transition Forest, River-flat Eucalypt Forest and Moist Shale Woodland.
- No threatened flora species were recorded; however potential habitat for four threatened flora species was determined to potentially be impacted by subsidence: *Epacris purpurascens var. purpurascens, Persicaria elatior, Pomaderris brunnea* and *Pterostylis saxicola*.
- The assessment has concluded that the longwalls are unlikely to have a significant impact on any of these threatened plant species.

- Limited potential habitat for a total of 31 threatened and/or migratory animal species was recorded. Three of these species Large-footed Myotis, Spotted-tailed Quoll, and Large-eared Pied-bat were considered to have potential habitat that may be impacted by subsidence. This assessment has concluded that the longwall extraction is unlikely to have a significant impact on a local population of any of these
- Species Impact Statements and/or Referrals to the Environment Minister were not recommended for any plant communities or plant or animal species.

### 4.2.2 Impacts of underground coal mining on natural features in the Southern Coalfields -Strategic Review (DOP 2008)

Key findings from the report include the following:

- Risk Management Zones (RMZs) should be identified for all significant environmental features which are sensitive to valley closure and upsidence, including rivers, significant streams, significant cliff lines and valley infill swamps. Tahmoor Coal applied the RMZ methodology to the project risk assessment.
- RMZs for watercourses should be applied to all streams of 3rd order or above, in the Strahler stream classification. RMZs should also be developed for valley infill swamps not on a 3$^{rd}$ or higher order stream and for other areas of irregular or severe topography, such as major cliff lines and overhangs not directly associated with watercourses.
- A minimum of two years of baseline data, collected at an appropriate frequency and scale, should be provided for significant natural features, whether located within an RMZ or not.
- Identification and assessment of significance for all natural features located within 600 m of the edge of secondary extraction.
- Before After Control Impact (BACI) study is considered the most appropriate design for many impact studies. Appropriate replication in both impact (directly above the mine) and control (outside direct impact zone) sites is required in monitoring programs so natural variability can be determined.
- Environmental assessments should include identification and assessment of significance for all natural features located within 600 m of the edge of secondary extraction.

### 4.2.3 Review of the Bulli Seam Operations Project (PAC 2009)

Key findings from the report include the following:

- A significant contributing factor to significance is that 'only streams larger than third order have been chosen for application of risk assessment procedures in the EA. In reality, the condition of third order streams cannot be divorced from the condition of their first and second order tributaries or for that matter, the condition of the swamps that supply their base flow. It follows that if any third order or larger stream qualifies for special protection or special significance status on these grounds, then assessment of all of its tributaries is required to determine whether subsidence-induced impacts could compromise the protection status of the stream itself.' Note: there are no swamps within the current study area.
- Clearing and catastrophic fire aside, the greatest risk to habitats in the Project Area (including EECs) derives from subsidence-induced impacts on the hydrology of these habitats.
- Comprehensive surveys should be conducted with a view to identifying EECs or threatened species and, where these are found, assessing population viability and risk from subsidence-related impacts of mining. If significant EECs or populations of threatened species are found, measures to protect those EECs and/or threatened species should be developed prior to any mining commencing.

- In the Panel views the sampling intensity for flora must be sufficient to identify and describe the key habitats (including all EECs that are present) and any threatened species or aggregations of threatened species that are present. It is only when the extent of the EECs and threatened species is properly mapped and described that any consideration of the possible environmental consequences can begin using the approaches recommended in the SCI and refined in the Metropolitan PAC Report.
- Recommended that EECs and vegetation communities be ground truthed.
- When considering Red-crowned Toadlet, the need to consider the 'potential impacts of subsidence on water quality in these ephemeral streams and the localised nature of the populations making them vulnerable to location-specific impacts'.

The current assessment has undertaken a survey within habitats that are susceptible to subsidence impacts at a suitable scale to detect the presence of threatened species or to infer their presence.

### 4.2.4 The Metropolitan Coal Project Review Report (PAC 2009)

Key findings from the report include the following:

- RMZs should be identified for all significant environmental features which are sensitive to valley closure and upsidence, including rivers, significant streams, significant cliff lines and valley infill swamps.
- 
- RMZs for watercourses should be applied to all streams of 3rd order or above, in the Strahler stream classification. RMZs should also be developed for valley infill swamps not on a 3rd or higher order stream and for other areas of irregular or severe topography, such as major cliff lines and overhangs not directly associated with watercourses.
- Environmental assessments for project applications lodged under Part 3A should be subject to the following improvements in the way in which they address subsidence effects, impacts and consequences:
  - a minimum of 2 years of baseline data, collected at an appropriate frequency and scale, should be provided for significant natural features, whether located within an RMZ or not;
  - identification and assessment of significance for all natural features located within 600 m of the edge of secondary extraction;
- There should be a no risk approach adapted to damage from mining, particularly for those habitats considered to be of high conservation value. This includes incised valleys and their creeks and streams, upland swamps and the endangered Southern Sydney Sheltered Forest on Transitional Sandstone Soils.
- The Panel considered that the likely impact on individual protected flora and fauna species will generally follow the same pattern as the likely impact on habitats. The only caveat to this is where a species may be rare and its occurrence confined to one or a few units of the habitat type within the Project Area. Negative environmental consequences for the habitat unit (of itself not significant in terms of overall security of the habitat type) could then produce a negative species outcome that was highly significant.
- Nothing of substance was presented to the Panel to suggest that any individual species other than those already on statutory schedules would be at risk from the mining proposal, although it is clear that some individual members of a species may suffer consequences from localized impacts.

# 5. Methodology

## 5.1 Field survey methodology

The study area was investigated by two ecologists - Luke Baker (Niche - Botanist) and Matthew Russel (Niche - Ecologist) on the 15th to 17th of October 2014. The northern section of the study area was inspected again on the 3rd of November 2014 by Dr Frank Lemckert (Niche – Ecologist and amphibian expert).

The survey focused on areas of habitat likely to be susceptible to subsidence, such as watercourses, ridgelines and riparian areas. Within the study area these areas included the land surrounding the following: Redbank Creek, Matthews Creek, Cedar Creek, and Stone Quarry Creek.

The current survey has relied upon existing vegetation mapping where possible. Detailed vegetation mapping was not considered necessary for this assessment given the very low likelihood of vegetation being impacted by subsidence (section 7.1). Further, it was not possible to obtain access to much of the vegetated lands as it occurs on private lands for which landowner permission was not granted.. However, to complement the existing data, 10 vegetation plots were conducted along riparian areas to confirm the presence/absence of Threatened Ecological Communities (TECs) within proximity to areas of potential subsidence.

General traverses were conducted between plot sites which yielded data such as the presence of threatened plant species.

## 5.2 Vegetation mapping

Vegetation mapping used in this assessment is the Native Vegetation of Southeast NSW (Tozer 2006).

Ten BioBanking plots each 50 metres by 20 metres were collected across the study area to compliment the existing mapping. The extent of the survey is shown in Figure 3.

The use of BioBanking plots allowed the following attributes to be collected:

- Native Species Richness (20 by 20 metre)
- Native Over-Storey Cover (Projective Foliage Cover at five metre intervals along 50 metre transect)
- Native Mid-Storey Cover (Projective Foliage Cover at five metre intervals along 50 metre transect)
- Native Ground Cover (grasses) (Frequency tally at one metre intervals along 50 metre transect)
- Native Ground Cover (shrubs) (Frequency tally at one metre intervals along 50 metre transect)
- Native Ground Cover (other) (Frequency tally at one metre intervals along 50 metre transect)
- Exotic Cover (as for native over-storey, mid-storey and groundcover)
- Overstorey Regeneration (proportion of overstorey dominants present as immature recruitment)
- Number Of Trees With Hollows (within 50 by 20 metre plot)
- Total Length of Fallen Logs (within 50 by 20 metre plot).

All vascular plant species were recorded within each 20 by 20 metre plot used for Native Plant Species Richness score in the BioBanking plots, and were assigned a cover abundance score using a modified six point scale:

1. Rare, few individuals (three or less) present and cover <5 %
2. Common (consistent throughout plot) and <5 %
3. Cover 6-20 %
4. Cover 21-50 %

5. Cover 51-75 %
6. Cover >75 %

Estimates were made of the height, cover and dominant species within each vegetation stratum. Measurements of slope, aspect, and horizon azimuths were taken. Notes on geology, disturbance and soil were compiled.

## 5.3 Fauna

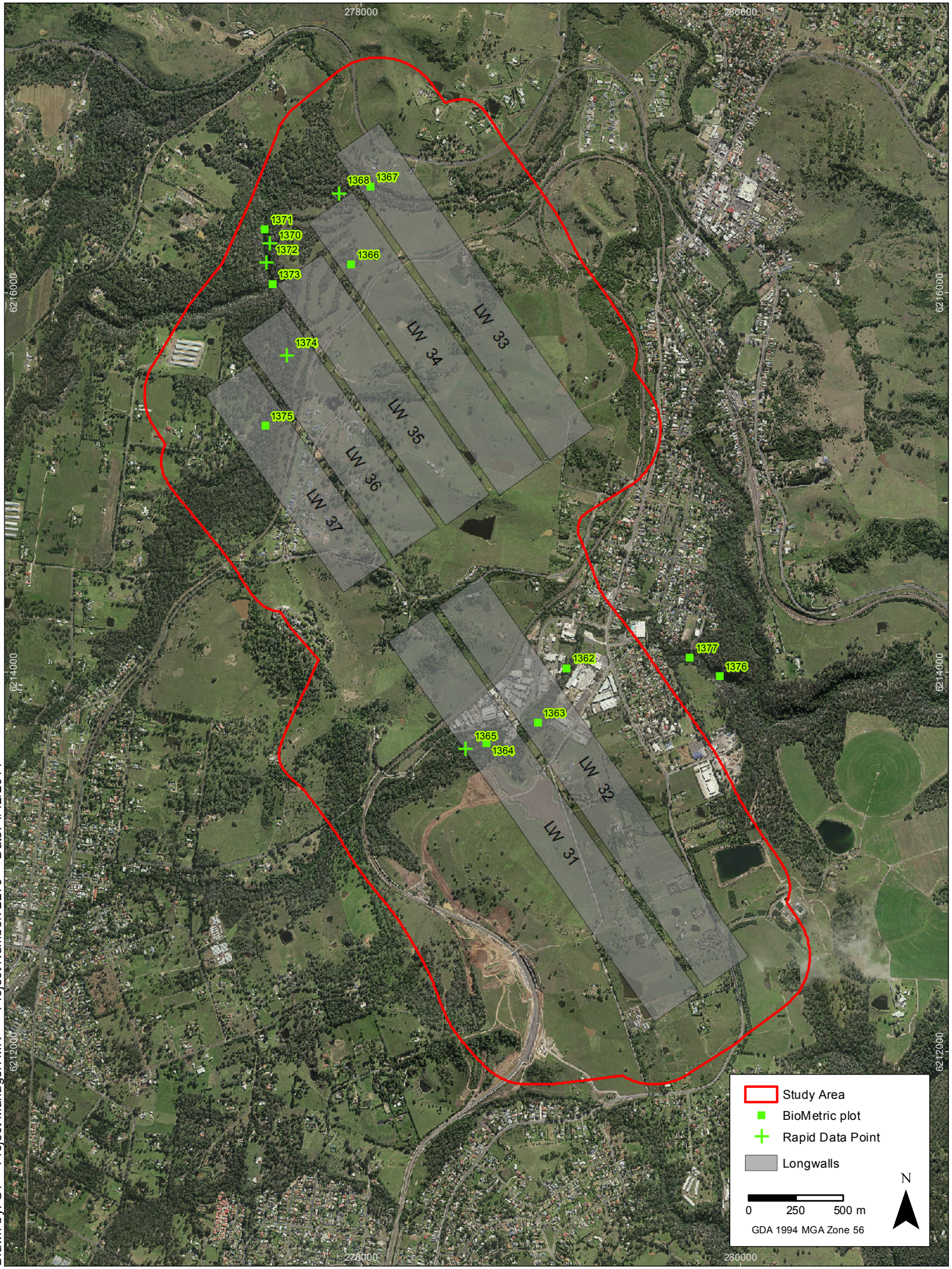
A habitat assessment was conducted within the study area, along with a tadpole search at key locations along the creek lines.

Opportunist rock rolling, bird surveys and herpetological searches were conducted during the field survey.

Habitat characteristics and parameters that were assessed included:

- Physical aspects of the site such as climate (desktop), geology, soils, slope, elevation, drainage and aspect.
- Floristic composition, structure and age.
- Vegetation condition (Niche use a measure of 'ecosystem resilience' as a function of disturbance);
- Composition of ground layer (bare earth, litter etc.).
- Presence and relative abundance of key habitat features (e.g. tree hollows, large logs, exfoliating rock, flowering resources, aquatic features).

Dr Frank Lemckert conducted an amphibian search along the watercourses within the study area. Specific attention was given to habitat for threatened amphibians: the Giant Burrowing Frog, Littlejohn's Tree Frog and Red-crowned Toadlet. Tadpole searches were undertaken during the field survey given the cryptic nature of the Giant Burrowing Frog and Littlejohn's Tree Frog.




Drawn by: GT Project Manager: MR Project Number: 2276 Date: 4/12/2014

Survey effort

Tahmoor North Subsidence Management Plan - Terrestrial Ecology Assessment

**FIGURE 3**

niche Environment and Heritage

Path: T:\spatial\projects\a2200\a2276_Tahmoor_LW_31_35\Maps\Ecology\2276_Figure_3_Effort.mxd

## 5.4 Threatened flora and fauna likelihood of occurrence

A list of subject threatened flora and fauna within the locality (10 kilometre radius) was determined from database searches (OEH Atlas of NSW Wildlife and EPBC Act Protected Matters Search Tool). The list of potentially impacted (affected) species is determined from consideration of this list.

In order to adequately determine the relevant level of assessment to apply to subject species, further analysis of the likelihood of those species occurring within the study area was completed.

Five categories for 'likelihood of occurrence' (Table 1) were attributed to species after consideration of criteria such as known records, presence or absence of important habitat features on the subject site, results of the field surveys and professional judgement. This process was completed on an individual species basis.

Species considered further in formal assessments of significance pursuant to relevant legislation were those in the 'Known' to 'Moderate' categories and where impacts for the species could reasonably occur from the development (refer to the outcomes of the affected species analysis in Section 7).

**Table 1: Likelihood of occurrence criteria**

| Likelihood rating | Threatened flora criteria | Threatened and migratory fauna criteria |
|---|---|---|
| Known | The species was observed within the study area. | The species was observed within the study area. |
| High | It is likely that a species inhabits or utilises habitat within the study area. | It is likely that a species inhabits or utilises habitat within the study area. |
| Moderate | Potential habitat for a species occurs on the site. Adequate field survey would determine if there is a 'high' or 'low' likelihood of occurrence for the species within the study area. | Potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. Species unlikely to be wholly dependent on the habitat present within the study area. |
| Low | It is unlikely that the species inhabits the study area. | It is unlikely that the species inhabits the study area. If present at the site the species would likely be a transient visitor. The site contains only very common habitat for this species which the species would not rely on for its on-going local existence. |
| None | The habitat within the study area is unsuitable for the species. | The habitat within the study area is unsuitable for the species. |

## 5.5 Impact assessment

Impact assessments were carried out on listed species, populations and ecological communities that occur or have a moderate-high likelihood of occurrence to occur within the study area (based on the presence of suitable habitat) and where there is potential for subsidence associated with mining of Longwalls 31 to 37 to impact the species/community or its habitat.

Where subsidence may impact individuals/communities (or their potential habitat) listed on the TSC Act or EPBC Act, Assessments of Significance are required to assess the potential significance of the impact.

It should be noted that in some cases habitat for a threatened species may be recorded within the study area, however the nature of subsidence may be such that there is no known mechanism for subsidence to impact that particular habitat feature (e.g. tree hollows). In the absence of direct or indirect impacts on a habitat for a threatened species, further impact assessments are not considered necessary and were not prepared for this assessment.

## 5.6 Limitations

This assessment was a habitat based assessment. As such, no targeted trapping fauna surveys were conducted for this assessment. Habitat-based assessments are considered a conservative method of assessing threatened fauna, as presence is determined on the basis of the presence of suitable habitat, not observations of species from the study area.

Existing vegetation mapping has been utilised. Areas which are likely to be susceptible to subsidence, for example along riparian areas, were surveyed using plots or RDPs to compliment existing mapping. Large scale validation of the existing vegetation mapping was not considered necessary for this assessment.

This report has relied upon the results of the MSEC (2014), GeoTerra (2014), WRN (2014) and the experience of the authors assessing coal mining and subsidence impacts on terrestrial ecological values in the Southern Coalfield to determine potential impacts to flora and fauna associated with the extraction of Longwalls 31 to 37.

Some plant species that occur in the local area are annuals (completing their life cycle within a single season) and are present only in the seed bank for much of the year. Other plant species are perennial but are inconspicuous unless flowering. Similarly, some fauna may be seasonally absent from the study area.

Access to private properties was not secured during the current assessment. As such not all of the study area was directly inspected. It should be noted that areas unable to be inspected did not contain natural features likely to be impacted by subsidence.

No nocturnal surveys were conducted. Given the cryptic nature of the Giant Burrowing Frog and Littlejohn's Tree Frog, a tadpole and habitat search were considered to be a more efficient approach to determining the presence of threatened amphibians. Amphibian expert Dr Frank Lemckert conducted the amphibian survey.

# 6. Results

## 6.1 Flora

A total of 89 plant species were recorded across the study area. Forty-six families of plants were recorded. Twenty-three of the species recorded are listed as introduced species.

Three of the introduced species recorded are listed as noxious weeds under the *Noxious Weeds Act 1993* for the Wollondilly Council: *Asparagus asparagoides, Senecio madagascariensis,* and *Cardiospermum grandiflorum*. All three of these species are listed as Class 4 weeds.

## 6.2 Vegetation

Vegetation in the study area has been mapped as part of NPWS (2002) Cumberland Plain Vegetation Mapping Project and Tozer (2006) Native vegetation of southeast NSW. The Tozer (2006) mapping has been relied upon in this assessment given it covers the entire locality.

Nine vegetation communities have been mapped within the study area. Descriptions of each vegetation community along with associated area have been included in Table 2.

The vegetation along the riparian corridors of the study area were surveyed (where possible) as these are the areas that may potentially be exposed to subsidence related impacts. Vegetation descriptions along each of the riparian corridors have been provided below:

**Redbank Creek (Longwalls 31 to 32)**

Vegetation along the banks of Redbank Creek has previously been mapped as Cumberland Shale Sandstone Transition Forest. Based on the result of the field survey, the vegetation mapping appears correct with plots conducted along the upper banks of the creek containing diagnostic overstorey species: *Eucalyptus crebra, Eucalyptus punctata* and *Angophora floribunda,* and understorey species consisting of *Acacia parramattensis, Sigesbeckia orientalis,* and *Indigofera australis.*

Tozer (2006) has also mapped the base of the Redbank Creek as Cumberland Shale Sandstone Transition Forest. However, based on the results of the field survey, the vegetation along the base of the creek line was similar to a Grey Myrtle Dry Rainforest community (Plate 1) given the presence and dominance of *Backhousei myrtifolia, Pteridium esculentum, Blechnum cartilagineum, Oplismenus aemulus,* and *Persicaria decipiens.* The extent of this community would be hard to map given it occurs sporadically and sometimes as thin strips throughout the creekline. This assessment has therefore maintained the Tozer (2006) results, which is more of a conservative approach given Cumberland Shale Sandstone Transition Forest is listed as a TEC (section 6.2.1).

The condition of the vegetation along Redbank Creek varied. Plots conducted along the eastern portion of the study area within Longwalls 32 to 33 containing high occurrences of introduced species, namely large-leaf privet (*Ligustrum lucidum*) and small-leaf privet (*Ligustrum sinense*) (Plate 2). Erosion and rubbish dumping was visible, particularly toward the industrial complexes toward Argle Street. The western portion of Redbank Creek was in a better condition than that of the eastern plots.

**Plate 1. Areas along Redbank Creek dominated by *Backhousei myrtifolia* which are likely to align to Grey Myrtle Dry Rainforest.**

**Plate 2. Privet and erosion along the eastern portion of Redbank Creek toward Argle Street.**

**Cedar Creek, Matthews Creek, Stonequarry Creek (Longwalls 33 to 37)**

Vegetation along the upper banks of the Stonequarry Creek, Matthew Creek and Stonequarry Creek has been mapped as Cumberland Shale Sandstone Transition Forest (Plate 3) with a small section of Cumberland River-flat Forest (Plate 4) occurring to the north of Longwall 33. Plots and observations during the field survey confirm the presence of diagnostic species for both these communities: *Eucalyptus crebra, Eucalyptus fibrosa, Eucalyptus punctata, Eucalyptus elata* and *Allocasuarina littoralis*. Dominant shrubs include: *Acacia decurrens, Bursaria spinosa, Ozothamnus diosmifolius* and *Persoonia linearis.* Groundcover included: *Aristida vagans, Cheilanthes sieberi, Dichondra repens, Echinopogon caespitosus, Lomandra multiflora, Microlaena stipoides, Panicum simile, Pomax umbellata, Pratia purpurascens,* and *Themeda australis.*

The condition of the vegetation communities varied depending on grazing, historic clearing and invasion of introduced species. The condition of River-flat Eucalypt Forest toward Longwall 33 contained a greater number of introduced species. Common introduced species recorded included: *Ageratina riparia, Conyza*

*bonariensis, Hypochaeris radicata, Lactuca saligna, Ligustrum lucidum, Ligustrum sinense, Senecio madagascariensis, Sida rhombifolia,* and *Tradescantia fluminensis.*

**Plate 3. Patches of Shale Sandstone Transition Forest along the top of the creek banks**

**Plate 4. Patch of River-flat Eucalypt Forest to the north of Longwall 33**

The vegetation along the banks of Matthews Creek and Cedar Creek has been mapped as Hinterland Sandstone Gully Forest (Plate 5). Dominant species within this community included: *Corymbia gummifera, Eucalyptus piperita, Persoonia linearis, Phyllanthus hirtellus, Leptospermum trinervium, Lomatia silaifolia, Banksia spinulosa, Platysace linearifolia,* and *Ceratopetalum gummiferum.* Groundcover included *Entolasia stricta, Pteridium esculentum, Dianella caerulea, Smilax glyciphylla, Lomandra longifolia, Lepidosperma laterale*, and *Lomandra obliqua*.

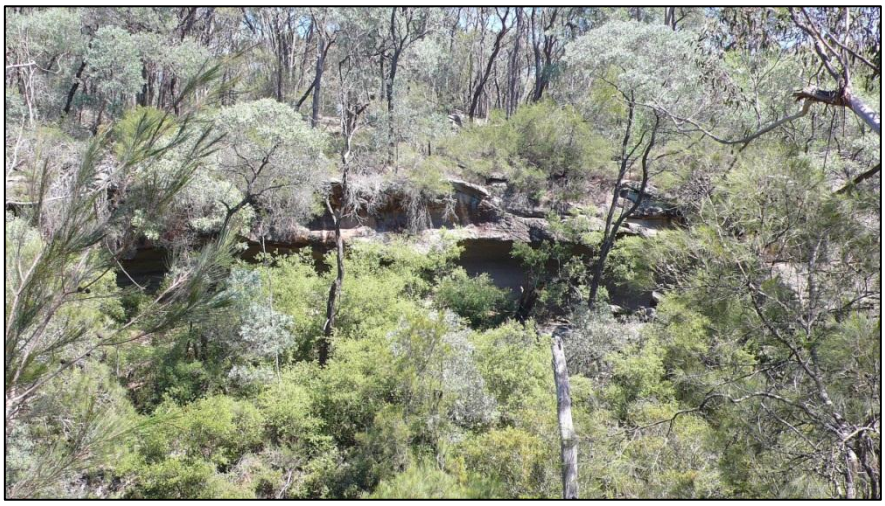


**Plate 5. Hinterland Sandstone Gully Forest within the gully of Matthew Creek**

**Cumberland Plain Woodland**

Very small patches of Cumberland Shale Plains Woodland have been mapped throughout the study area. These remnants have mostly lost their understorey shrub layer and have a highly modified ground cover layer with low native species diversity and abundant weeds (Plate 6). Their condition and resilience are considered to be low to moderate.

Based on a previous assessment conducted by Niche (2012) at Innes Street, which occurs toward the center of the study area, dominant eucalyptus within Cumberland Shale Plains Woodland include: *Eucalyptus tereticornis* and *Eucalyptus crebra*. *Angophora floribunda* and *Brachychiton populous* was also recorded in the study area though in low abundance. Scattered shrub species included: *Acacia decurrens, Bursaria spinosa and Allocasuarina littoralis. Ground cover included: Cheilanthes sieberi, Commelina cyanea, Cyperus gracilis, Dichondra repens, Einadia hastata, Glycine microphylla, Plectranthus parviflorus, Pseuderanthemum variabile, Sigesbeckia orientalis, Solanum prinophyllum, Tricoryne elatior and Wahlenbergia gracilis. Native grasses included: Aristida ramosa, Aristida vagans, Echinopogon caespitosus, Dichelachne micrantha, Microlaena stipoides, Oplismenus aemulus, Panicum simile* and *Themeda australis*.

**Plate 6. Cumberland Plain Woodland at Innes Street within the study area**

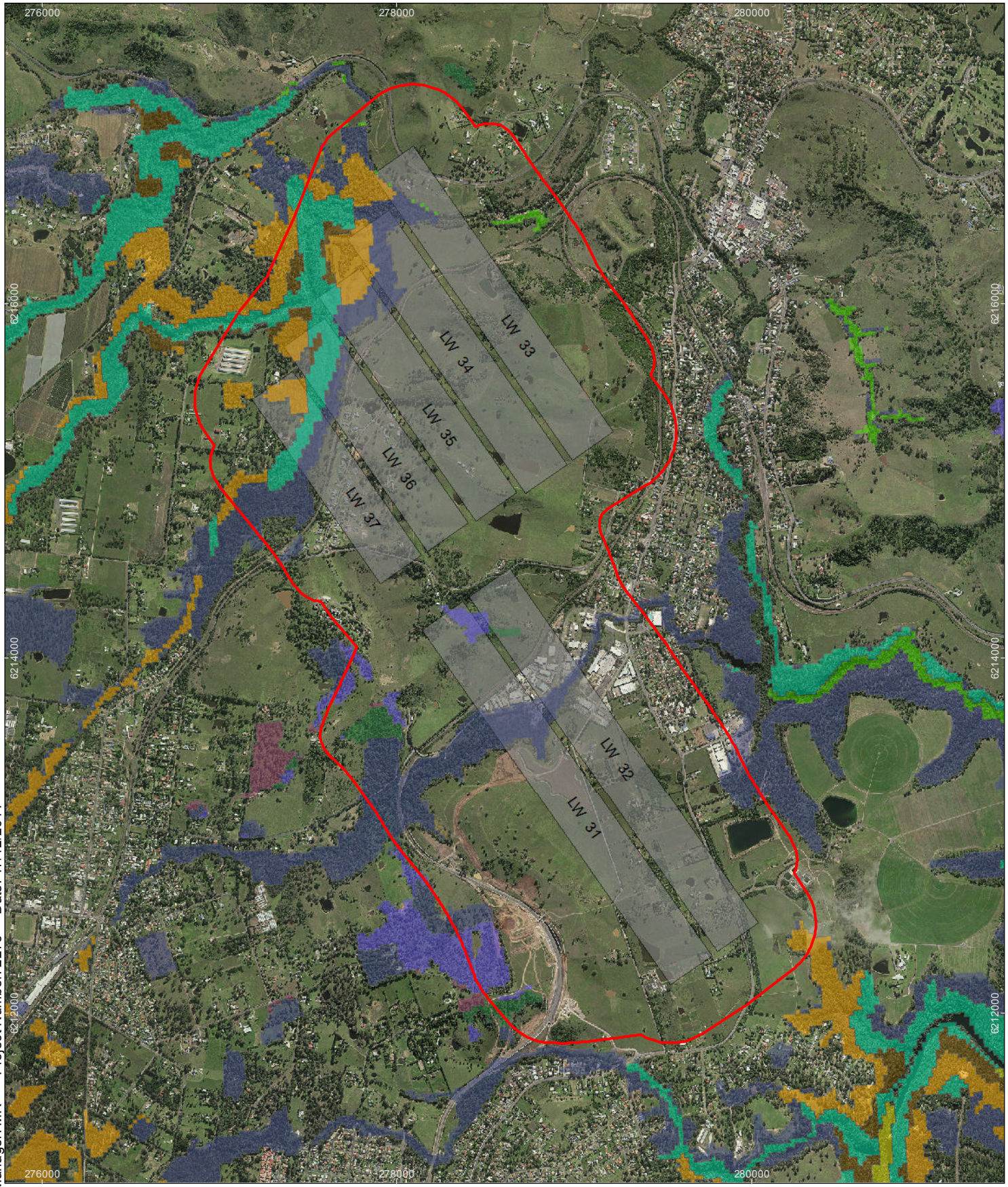
**Table 2: Mapped vegetation communities and areas**

| Vegetation community | Description[1] | Area (ha) study area | Area (ha) locality |
|---|---|---|---|
| P2. Cumberland Shale Sandstone Transition Forest | Cumberland Shale Sandstone Transition Forest is a eucalypt forest or woodland with a mixed understorey of sclerophyll shrubs and grasses. It occurs on clay soils derived from Wianamatta shale (Bannerman and Hazelton 1990) predominantly on the margins of the Cumberland Plain, Sydney, where the underlying sandstone strata are near the surface. Minor occurrences are found on isolated shale remnants in the lower Blue Mountains and the Hornsby and Woronora plateaux and, more rarely, associated with shale lenses within sandstone strata. Cumberland Shale Sandstone Transition Forest is found up to 350m ASL in areas where mean annual rainfall ranges from 800 to 1100mm. Floristic Summary: Trees: *Eucalyptus crebra, Eucalyptus fibrosa, Allocasuarina littoralis, Eucalyptus punctata*. Shrubs: *Persoonia linearis, Bursaria spinosa, Ozothamnus diosmifolius, Hibbertia aspera.* Climbers: *Glycine clandestina. Groundcover: Lepidosperma laterale, Cheilanthes sieberi, Aristida vagans, Pratia purpurascens, Microlaena stipoides, Entolasia stricta, Lomandra multiflora, Themeda australis, Panicum simile, Echinopogon caespitosus, Pomax umbellata, Dichondra spp., Billardiera scandens, Opercularia diphylla*. | 77.5 | 13.6 |
| p28: Cumberland Shale Hills Woodland | Cumberland Shale Hills Woodland is a eucalypt woodland with an open shrub layer and grassy groundcover, restricted to clay-loam soils derived from Wianamatta Shale on the southern half of the Cumberland Plain, Western Sydney. Cumberland Shale Hills Woodland is closely related to Cumberland Shale Plains Woodland but typically occurs on steeper and more undulating terrain. Trees: *Acacia implexa, Eucalyptus moluccana, E. tereticornis*. Shrubs: *Bursaria spinosa, Rubus parvifolius*. Climbers: *Clematis glycinoides, Glycine tabacina*. Groundcover: *Dichondra repens, Brunoniella australis, Desmodium gunnii, Aristida ramosa, Microlaena stipoides, Carex inversa, Themeda australis, Cyperus gracilis, Dichelachne micrantha, Asperula conferta, Oxalis perennans, Cheilanthes sieberi, Desmodium brachypodum, Sporobolus creber, Wahlenbergia gracilis.* | 13.9 | 400.3 |
| P29: Cumberland Shale Plains Woodland | Cumberland Shale Plains Woodland is a eucalypt woodland with an open shrub layer and grassy groundcover. It occurs on clay-loam soils derived from Wianamatta shale and is restricted to the Cumberland Plain, western Sydney. Cumberland Shale Plains Woodland grades into Cumberland Shale Hills Woodland (GW p28) as elevation and topographic roughness increase in the southern half of the Cumberland Plain. Towards the margins of the plain Cumberland Shale Plains Woodland grades into Cumberland Shale Sandstone Transition Forest as the depth of the underlying sandstone strata decreases. Floristic Summary: Trees: *Eucalyptus moluccana, E. tereticornis.* Shrubs: *Bursaria spinosa. Climbers: Glycine tabacina, G. clandestina.* Groundcover: *Dichondra repens, Cheilanthes sieberi, Aristida vagans, Microlaena stipoides, Themeda australis, Brunoniella australis, Desmodium gunnii, Opercularia diphylla, Wahlenbergia gracilis, Dichelachne micrantha, Paspalidium distans, Eragrostis leptostachya, Lomandra filiformis, L. multiflora, Dianella longifolia, Oxalis perennans, Euchiton sphaericus, Goodenia hederacea, Aristida ramosa, Arthropodium milleflorum, Austrodanthonia tenuior, Cymbopogon refractus, Echinopogon caespitosus.* | 0.2 | 13.6 |

[1] Tozer (2010) South Coast Vegetation Mapping Project

| Vegetation community | Description[1] | Area (ha) study area | Area (ha) locality |
|---|---|---|---|
| p33: Cumberland River Flat Forest | Cumberland River Flat Forest is a woodland to open forest with open shrub layer and continuous groundcover of grasses and forbs. Its distribution is restricted to the Hawkesbury-Nepean and Georges River systems on the Cumberland Plain, on stream banks and alluvial flats draining soils derived from Wianamatta Shale. It occurs at altitudes from 1m to 160m ASL, where mean annual rainfall is in the range 750-900mm. Trees: *Eucalyptus tereticornis, Angophora floribunda, E. amplifolia*. Shrubs: *Acacia parramattensis, Bursaria spinosa, Sigesbeckia orientalis*. Groundcover: *Microlaena stipoides, Oplismenus aemulus, Dichondra spp., Entolasia marginata, Solanum prinophyllum, Pratia purpurascens, Echinopogon ovatus, Desmodium gunnii, Commelina cyanea, Veronica plebeia*. | 2.1 | 38.7 |
| p38: Grey Myrtle Dry Rainforest | This unit is a simple, low closed forest with a sparse groundcover. It is widely distributed as small patches throughout the dry gorge country of the southern Blue Mountains (Coxs, Kowmung and Wollondilly gorges), the margins of the Cumberland Plain, and the Shoalhaven and Ettrema Gorges. It usually occupies the steep lower slopes of gorges below 600m ASL with an annual rainfall from 750 - 900mm, where pre-Permian rocks underlying those of the Sydney Basin are exposed. Floristic Summary: Trees: *Backhousia myrtifolia. Shrubs: Notelaea longifolia, Breynia oblongifolia, Hymenanthera dentata, Sigesbeckia orientalis*. Climbers: *Geitonoplesium cymosum, Pandorea pandorana, Aphanopetalum resinosum, Eustrephus latifolius, Cayratia clematidea*. Groundcover: *Adiantum aethiopicum, Asplenium flabellifolium, Pellaea falcata, Dichondra spp., Microlaena stipoides, Oplismenus imbecillis, Desmodium varians, Plectranthus parviflorus, Stellaria flaccida*. | 0.5 | 80.1 |
| P131: Coastal Sandstone Ridetop Woodland | Coastal Sandstone Ridgetop Woodland is a low eucalypt forest with a diverse sclerophyll shrub layer and open groundcover of sedges. It is extensively distributed on the Triassic Hawkesbury sandstone plateaux surrounding the Sydney Basin, and is widespread on ridgetops and upper valley slopes of the Hornsby and Woronora Plateaux and the lower Blue Mountains. Floristic Summary: Trees: *Corymbia gummifera, E. sieberi, E. racemosa.* Shrubs*: Leptospermum trinervium, Lambertia formosa, Persoonia levis, Banksia serrata, Platysace linearifolia, Acacia suaveolens, Isopogon anemonifolius, Dillwynia retorta, Petrophile pulchella, Banksia spinulosa, Bossiaea heterophylla, Banksia ericifolia, Acacia ulicifolia, Monotoca scoparia, Hakea dactyloides*. Groundcover: *Caustis flexuosa, Lomandra obliqua, Dampiera stricta, Entolasia stricta, Actinotus minor, Cyathochaeta diandra, Lomandra glauca.* | 5.1 | 108.0 |
| p142: Hinterland Sandstone Gully Forest | Hinterland Sandstone Gully Forest is an open eucalypt forest with an abundant sclerophyll shrub stratum and a groundcover dominated by sedges. This forest surrounds the Cumberland plain, occurring along the western portion of the Hornsby and Woronora plateaux and in the lower Blue Mountains. Within this distribution Hinterland Sandstone Gully Forest occurs on lower slopes of dry sandstone gullies up to 600m ASL where average annual rainfall ranges from 850 to 1300mm. Floristic Summary: Trees: *Angophora costata, Corymbia gummifera, Banksia serrata, Eucalyptus piperita*. Shrubs: *Persoonia linearis, P. levis, Phyllanthus hirtellus, Leptospermum trinervium, Lomatia silaifolia, Banksia spinulosa, Platysace linearifolia, Ceratopetalum gummiferum, Acacia ulicifolia, Acacia terminalis*. Climbers: *Billardiera scandens.* Groundcover: En*tolasia stricta, Pteridium esculentum, Dianella caerulea, Smilax glyciphylla, Xanthosia pilosa, Lomandra longifolia, Lepidosperma laterale, Lomandra obliqua.* | 29.0 | 470.4 |

| Vegetation community | Description[1] | Area (ha) study area | Area (ha) locality |
|---|---|---|---|
| P146: Sydney Hinterland Transition Woodland | Sydney Hinterland Transition Woodland is a eucalypt woodland with an open understorey of sclerophyll shrubs, sedges, forbs and grasses. This transition woodland encircles the Cumberland Plain rainshadow, on loamy soils typically derived from sediments belonging to the Hawkesbury or Mittagong formations. Floristic Summary: Trees: Corymbia gummifera, Eucalyptus punctata, Angophora costata, Syncarpia glomulifera. Shrubs: Phyllanthus hirtellus, Persoonia linearis, Leptospermum trinervium, Acacia ulicifolia, Persoonia levis, Acacia linifolia, Banksia spinulosa, Pimelea linifolia. Climbers: Billardiera scandens. Groundcover: Entolasia stricta, Lomandra obliqua, Pomax umbellata, Themeda australis, Lomandra multiflora, Lepidosperma laterale, Dianella revoluta, Austrostipa pubescens, Goodenia hederacea. | 34.4 | 1961.9 |
| p514: Cumberland Moist Shale Woodland | This unit is a eucalypt woodland with a sparse semi-mesic shrub layer and grassy groundcover. It is restricted to rugged areas at higher elevations in the southern half of the Cumberland Plain, where it occurs exclusively on soils derived from Wianamatta Shale. It has been recorded at sites with elevations from 50m to 300m ASL and mean annual rainfall of 800-900mm. Floristic Summary: Trees: *Eucalyptus tereticornis, E. moluccana.* Shrubs: *Breynia oblongifolia, Clerodendrum tomentosum, Sigesbeckia orientalis, Olearia viscidula, Bursaria spinosa.* Climbers: *Cayratia clematidea, Glycine clandestina. Groundcover: Desmodium gunnii, Cyperus gracilis, Galium propinquum, Brunoniella australis, Desmodium brachypodum, Solanum prinophyllum, Microlaena stipoides, Arthropodium milleflorum, Echinopogon ovatus, Einadia hastata, Nyssanthes diffusa, Oxalis perennans, Plectranthus parviflorus, Rumex brownii, Wahlenbergia gracilis*. | 7.1 | 99.9 |
| Total mapped in study area | | 169.8 | 3186.5 |




Drawn by: GT
Project Manager: MR
Project Number: 2276
Date: 17/12/2014

Study Area
Longwalls

Vegetation (Tozer *et al* 2006)

p131, Coastal Sandstone Ridgetop Woodland
p142, Hinterland Sandstone Gully Forest
p146, Sydney Hinterland Transition Woodland
p2, Cumberland Shale Sandstone Transition Forest
p28, Cumberland Shale Hills Woodland
p29, Cumberland Shale Plains Woodland
p33, Cumberland River Flat Forest
p38, Grey Myrtle Dry Rainforest
p514, Cumberland Moist Shale Woodland
p58, Sandstone Riparian Scrub

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0 200 400 m

GDA 1994 MGA Zone 56

Vegetation of the Study Area

Tahmoor North Subsidence Management Plan - Terrestrial Ecology Assessment

**FIGURE 4**

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### 6.2.1 Threatened ecological communities

A list of TECs occurring or potentially occurring within the locality was determined from database searches (the NSW Bionet Database Search tool and EPBC Act Protected Matters Search Tool) and the literature review. Based on the results of the database searches, nine TECs have been identified as potentially occurring within the locality as outlined in Table 3.

Based on Tozer (2006) and the results of the field survey, four TECs are likely to occur in the study area:

- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest;
- Shale Sandstone Transition Forest;
- Moist Shale Woodland in the Sydney Basin Bioregion;
- River-flat Eucalypt Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregion.

Each of these TECs have been considered further in section 6.2.1.

**Table 3. Threatened ecological communities potentially occurring within the locality**

| Threatened Ecological Community | Description[2] | EPBC Act Status | TSC Act Status | Equivalent vegetation communities (NPWS 2002) mapped within study area | To be considered further? |
|---|---|---|---|---|---|
| Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest | The Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest lies in a coastal valley rain shadow that occupies the driest part of the Cumberland Plain. It typically occurs on flat to undulating or hilly terrain, at elevations up to about 350 m above sea level, and on clay soils (derived from Wianamatta Group shales), with some occurrences on other soils. This ecological community has several vegetation layers in its natural state. The tree canopy is typically dominated by *Eucalyptus moluccana, E. tereticornis*, and/or *E. fibrosa*. | Critically Endangered | Critically Endangered | Cumberland Shale Hills Woodland | Previously mapped within study area and previous study by Niche (2012). Has also been mapped in the study area by Tozer (2006) .<br>Considered further in section 7.2. |
| Shale Sandstone Transition Forest | Occurs at the edges of the Cumberland Plain, where clay soils from the shale rock intergrade with earthy and sandy soils from sandstone, or where shale caps overlay sandstone. The boundaries are indistinct, and the species composition varies depending on the soil influences. The main tree species include *Eucalyptus tereticornis*, *E. punctata*, *E. globoidea, E. eugenioides* and *E. fibrosa* and *E. crebra*. Areas of low sandstone influence (more clay-loam soil texture) have an understorey that is closer to Cumberland Plain Woodland. | Endangered | Endangered | Cumberland Shale Sandstone Transition Forest | Previously mapped within study area and current survey.<br>Considered further in section 7.2. |
| Coastal Upland Swamps in the Sydney Basin Bioregion | The Coastal Upland Swamp in the Sydney Basin Bioregion includes open graminiod heath, sedgeland and tall scrub associated with periodically waterlogged soils on the Hawkesbury sandstone plateaux. The Coastal Upland Swamp is generally associated with soils that are acidic and vary from yellow or grey mineral sandy loams with a shallow organic horizon to highly organic spongy black peat soils with pallid subsoils. The vegetation of the Coastal Upland Swamp may include tall open scrubs, tall closed scrubs, closed heaths, open graminoid heaths, sedgelands and fernlands. Larger examples may include a complex of these structural forms. The flora comprising the upland swamp is diverse there are 73 plant species listed as characterising the ecological community. | Endangered | Endangered | Not previously mapped within study area. | Not mapped in study area. Not recorded during field survey.<br>Not considered further. |
| Turpentine-Ironbark Forest in the Sydney Basin Bioregion | Open forest, with dominant canopy trees including *Syncarpia glomulifera, Eucalyptus punctata, E. paniculata* and *E. eugenoides*. In areas of high rainfall (over 1050 mm per annum) *E. saligna* is more dominant. The shrub stratum is usually sparse and may contain mesic species such as *Pittosporum undulatum* and *Polyscias sambucifolia*. | Critically Endangered | Endangered | Not previously mapped within study area. | Not mapped in study area. Not recorded during field survey.<br>Not considered further. |
| Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion | Tableland Basalt Forest is dominated by an open eucalypt canopy of variable composition. *Eucalyptus viminalis, E. radiata, E. dalrympleana subsp. dalrympleana* and *E. pauciflora* may occur in the community in pure stands or in varying combinations. The community typically has an open canopy of eucalypts with sparse mid-story shrubs (e.g. *Acacia* | Endangered | Endangered | Not previously mapped within study area. | Previously mapped within study area and previous study by Niche (2012). |

[2] Scientific determination descriptions

| Threatened Ecological Community | Description[2] | EPBC Act Status | TSC Act Status | Equivalent vegetation communities (NPWS 2002) mapped within study area | To be considered further? |
|---|---|---|---|---|---|
| | *melanoxylon* and *A. dealbata*) and understory shrubs (e.g. Rubus parvifolius) and a dense groundcover of herbs and grasses, although disturbed stands may lack either or both of the woody strata. The structure of the community varies depending on past and current disturbances, particularly fire history, clearing and grazing. Contemporary tree-dominated stands of the community are largely relics or regrowth of originally taller forests and woodlands, which are likely to have had scattered shrubs and a largely continuous grassy groundcover. At some sites, mature trees may exceed 30 m tall, although regrowth stands may be shorter than 10 m tall. The ecological community occurs in areas of high rainfall, generally ranging from 950 to 1600 mm/year. The ecological community typically occurs at elevations between 650 and 1050 m above sea level, although it has been recorded at elevations as low as 350 m at the back of the Illawarra Escarpment in the Upper Nepean Sydney Catchment Authority (SCA) lands where proximity to the coast provides higher rainfall at lower elevations. The ecological community may occur at elevations of 1200 m or more within its range, such as on the Boyd Plateau in the western Blue Mountains. Confined to soils derived from basalt and basalt-like substrates; Typically occurs at elevations between 650–1050 m above sea level (a.s.l.), with certain outlying occurrences at lower (to 350 m a.s.l.) or higher (above 1200 m a.s.l.) elevations | | | | Considered further in section 7.2. |
| Moist Shale Woodland in the Sydney Basin Bioregion | Similar to Cumberland Plain Woodland. It differs in having a shrub understorey that contains plants from moist habitats. Dominant canopy trees include *Eucalyptus tereticornis, E. moluccana, E. crebra* and *Corymbia maculata*. Small trees, such as *Acacia implexa* and *A. parramattensis subsp. parramattensis* are also common. The shrub layer includes *Breynia oblongifolia, Clerodendrum tomentosum* and *Sigesbeckia orientalis subsp. orientalis*. Contains many more species and other references should be consulted to identify these. | Critically Endangered | Endangered | Cumberland Moist Shale Woodland | Previously mapped within study area and previous study by Niche (2012).<br>Considered further in section 7.2. |
| Western Sydney Dry Rainforest of the Sydney Basin Bioregion | A dry vine scrub community of the Cumberland Plain, western Sydney. Canopy trees include *Melaleuca styphelioides, Acacia implexa* and *Alectryon subcinereus*. There are many rainforest species in the shrub layer, such as *Notelaea longifolia, Clerodendrum tomentosum* and *Pittosporum revolutum*. The shrub layer combines with vines, such as *Aphanopetalum resinosum, Pandorea pandorana* and *Cayratia clematidea* to form dense thickets in sheltered locations. | Critically Endangered | Endangered | Not previously mapped within study area. | Not mapped in study area. Not recorded during field survey.<br>Not considered further. |
| White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland | White Box Yellow Box Blakely's Red Gum Woodland (commonly referred to as Box-Gum Woodland) is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following *Eucalyptus albens, E. melliodora* and *E. blakelyi*. Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. The community also includes a range of mammal, bird, reptile, frog and invertebrate fauna species. Intact stands that contain diverse upper and mid-storeys and ground layers are rare. | Critically Endangered | Endangered | Not previously mapped within study area. | Not mapped in study area. Not recorded during field survey,<br>Not considered further. |

| Threatened Ecological Community | Description[2] | EPBC Act Status | TSC Act Status | Equivalent vegetation communities (NPWS 2002) mapped within study area | To be considered further? |
|---|---|---|---|---|---|
| River-flat Eucalypt Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregion | As the name suggests, this EEC is found on the river flats of the coastal floodplains. It has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include *Eucalyptus tereticornis, E. amplifolia, Angophora floribunda* and *A. subvelutina. Eucalyptus baueriana, E. botryoides* and *E. elata* may be common south from Sydney, E. *ovata* occurs on the far south coast, *E. saligna* and *E. grandis* may occur north of Sydney, while *E. benthamii* is restricted to the Hawkesbury floodplain. | Not listed | Endangered | Cumberland River Flat Forest | Previously mapped within study area and previous study by Niche (2012).<br>Considered further in section 7.2. |

## 6.3 Threatened flora

A total of 36 threatened flora listed on the TSC and/or EPBC Act were identified as subject species in this assessment. This list was derived from the database searches outlined in Section 5.4.

No threatened flora listed on the TSC and/or EPBC Act were recorded in the study area during the current survey.

Threatened flora with a moderate to high likelihood of occurrence include: *Acacia pubescens, Epacris purpurascens* var*. purpurascens, Grevillea parviflora* subsp*. parviflora, Leucopogon exolasius, Persoonia bargoensis, Pimelea spicata, Pomaderris brunnea, Pterostylis saxicola* and *Tetratheca glandulosa.*

These species are discussed further below:

*Acacia pubescens*: Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Patches of Cumberland Plain Woodland have been previously mapped throughout the study area. Some of the areas were not able to be surveyed during the current assessment due to land holder access restrictions. Potential habitat includes: Cumberland Shale Hills Woodland, Cumberland River Flat Forest, and Cumberland Moist Shale Woodland.

*Epacris purpurascens* var. *purpurascens*: Potential habitat within lower lying areas of native vegetation, particularly along ephemeral drainage lines. Potential habitat associated with strong shale soil influence communities: Cumberland Shale Sandstone Transition Forest, Cumberland Shale Hills Woodland, Cumberland River Flat Forest, Hinterland Sandstone Gully Forest and Cumberland Moist Shale Woodland.

*Grevillea parviflora* subsp. *parviflora*: Potential habitat with shale/sandstone transition areas with populations are more commonly found in relatively open, disturbed sites along roads and tracks in areas of open-forest or woodland. Potential habitat includes: Cumberland Shale Sandstone Transition Forest, Cumberland Shale Hills Woodland, and Cumberland Moist Shale Woodland.

*Leucopogon exolasius:* occurs on woodland on sandstone. Much of the land with potential habitat occurs along the banks and higher terrain adjacent to Matthews Creek and Cedar Creek. Potential habitat includes the following vegetation communities: Hinterland Sandstone Gully Forest.

*Persoonia bargoensis*: have habitat within dry sclerophyll forest on sandstone and on heavier, well drained, loamy, gravelly soils of the Wianamatta Shale and Hawkesbury Sandstone. Potential habitat includes: Cumberland Shale Sandstone Transition Forest, Cumberland Shale Hills Woodland, Cumberland River Flat Forest, Hinterland Sandstone Gully Forest and Cumberland Moist Shale Woodland.

*Pomaderris brunnea*: Occurs along creekline vegetation. A large population has been previously been recorded by Niche (2014) approximately 10 kilometres to the south of the study area within Hinterland Sandstone Gully Forest. The species has potential habitat along Cedar Creek, Matthews Creek and Stonequarry Creek toward the north of the study area.

*Pterostylis saxicola*: habitat for the species is on sandy soil over flat sheets of sandstone rock shelves above cliff lines and also in crevices between sandstone boulders; often in close proximity to streams. Limited habitat occurs along the ridgeline along Matthews Creek, Cedar Creek and Stonequarry Creek. Potential habitat includes: Coastal Sandstone Ridgetop Woodland and Shale Sandstone Transition Forest.

*Pimelea spicata*: has potential to occur in associated with Grey Box communities (particularly Cumberland Plain Woodland variants and Moist Shale Woodland) and in areas of ironbark. Potential habitat in the study area includes: Cumberland Shale Hills Woodland, Cumberland River Flat Forest, and Cumberland Moist Shale Woodland.

*Tetratheca glandulosa*: Marginal habitat occurs toward the north of the study area in Cumberland Shale Sandstone Transition Forest associated with the Lucas Heights landscape.

Potential impacts associated with the proposal towards each subject threatened flora are discussed in section 7.3.

## 6.4 Fauna

A total of 24 fauna species were recorded during the current assessment. The species list is provided in Appendix C.

### 6.4.1 Habitat types

Fauna habitat within the study area is broadly dependant on vegetation type and topography with specific structural features also important in determining the presence and distribution of fauna. Species from different fauna guilds may have specific habitat requirements that are represented in only one, or many, of the identified vegetation types.

The following distinct habitat types and features have been identified and are referred to throughout this report:

- woodland/Forest
- pasture/Paddocks
- creeks and drainage lines
- sandstone outcrops, overhangs and caves
- important microhabitat features.

### 6.4.2 Woodland/forest

Transitional shale sandstone communities and sandstone vegetation occupy a portion of the study area. The larger remnants occur along the creeklines, whilst scattered remnants, including scattered remnant , isolated, trees occur throughout paddocks and rural residential property. The communities range from open woodland along ridge tops and exposed slopes to gully forest and riparian vegetation associated with creeklines.

Woodland and Forest habitats provide a wide range of food and shelter for vertebrate fauna. Myrtaceaeous trees, mostly Eucalypt species, generally dominate the upper canopy in these areas and supply direct (foliage, nectar, exudates) and indirect food (arthropods) for a range of vertebrates, particularly birds and arboreal mammals.

Dense understorey and shrub vegetation was observed along sections of Matthews Creek, Cedar Creek and Stonequarry Creek. These areas provide important habitat for a range of species. These include small birds and ground-dwelling mammals.

### 6.4.3 Pasture/paddocks

The pasture and paddocks which occupy most of the study area provide little habitat for native fauna. The pasture and paddocks provide some foraging habitat for opportunistic species.

### 6.4.4 Creeks and drainage Lines

Watercourses within the study area include: Redbank Creek, Stonequarry Creek, Matthews Creek and Cedar Creek. A number of drainage lines also occur without the study area. Habitat features associated with these creeks and drainage lines include: emergent vegetation, riffles, pools, sandy substrate and rocks.

Creek lines are important to particular frogs and reptiles including threatened species, with water facilitating the breeding cycle of most frogs. In addition, many terrestrial species rely upon streams of the study area for some aspect of their life cycle or to provide drinking water.

Drainage lines located within areas of woodland or forest provide habitat for the Red-crowned Toadlet. This species does not require constant flowing water.

### 6.4.5 Sandstone outcrops and overhangs

Sandstone outcrops and overhangs mainly occur toward the north of the study area along Cedar Creek, Matthews Creek and Stone Quarry Creek within Longwalls 34-36. The habitat feature also occurs along Redbank Creek near Longwall 31. This habitat feature is of particular importance to reptile and bat species. Threatened reptiles that may utilise such a feature include the threatened Eastern False Pipistrelle, Large-eared Pied Bat, Eastern Bentwing-bat and Little Bentwing-bat.

### 6.4.6 Microhabitat features

Other habitat features that occur across the study area include micro habitat features such as:

- hollow bearing trees
- mature trees
- woody debris
- termite mounds
- leaf litter
- exfoliating bark.

### 6.4.7 Threatened fauna

A total of 61 threatened fauna listed on the TSC and EPBC Acts have previously been recorded or are predicted to have habitat within 10 km of the study area (Appendix A).

One threatened fauna species listed on the TSC Act was recorded within the study area during the current survey: The Varied sittella which was recorded along Stonequarry Creek (Figure 5).

The Cumberland Plain Land Snail has been recorded just outside the study area during a previous assessment undertaken by Niche (Niche 2012) (Figure 5).

After considering the habitat present in the study area and the results of the field survey, 32 of these threatened fauna were considered to have a moderate to high likelihood of occurrence study area. These species include:

- Amphibians: Red-crowned Toadlet.

- Birds: Regent Honeyeater, Great Egret, Bush Stone-curlew, Gang-gang Cockatoo, Glossy Black-Cockatoo, Brown Treecreeper (eastern subspecies), Varied Sittella, Little Eagle, White-throated Needletail, Swift Parrot, Hooded Robin (south-eastern form), Black-chinned Honeyeater (eastern subspecies), Rainbow Bee-eater, Black-faced Monarch, Satin Flycatcher, Turquoise Parrot, Barking Owl, Powerful Owl, Scarlet Robin, Speckled Warbler, Rufous Fantail, Masked Owl.
- Invertebrates: Cumberland Plain Land Snail.
- Mammals: Large-eared Pied Bat, Little Bentwing-bat, Eastern Bentwing-bat, Eastern Freetail-bat, Southern Myotis, Koala, Grey-headed Flying-fox, Greater Broad-nosed Bat.

Descriptions of each class of fauna are provided below.

An assessment of the potential impacts of the proposal on threatened species is provided in section 7.

#### 6.4.7.1 Amphibians

The Red-crowned Toadlet has potential habitat along the ephemeral drainage lines along Matthews Creek, Cedar Creek and Stonequary Creek toward the north of the study area. The species has been recorded by Niche during previous assessments near to the townships of Tahmoor and Bargo.

The Giant Burrowing Frog has very limited potential habitat given the presence of semi-permanent deep pools with leaf litter and flowing water within the small portion of the watercourse where Stonequarry Creek meets Cedar Creek. This area occurs just to the immediate north of Longwall 35. No tadpoles of the Giant Burrowing Frog were recorded during the field survey. Furthermore, no records of the species occur within the locality. However, it should be noted that Niche has recorded tadpoles of the Giant Burrowing Frog in Washhouse Gully and an unnamed tributary of the Bargo River during previous assessments for Tahmoor Coal. The records are approximately 15 kilometres from the study area. Whilst there is a limited amount of potential habitat within a stretch of Cedar Creek and Stonequarry Creek for Giant Burrowing Frog, the species is unlikely to occupy it.

#### 6.4.7.2 Terrestrial mammals

The Koala has potential habitat within all open woodland types within the study area. Those areas more likely to contain habitat for the koala are those connected to larger patches of vegetation. Numerous previous records for the Koala are located throughout the township of Tahmoor, Picton and Bargo.

#### 6.4.7.3 Bats

Large-eared Pied Bat, Little Bentwing-bat, Eastern Bentwing-bat, Eastern Freetail-bat, Southern Myotis, Grey-headed Flying-fox, and Greater Broad-nosed Bat all have potential habitat within the study area. All these species are mobile are likely to forage in the study area and outside of the study area.

Overhangs are important to the Large-footed Myotis, Eastern Bent-wing-Bat, and Large-eared Pied Bat. These habitat features were located along the steep incised gullies of Stonequarry Creek, Matthews Creek and Cedar Creek.

The Grey-headed Flying-fox requires foraging resources and roosting sites. It is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, Melaleuca swamps and Banksia woodlands. It also feeds on commercial fruit crops and on introduced tree species in urban areas. The species therefore has potential habitat throughout the study area. No known camp sites have been recorded in the study area.

#### 6.4.7.4 Birds

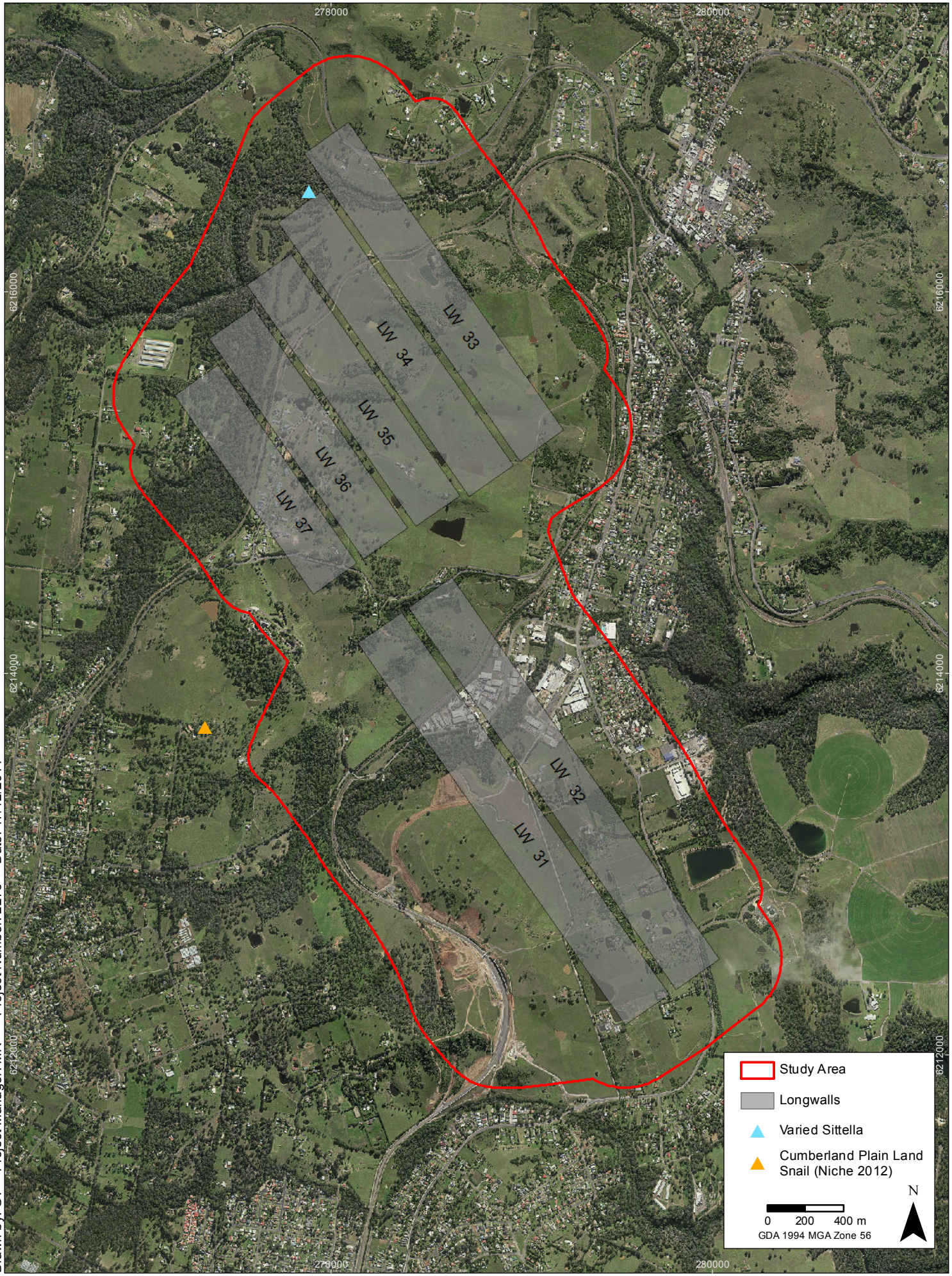
Twenty-two threatened birds, including four owls, have potential to occur within the study area. Only one threatened bird species was recorded during the current survey – Varied Sittella.

The threatened birds are likely to occasionally use the larger open areas for foraging. Nesting habitat is likely to occur along the riparian vegetation of the creeklines in the study area.

Nesting for species, such as the Barking Owl, Powerful Owl and Masked Owl may occur within hollow-bearing trees particularly to the north of the site within the deeper gullies.

#### 6.4.7.5 Invertebrates

The Cumberland Plain Land Snail has been previously recorded by Niche (2012) just to the immediate west of the study area during an assessment at Innes Street, Thirlmere. The species is likely to occupy areas of Cumberland Plain Woodland within the study area and locality.




Threatened species recorded during current assessment

Tahmoor North Subsidence Management Plan - Terrestrial Ecology Assessment

**FIGURE 5**

niche Environment and Heritage

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## 6.5 Migratory species (JAMBA, CAMBA, ROKAMBA)

Migratory species listed under the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA), and the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA), which have been previously recorded, or have predicted habitat within the study area (Appendix A) include the following species: Regent Honeyeater, Fork-tailed Swift, Great Egret, White-throated Needletail, Rainbow Bee-eater, Black-faced Monarch, Satin Flycatcher and Rufous Fantail.

## 6.6 Key Threatening Processes

A list of Key Threatening Processes (KTPs) is maintained under Schedule 3 of the TSC Act and under the EPBC Act. Key-threatening processes relevant to the proposal are listed in Table 4 and detailed further below. Unless otherwise stated, the information regarding the KTPs have been taken from the Final Determinations or Profile of the KTP.

**Table 4. Key Threatening Processes relevant to the proposal**

| Key Threatening Process | TSC Act | EPBC Act equivalent | Operating presently or historically | Increased by proposal |
|---|---|---|---|---|
| Alteration of habitat following subsidence due to longwall mining | | x | Yes (south-west portion of study area) | Yes |
| Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands | | x | No | Yes |
| Bushrock removal | | x | No | No |
| Clearing of native vegetation | | | No | No |
| Ecological consequences of high frequency fires | | x | No | No |
| Human-caused climate change | | | No | No |
| Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis | | | No | Potential should any remedial works in creeklines be required, but unlikely |
| Infection of native plants by *Phytophthora cinnamomi* | | | No | Unlikely |
| Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae | | x | No | No |
| Invasion and establishment of exotic vines and scramblers | | x | No | Unlikely |
| Invasion of native plant communities by exotic perennial grasses | | (only N. Aust) | No | Unlikely |
| Loss of hollow-bearing trees | | x | No | No |
| Removal of dead wood and dead trees | | x | No | No |

### 6.6.8 Alteration of habitat following subsidence due to Longwall mining

Subsidence due to longwall mining has been recognised as causing habitat alteration, with species and ecological communities that depend on aquatic and semi-aquatic habitats being particularly susceptible to the impacts of subsidence.

A list of threatened species, populations and TECs potentially impacted by longwall mining is provided in the NSW Scientific Committee Final Determination for this KTP.

Flora of relevance to this assessment include: *Epacris purpurascens* var*. purpurascens.*

Fauna of relevance to this assessment include: Giant Burrowing Frog (*Heleioporus australiacus*), Black Bittern (*Ixobrychus flavicollis*), Large-footed Myotis (*Myotis adversus*), Red-crowned Toadlet (*Pseudophryne australis*), and Grey-headed Flying Fox (*Pteropus poliocephalus*).

Shale Sandstone Transition Forest has also been listed in the KTP and is relevant to the proposal.

### 6.6.9 Alteration of the natural flow regimes of rivers, stream, floodplains and wetlands

Alteration to natural flow regimes can occur through reducing or increasing flows, altering seasonality of flows, changing the frequency, duration, magnitude, timing, predictability and variability of flow events, altering surface and subsurface water levels and changing the rate of rise or fall of water levels. Based on the MSEC (2014) report, the proposal has the potential to impact upon all watercourses in the Project Area, particularly those directly above longwalls.

## 6.7 Critical habitat

The Director General of OEH maintains a Register of Critical Habitat under the TSC Act. The Threatened Species Scientific Committee and the Minister for DoE maintain a Register of Critical Habitat under the EPBC Act.

No Critical Habitat to date has been declared for any ecological values within the study area. No Critical Habitat under either the TSC or EPBC Acts will be impacted by the proposal.

# 7. Impact assessment

## 7.1 Affected native vegetation

Vegetation within the study area has been previously mapped and surveyed as discussed in section 5.2. None of the vegetation within the study area will be cleared due to the proposal.

The majority of vegetation within the study area would not be impacted by subsidence due to underground mining but impacts may potentially occur for riparian vegetation. Riparian vegetation potentially impacted by subsidence is generally not mapped as discrete vegetation communities, rather these areas display structural and floristic variation within their composite community in response to more frequent contact with the local water table. As such, it would be hard to distinguish impacts to truly riparian vegetation and the intergrade between riparian and woodland communities.

Vegetation which occurs on undulating lands or on ridgelines is unlikely to be impacted by subsidence. It is possible that cracking may occur within these communities, however cracking is unlikely to result in vegetation change as these communities occur in drier soils and are not ultimately reliant upon groundwater for their floristic make up or distribution.

Riparian vegetation may be impacted by subsidence through water diversion, cracking of bedrock or the release of strata gas. The overall stability of the bed and banks of overlying creeks could be indirectly affected by subsidence induced fracturing and enhanced drainage of groundwater from the banks and bed of creeks leading to loss of riparian vegetation. However, based on previous observations within the Southern Coalfields and Tahmoor North to date, such incidents have generally not occurred. Based on the present information, it is considered unlikely significant lowering of groundwater levels will occur. As only minor changes in ground water are predicted, it is unlikely significant impacts to native vegetation will occur as a result of the proposal

MSEC (2014) states that gas emissions may occur as a result of subsidence. In the Southern Coalfield, impacts to vegetation as a result of subsidence are minor in occurrence. Previous examples of impacts include: dieback of riparian vegetation as a result of subsidence which occurred nearby Cataract River during the 1990s (Eco Logical Australia, 2004 in TEC 1997), and small localised changes to riparian vegetation along a Section of the Waratah Rivulet (HC 2007). Strata gas emissions association with subsidence are temporary (generally less than 12 months), and therefore are unlikely to cause long-term adverse changes to the habitat of threatened riparian species (FloraSearch 2009).

Impacts to vegetation associated with subsidence are unlikely, and if occurred, are likely to be localised minor floristic changes.

Impacts to vegetation communities are unlikely to result in a significant impact based on the following:

- Previous impacts to vegetation as a result of gas emissions in the Southern Coalfield are isolated and minor.
- Surface cracking as a result of subsidence movements is expected to be isolated and minor.
- In alluvial environments mine subsidence has some potential to affect threatened plant species through changes in hydrology impacting on individual plants or groups of plants. However, impacts to hydrology and surface flow are likely to be minor and localised. Further, the availability of water to the vegetation of the study area is not likely to be altered as the majority of this vegetation is not reliant on standing or flowing surface waters for their distribution and existence.

- Riparian vegetation associated with streams overlying the study area is relatively robust and unlikely to be sensitive to minor change in the moisture level fluctuations associated with the effects of subsidence.
- Strata gas release has the potential to result in vegetation die back near the points of emission. Such events are rare and affect relatively small areas (e.g. 0.12 hectares in one documented case on the Cataract River near Appin, (Eco Logical Australia, 2004 in TEC 1997). The vegetation in the affected area subsequently recovered through assisted and natural regeneration.
- Ridgetop, woodland and paddock vegetation is unlikely to be impacted by subsidence. Some cracking may be observed in the soil, however it is unlikely to result in a significant impact to vegetation composition.

## 7.2 Affected Threatened Ecological Communities

As discussed in Section 7.1 subsidence is unlikely to result in impacts to native vegetation that do not occur within the creeklines or immediately adjacent. The TECs observed during the field survey were located toward the top portions of the creek valleys (section 5.2) and therefore are unlikely to be exposed to any gas emissions from subsidence.

All the TECs that occur within the study area are associated with shale, alluvial and shale/sandstone transition soils which are unlikely to be subject to any biologically significant effects, due to soil moisture change. As only minor changes in ground water are predicted, it is unlikely significant impacts to native vegetation will occur as a result of the proposal

No Assessments of Significance have therefore been conducted for any TEC.

## 7.3 Affected threatened flora

A total of nine threatened flora have been identified in this assessment as affected species (Table 5).

Impacts from the proposal on each of the affected species are summarised in Table 12 and discussed in detail below.

Threatened flora species reliant upon watercourses, and riparian zones may be potentially impacted by subsidence. Within the study area, potential subsidence induced impacts may impact habitat for *Epacris purpurascens var. purpurascens,* and *Pomaderris brunnea* (Table 5). Impacts may occur as a result of the following:

- Gas emissions from sandstone fracturing above extracted longwalls may cause die back and changes in potential habitat within riparian vegetation.
- Changes in hydrology from creek bed cracking, causing localised vegetation structure and composition changes to potential habitat.
- Loss of individuals due to changes in hydrology, and groundwater changes.

The remainder of affected species are not likely to be reliant on any landscape feature that may be significantly affected by subsidence.

Based on previous experience at Dendrobium, Appin and Tower Mines within the Southern Coalfields, potential impacts are likely to have a minimal effect on vegetation composition, dispersal mechanisms, or isolation of potential populations where those vegetation communities are not dependent on surface water flows of groundwater levels.

As a precautionary approach, Assessment of Significance have been conducted for *Epacris purpurascens* var*. purpurascens* and *Pomaderris brunnea* (Appendix D and E).

The results concluded that subsidence impacts from the proposal are not considered likely to have a significant impact on threatened flora for the following reasons:

- Large areas of potential habitat for the species within the study area and locality are not predicted to be impacted by subsidence.
- Records of the species occur within Sydney Metropolitan Catchment Areas, Bargo Conservation Area and Thirlmere Lakes National Park which will not be impacted by subsidence.
- Subsidence is unlikely to impact on known pollination and dispersal mechanisms of the affected threatened species.
- Surface cracking as a result of subsidence movements is expected to be isolated and minor.
- In alluvial environments mine subsidence has some potential to affect threatened plant species through changes in hydrology impacting on individual plants or groups of plants. However, impacts to hydrology and flow are likely to be minor and localised. Further in relation to *Pomaderris brunnea* the species has bee previously recorded in the locality within a section of Tea Tree Hollow that is almost always dry and therefore the plants are not reliant on standing water in pools along this creek.
- Strata gas release has the potential to result in vegetation die back near the points of emission. Such events are rare and affect relatively small areas.
- *Epacris purpurascens* var. *purpurascens,* and *Pomaderris brunnea* occur adjacent to the riparian zone of the creeks, along the hill slopes and on top of banks. It is unlikely gas emissions would cause any significant impact to vegetation within these areas.

Subsidence is not likely to impact known populations of either *Epacris purpurascens* var. *purpurascens*, or *Pomaderris brunnea*.

**Table 5. Threatened flora potential impacts**

| Threatened flora | TSC Act | EPBC Act | Likelihood | Impact by subsidence? | Assessment of Significance required? |
|---|---|---|---|---|---|
| *Acacia pubescens* | V | V | Moderate | Potential habitat includes: Cumberland Shale Hills Woodland, Cumberland River Flat Forest, and Cumberland Moist Shale Woodland. Unlikely to occur immediately adjacent to watercourses. | No |
| *Epacris purpurascens var. purpurascens* | V | - | High | Potential to occur along creeklines and moist gullies. Subsidence may result in changes in hydrology adjacent to the species habitat. Die back from gas emissions is unlikely. | As a precaution a Seven-part test has been conducted. |
| *Grevillea parviflora subsp. parviflora* | V | V | High | Potential habitat includes: Cumberland Shale Sandstone Transition Forest, Cumberland Shale Hills Woodland, and Cumberland Moist Shale Woodland. Unlikely to occur immediately adjacent to watercourses. | No |
| *Leucopogon exolasius* | V | V | Moderate | Much of the land with potential habitat occurs along the banks and higher terrain adjacent to Matthews Creek and Cedar Creek. Potential habitat includes the following vegetation communities: Hinterland Sandstone Gully Forest. Species unlikely to be impacted by subsidence as it prefers the hill sides along creek valleys and therefore it is not within the riparian zone which may be exposed to gas emissions. | No |
| *Persoonia bargoensis* | E | V | Moderate – study area is close to known distribution of the species | Potential habitat includes: Cumberland Shale Sandstone Transition Forest, Cumberland Shale Hills Woodland, Cumberland River Flat Forest, Hinterland Sandstone Gully Forest and Cumberland Moist Shale Woodland. | No |
| *Pimelea spicata* | E | E | Moderate | Potential habitat in the study area includes: Cumberland Shale Hills Woodland, Cumberland River Flat Forest, and Cumberland Moist Shale Woodland. | No |

| Threatened flora | TSC Act | EPBC Act | Likelihood | Impact by subsidence? | Assessment of Significance required? |
|---|---|---|---|---|---|
| *Pomaderris brunnea* | V | V | Moderate to High – close proximity to large population along Teatree Hollow Creek (Niche 2014) | Grows along creeklines and moist gullies. Subsidence may result in changes in hydrology adjacent to the species habitat. Die back from gas emissions is unlikely. | As a precaution a Seven-part test has been conducted. |
| *Pterostylis saxicola* | E | E | Moderate habitat along Matthews Creek, Cedar Creek and Stonequarry creek in north of study area. | Potential habitat in the study area includes: Cumberland Shale Hills Woodland, Cumberland River Flat Forest, and Cumberland Moist Shale Woodland. | No |
| *Tetratheca glandulosa* | V | V | Low to moderate | Marginal habitat occurs toward the north of the study area in Cumberland Shale Sandstone Transition Forest associated with the Lucas Heights landscape. | No |

## 7.4 Affected threatened fauna

The analysis of subject species resulted in 32 threatened fauna listed on the TSC and/or EPBC Acts being rated as having a moderate or higher likelihood of occurrence within the study area.

Developments can impact upon fauna in a number of ways. The significance of an impact would be greatest if any of the following situations occur:

- death or injury of individuals
- loss or disturbance of limiting foraging resources
- loss or disturbance of limiting breeding resources.

Limiting resources are those that are of particular importance for the survival of a species. Limiting resources within the study area include:

- creekline habitats
- hollow bearing trees
- overhangs
- rock crevices
- termite mounds
- riparian vegetation
- ephemeral drainage lines.

Hollow-bearing trees and termite mounds are unlikely to be impacted by subsidence. The potential impacts to creeklines, overhangs, rock crevices and riparian vegetation are detailed in section 3.4.

A number of species with potential habitat within the study area are unlikely to have limiting resources impacted by the proposal. Assessments of Significance under the TSC and/or EPBC Acts were not carried for the following species, as these species are generally highly mobile, and are unlikely to have any potential habitat impacted by subsidence:

- Birds: Regent Honeyeater, Great Egret, Bush Stone-curlew, Gang-gang Cockatoo, Glossy Black-Cockatoo, Brown Treecreeper (eastern subspecies), Varied Sittella, Little Eagle, White-throated Needletail, Swift Parrot, Hooded Robin (south-eastern form), Black-chinned Honeyeater (eastern subspecies), Rainbow Bee-eater, Black-faced Monarch, Satin Flycatcher, Turquoise Parrot, Barking Owl, Powerful Owl, Scarlet Robin, Speckled Warbler, Rufous Fantail, Masked Owl.
- Invertebrates: Cumberland Plain Land Snail.
- Mammals: Koala and Grey-headed Flying Fox.

Assessments of Significance under the TSC and/or EPBC Acts were carried out for the following species Frogs:

- Red-crowned Toadlet;
- Mammals: Large-eared Pied Bat, Little Bentwing-bat, Eastern Bentwing-bat, Eastern Freetail-bat, Southern Myotis, Greater Broad-nosed Bat.

The Assessments of Significance under the TSC Act are provided in Appendix D and the Assessments of Significance under the EPBC Act are provided in Appendix E.

The Assessments concluded that the proposal is unlikely to have significant impact on any threatened fauna species.

No fauna listed under the JAMBA, CAMBA and/or ROKAMBA are likely to be significantly impacted by the proposal.

## 7.5 SEPP 44 Koala habitat

SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline:

1. by requiring the preparation of plans of management before development consent can be granted in relation to areas of core Koala habitat; and
2. by encouraging the identification of areas of core Koala habitat; and
3. by encouraging the inclusion of areas of core Koala habitat in environment protection zones.

No removal of habitat trees will occur as a result of the proposal. The proposal is unlikely to result in any disruptions to core populations of the koala. As such, the proposal will not impact upon SEPP 44 Koala Habitat.

# 8. Recommendations

- All remediation works that are undertaken near waterways, must take appropriate measures to minimise environmental impacts. This includes avoiding the spread of Chytrid Fungus following the NPWS guidelines and clearing extensive areas of riparian vegetation to access the creek bed for remediation's work.
- Any subsidence impacts from the proposal on terrestrial ecology should be assessed at the completion of each longwall panel to ensure any remediation (if required) is undertaken in a timely manner. This will also assist in increasing the accuracy of predictions of impacts from future longwall mining in the area. The condition of plant communities and habitats should be assessed at sample sites that were assessed prior to the commencement of longwall mining to gain further information regarding possible changes to the habitats due to mining related subsidence.
- In the unlikely event that gas release related die-off is observed, actions should be taken to monitor the extent of and recovery of any such vegetation impacts.
- Species Impact Statements and/or Referrals to the Environment Minister are not recommended for any threatened biodiversity.

# 9. Conclusion

This report provides a terrestrial ecological assessment to address the potential impacts associated with the extraction of Longwalls 31 to 37 (the proposal) at Tahmoor Colliery.

The current assessment involved a thorough review of the previous assessments, targeted threatened flora and fauna surveys, and general habitat searches of the study area.

Subsidence predictions and changes to hydrology detailed in MSEC (2014), GeoTerra (2014), and WRM (2014) and were used as the basis to which the impact assessments for threatened flora, fauna and ecological communities have been assessed in this report insofar as subsidence related impacts are concerned.

This assessment concludes that majority of vegetation within the study area would not be impacted by subsidence due to underground mining, but riparian vegetation may be potentially affected. Gas emissions as a result of subsidence may occur within low lying areas and cause localized vegetation dieback. Based on previous experience in the Southern Coalfields, any impact is likely to be localized. It is therefore likely that any potential impacts to vegetation as a result of subsidence be minor in occurrence and impact. Therefore, no TECs were likely to be significantly impacted by the proposal.

Assessments of Significance under the TSC and/or EPBC Act have been conducted for two threatened flora species: *Epacris purpurascens* var. *purpurascens* and *Pomaderris brunnea*. The assessments concluded that the proposal is unlikely to have a significant impact on any threatened flora listed on the TSC Act and EPBC Act.

Assessments of Significance under the TSC and/or EPBC Act have been conducted for eight threatened fauna species: Red-crowned Toadlet, Large-eared Pied Bat, Little Bentwing-bat, Eastern Bentwing-bat, Eastern Freetail-bat, Southern Myotis, and Greater Broad-nosed Bat. The assessments concluded that the proposal is unlikely to have a significant impact on any threatened fauna species.

No Critical Habitat will be impacted by the proposal.

No fauna listed under the JAMBA, CAMBA and/or ROKAMBA are likely to be significantly impacted by the proposal.

Species Impact Statements and/or a Referral to the Environment Minister are not recommended for the proposal.

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# Appendix A Threatened flora and fauna likelihood of occurrence

| Scientific Name | Common Name | TSC Act | EPBC Act | Habitat | Likelihood of occurrence |
|---|---|---|---|---|---|
| *Heleioporus australiacus* | Giant Burrowing Frog | V | V | The Giant Burrowing Frog has been recorded breeding in a range of water bodies associated with more sandy environments of the coast and adjacent ranges from the Sydney Basin south the eastern Victoria. It breeds in hanging swamps, perennial non-flooding creeks and occasionally permanent pools, but permanent water must be present to allow its large tadpoles time to reach metamorphosis. | Low –very limited habitat occurs toward Cedar and Stonequarry Creek, however no tadpoles were detected during field survey and the species has not been previously recorded in study area. |
| *Litoria aurea* | Green and Golden Bell Frog | E | V | Inhabits a very wide range of water bodies including marshes, dams and streams, particularly those containing emergent vegetation such as bullrushes or spikerushes. It also inhabits numerous types of man-made water bodies including quarries and sand extraction sites. Optimum habitat includes water-bodies that are un-shaded, free of predatory fish such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available. | Low – has not been recorded in previously Locality |
| *Litoria littlejohni* | Littlejohn's Tree Frog | V | V | Occurs in wet and dry sclerophyll forests and heathland associated with sandstone outcrops between 280 and 1000 m on the eastern slopes of the Great Dividing Range from the Central Coast down into Victoria. Individuals have been collected from a wide range of water bodies that includes semi-permanent dams, permanent ponds, temporary pools and permanent streams, with calling occurring from fringing vegeation or on the banks. Individuals have been observed sheltering under rocks on high exposed ridges during summer and within deep leaf litter adjacent to the breeding site. Calling occurs in all months of the year, often in association with heavy rains. The tadpoles are distinctive, being large and very dark in colouration. | Low – has not been recorded in locality. |
| *Mixophyes balbus* | Stuttering Frog | E | V | Associated with streams in dry sclerophyll and wet sclerophyll forests and rainforests of more upland areas of the Great Dividing Range of NSW and down into Victoria. Breeding occurs along forest streams with permanent water where eggs are deposited within nests excavated in riffle zones by the females and the tadpoles swim free into the stream when large enough to do so. Outside of breeding, individuals range widely across the forest floor and can be found hundreds of metres from water | Low – has not been recorded in locality. |
| *Pseudophryne australis* | Red-crowned Toadlet | V | - | Occurs on wetter ridge tops and upper slopes of sandstone formations on which the predominant vegetation is dry open forests and heaths. This species typically breeds within small ephemeral creeks that feed into larger semi-perennial streams. After rain these creeks are characterised by a series of shallow pools lined by dense grasses, ferns and low shrubs and usually contain leaf litter for shelter. Eggs are terrestrial and laid under litter, vegetation or rocks where the tadpoles inside will reach a relatively late stage of development before waiting for flooding waters before hatching will occur. | High |

| Scientific Name | Common Name | TSC Act | EPBC Act | Habitat | Likelihood of occurrence |
|---|---|---|---|---|---|
| *Anthochaera phrygia* | Regent Honeyeater | CE | E,M | The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests. | High |
| *Apus pacificus* | Fork-tailed Swift | - | M | The Fork-tailed Swift is almost exclusively aerial, flying from less then one metre to at least 300 metres above ground and probably much higher. | Moderate - May fly over area |
| *Ardea alba* | Great Egret | - | M | Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. | High |
| *Burhinus grallarius* | Bush Stone-curlew | E | - | The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights. | Moderate |
| *Callocephalon fimbriatum* | Gang-gang Cockatoo | V | - | In summer, 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. | Moderate |
| *Calyptorhynchus lathami* | Glossy Black-Cockatoo | 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. Endangered population in the Riverina. | Moderate to High |
| *Climacteris picumnus victoriae* | Brown Treecreeper (eastern subspecies) | 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 forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. | High |
| *Daphoenositta chrysoptera* | Varied Sittella | 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. | Known |
| *Gallinago hardwickii* | Latham's Snipe | - | M | Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. Seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. | Low – no wetlands |
| *Glossopsitta pusilla* | Little Lorikeet | 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. | Low |

| Scientific Name | Common Name | TSC Act | EPBC Act | Habitat | Likelihood of occurrence |
|---|---|---|---|---|---|
| *Haliaeetus leucogaster* | White-bellied Sea-Eagle | - | M | Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna. | Low |
| *Hieraaetus morphnoides* | Little Eagle | 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. | Moderate |
| *Hirundapus caudacutus* | White-throated Needletail | - | M | An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. | High |
| *Lathamus discolor* | Swift Parrot | 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. | Low – moderate |
| *Lophoictinia isura* | Square-tailed Kite | 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 100km2. 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. | Low – marginal habitat towards northern longwalls |
| *Melanodryas cucullata cucullata* | Hooded Robin (south-eastern form) | V | - | Occupy a wide range of eucalypt woodlands, Acacia shrublands and open forests. | High |
| *Melithreptus gularis* | Black-chinned Honeyeater (eastern subspecies) | V | - | Eucalypt woodlands within an approximate annual rainfall range of 400-700mm | High |
| *Merops ornatus* | Rainbow Bee-eater | - | M | Found throughout mainland Australia most often in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels. | High |
| *Monarcha melanopsis* | Black-faced Monarch | - | M | Found along the coast of eastern Australia, becoming less common further south. Inhabits rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. | High |
| *Myiagra cyanoleuca* | Satin Flycatcher | - | M | The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. Found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests. | Moderate |
| *Neophema pulchella* | Turquoise Parrot | V | - | The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust. | Moderate |
| *Ninox connivens* | Barking Owl | 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 – towards northern longwalls |
| *Ninox strenua* | Powerful Owl | 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. It is most commonly recorded within red turpentine in tall open forests and black she-oak within open forests. 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 – toward northern longwalls |

| Scientific Name | Common Name | TSC Act | EPBC Act | Habitat | Likelihood of occurrence |
|---|---|---|---|---|---|
| *Pandion haliaetus* | Osprey | V | - | Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. | Low |
| *Petroica boodang* | Scarlet Robin | V | - | The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. | Moderate-high |
| *Pyrrholaemus saggitatus* | Speckled Warbler | V | - | The Speckled Warbler lives in a wide range of eucalypt 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 |
| *Rhipidura rufifrons* | Rufous Fantail | - | M | Found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. Inhabits tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests. | Moderate |
| *Rostratula australis* | Australian Painted Snipe | E | E, M | In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. | Low |
| *Stagonopleura guttata* | Diamond Firetail | 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 woodlands. Also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities. | Low |
| *Sterna fuscata* | Sooty Tern | V | - | The Sooty Tern is found over tropical and sub-tropical seas and on associated islands and cays around Northern Australia. In NSW only known to breed at Lord Howe Island. Large flocks can be seen soaring, skimming and dipping but seldom plunging in off shore waters. Breeds in large colonies in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands. | None |
| *Tyto novaehollandiae* | Masked Owl | V | - | Inhabits a diverse range of wooded habitat that provides 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 |
| *Tyto tenebricosa* | Sooty Owl | 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 metres. 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 in diameter. | Low |
| *Meridolum corneovirens* | Cumberland Plain Land Snail | E | - | Primarily inhabits Cumberland Plain woodland (an EEC). This community is a grassy, open woodland with occasional dense patches of shrubs. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish. | Previously recorded to the immediate west of the study area during Niche (2012). Likely to occur in study area. |

| Scientific Name | Common Name | TSC Act | EPBC Act | Habitat | Likelihood of occurrence |
|---|---|---|---|---|---|
| *Bettongia penicillata* | Brush-tailed Bettong (South-East Mainland) | Extinct | Extinct | Formerly ranged over all of the southwest of Eastern Australia, most of South Australia , the northwest corner of Victoria and across the central portion of New South Wales . By the 1920s, it was extinct over much of its range. Associated with grassland, heath and sclerophyll woodland. Other accounts record the subspecies from open eucalypt forest with low woody scrub, tussock grass and occasional bare patches. | None |
| *Cercartetus nanus* | Eastern Pygmy-possum | V | - | Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Will often nest in tree hollows, but can also construct its own nest . Because of its small size it is able to utilise a range of hollow sizes including very small hollows. Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5ha area over a 5 month period . | Low |
| *Chalinolobus dwyeri* | Large-eared Pied Bat | 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 3 and 37 individuals. | High |
| *Dasyurus maculatus maculatus* | Spotted-tailed Quoll | V | E | Spotted-tailed Quoll are found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. | Low – not been recorded in locality. Not recorded in better habitat during Niche (2014) approximately 11 km to south of study area. |
| *Isoodon obesulus obesulus* | Southern Brown Bandicoot (eastern) | E | - | Prefers sandy soils with scrubby vegetation and-or areas with low ground cover that are burn from time to time. A mosaic of post fire vegetation is important for this species. | Low – not been recorded in locality. Not recorded in better habitat during Niche (2014) approximately 11 km to south of study area. |
| *Miniopterus australis* | Little Bentwing-bat | 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 100s km from feeding home ranges to breeding sites. Little Bent-wing Bat has a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects. | High |
| *Miniopterus schreibersii oceanensis* | Eastern Bentwing-bat | V | - | Eastern Bent-wing Bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. | High |
| *Mormopterus norfolkensis* | Eastern Freetail-bat | 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 |
| *Myotis macropus* | Southern Myotis | V | - | The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. | High |

| Scientific Name | Common Name | TSC Act | EPBC Act | Habitat | Likelihood of occurrence |
|---|---|---|---|---|---|
| *Petaurus australis* | Yellow-bellied Glider | V | - | Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. | None – has not been recorded in locality and no old growth or coastal gully forest present |
| *Petrogale penicillata* | Brush-tailed Rock-wallaby | E | V | 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. | None – no records in Locality |
| *Phascolarctos cinereus* | Koala | 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 . | High |
| *Pseudomys novaehollandiae* | New Holland Mouse | - | V | The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. | Low |
| *Pteropus poliocephalus* | Grey-headed Flying-fox | 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 – may forage in study area. No camp sites were recorded during field survey. |
| *Scoteanax rueppellii* | Greater Broad-nosed Bat | 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 |
| **Reptiles** | | | | | |
| *Hoplocephalus bungaroides* | Broad-headed Snake | E | V | Occurs almost exclusively 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 spend most of the year sheltering in and under rock crevices and exfoliating rock. However, some individuals will migrate to tree hollows to find shelter during hotter parts of summer. | Low – no known records in study area. Potential habitat marginal to the northern longwalls |
| ***Threatened flora*** | | | | | |
| *Acacia bynoeana* | Bynoe's Wattle | E | V | Grows mainly in heath and dry sclerophyll forest in sandy soils. Mainly south of Dora Creek-Morisset area to Berrima and the Illawarra region, west to the Blue Mountains, also recorded from near Kurri Kurri in the Hunter Valley and from Morton National Park. | Low - no habitat surveyed which represent similar habitat where populations have been recorded. |
| *Acacia flocktoniae* | Flockton Wattle | V | V | Grows in dry sclerophyll forest on sandstone. The Flockton Wattle is found only in the Southern Blue Mountains (at Mt Victoria, Megalong Valley and Yerranderie). | Low |

| Scientific Name | Common Name | TSC Act | EPBC Act | Habitat | Likelihood of occurrence |
|---|---|---|---|---|---|
| *Acacia pubescens* | | V | V | Concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone. Grows in open woodland and forest, in a variety of plant communities, including Cooks River-Castlereagh Ironbark forest, Shale-Gravel Transition forest and Cumberland Plain woodland. | Moderate |
| *Allocasuarina glareicola* | | E | E | Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows in Castlereagh woodland on lateritic soil. Found in open woodland with Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla and Melaleuca decora. Common associated understorey species include Melaleuca nodosa, Hakea dactyloides, Hakea sericea, Dillwynia tenuifolia, Micromyrtus minutiflora, Acacia elongata, Acacia brownei, Themeda australis and Xanthorrhoea minor. | Low – not within known habitat. |
| *Asterolasia elegans* | | E | E | Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve. Occurs on Hawkesbury sandstone in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. | Low – not within known habitat |
| *Caladenia tessellata* | Thick-lip Spider Orchid | E | V | The Tessellated Spider Orchid is found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. | Low – nearest population is Braidwood |
| *Commersonia prostrata* | | E | E | The Dwarf Kerrawang occurs disjunctly in south-east Australia, from the Gippsland Lakes hinterland in Victoria to the Tomago sandbeds north-east of Newcastle in New South Wales. In NSW, the Dwarf Kerrawang occurs on sandy, sometimes peaty soils, in a wide variety of habitats including; Snow Gum (Eucalyptus pauciflora) Woodland at Rose Lagoon, Blue leaved Stringybark (E. agglomerata) Open Forest at Tallong, Brittle Gum (E. mannifera) Low Open Woodland at Penrose, Scribbly Gum (E. haemostoma)/ Swamp Mahogany (E. robusta)/ Broad-leaved Paperbark (Melaleuca quinquenervia) Ecotonal Forest at Tomago the ecotone between Sedge Swamp and Swamp Forest, a groundwater dependant ecosystem that represents a substantial vegetation community of the Tomago sandbeds. | Low – closest record is Picton Lakes 1911 |
| *Cryptostylis hunteriana* | Leafless Tongue-orchid | V | V | Grows in swamp-heath on sandy soils, chiefly in coastal districts, south from the Gibraltar Range. | Low – known to occur in the Pittswater subregion of CMA. No records in locality. |
| *Cynanchum elegans* | White-flowered Wax Plant | E | E | Recorded from rainforest gullies scrub and scree slopes from the Gloucester district to the Wollongong area and inland to Mt Dangar. | Low – habitat not suitable |

| Scientific Name | Common Name | TSC Act | EPBC Act | Habitat | Likelihood of occurrence |
|---|---|---|---|---|---|
| *Darwinia peduncularis* | | V | - | Occurs as local disjunct populations in coastal NSW with a couple of isolated populations in the Blue Mountains. It has been recorded from Brooklyn, Berowra, Galston Gorge, Hornsby, Bargo River, Glen Davis, Mount Boonbourwa and Kings Tableland. Usually grows on or near rocky outcrops on sandy, well drained, low nutrient soil over sandstone. | Low – marginal habitat present |
| *Epacris purpurascens var. purpurascens* | | V | - | Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Found in a range of habitat types, most of which have a strong shale soil influence. | High |
| *Eucalyptus benthamii* | Camden White Gum | V | V | Occurs on the alluvial flats of the Nepean River and its tributaries. There are two major subpopulations: in the Kedumba Valley of the Blue Mountains National Park and at Bents Basin State Recreation Area. Several trees are scattered along the Nepean River around Camden and Cobbitty. At least five trees occur on the Nattai River in Nattai National Park. Requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment. Occurs in open forest. | Low – not detected in areas of River-flat Eucalypt Forest during survey |
| *Eucalyptus macarthurii* | | V | - | A moderately restricted distribution, recorded from the Moss Vale District to Kanangra Boyd National Park. In the Southern Highlands it occurs mainly on private land, often as isolated individuals in, or on the edges, of paddocks. Isolated stands occur in the north west part of the range on the Boyd Plateau. The only known record in the conservation estate is within Kanangra Boyd National Park. Occurs on grassy woodland on relatively fertile soils on broad cold flats. | Low – known individual occurs just outside of study area. |
| *Genoplesium baueri* | Bauer's Midge Orchid | E | E | Grows in dry sclerophyll forest and moss gardens over sandstone. Flowers February to March. Has been recorded between Ulladulla and Port Stephens. Currently the species is known from just over 200 plants across 13 sites. The species has been recorded in Berowra Valley Regional Park, Royal National Park and Lane Cove National Park and may also occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. | Low – no known populations in locality |
| *Grevillea parviflora subsp. parviflora* | Small-flowered Grevillea | V | V | Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks. | High |
| *Gyrostemon thesioides* | | E | - | Grows on hillsides and riverbanks and may be restricted to fine sandy soils Within NSW, has only ever been recorded at three sites, to the west of Sydney, near the Colo, Georges and Nepean Rivers. The most recent sighting was of a single male plant near the Colo River within Wollemi National Park. The species has not been recorded from the Nepean and Georges Rivers for 90 and 30 years respectively, despite searches. Also occurs in Western Australia, South Australia, Victoria and Tasmania. | Low – only known from three locations. |

| Scientific Name | Common Name | TSC Act | EPBC Act | Habitat | Likelihood of occurrence |
|---|---|---|---|---|---|
| *Haloragis exalata subsp. exalata* | | V | V | Square Raspwort occurs in 4 widely scattered localities in eastern NSW. It is disjunctly distributed in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. Square Raspwort appears to require protected and shaded damp situations in riparian habitats. | Low – not previously recorded in locality |
| *Lepidium hyssopifolium* | | E | E | The species occurs in a variety of habitats including woodland with a grassy understorey and grassland. In NSW, there is a small population consisting near Bathurst, two populations near Bungendore, and one near Crookwell. Historical records also exist from near Armidale and possibly Cooma. | Low – not previously recorded in locality |
| *Leucopogon exolasius* | Woronora Beard-heath | V | V | Grows in woodland on sandstone. Restricted to the Woronora and Grose Rivers and Stokes Creek, Royal National Park. | Moderate |
| *Melaleuca biconvexa* | Biconvex Paperbark | V | V | Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. | Low – not previously recorded in locality |
| *Melaleuca deanei* | Dean's Paperbark | V | V | Grows in wet heath on sandstone in coastal districts from Berowra to Nowra. | Low – not previously recorded in locality |
| *Pelargonium sp. Striatellum* | Omeo's Stork's-bill | E | E | Flowering occurs from October to March. Occurs in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds. The species is known to form clonal colonies by rhizomatous propagation. | Low – not previously recorded in locality. Habitat not suitable. |
| *Persicaria elatior* | | V | V | This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. | Low – recorded in Picton Lakes. Habitat in study area not suitable. |
| *Persoonia acerosa* | | V | V | Occurs in dry sclerophyll forest, scrubby low-woodland and heath on low fertility soils. Recorded only on the central coast and in the Blue Mountains, from Mt Tomah in the north to as far south as Hill Top where it is now believed to be extinct. Mainly in the Katoomba, Wentworth Falls, Springwood area. | Low – not previously recorded in locality. |
| *Persoonia bargoensis* | Bargo Geebung | E | V | The Bargo Geebung occurs in woodland or dry sclerophyll forest on sandstone and on heavier, well drained, loamy, gravely soils. | Moderate – near main distribution. |

| Scientific Name | Common Name | TSC Act | EPBC Act | Habitat | Likelihood of occurrence |
|---|---|---|---|---|---|
| *Pimelea spicata* | Spiked Rice-flower | E | E | Once widespread on the Cumberland Plain, the Spiked Rice-flower occurs in two disjunct areas; the Cumberland Plain (Narellan, Marayong, Prospect Reservoir areas) and the Illawarra (Landsdowne to Shellharbour to northern Kiama). In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils. On the inland Cumberland Plain sites it is associated with grey box and Ironbark. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a better developed shrub and grass understorey. | Moderate |
| *Pomaderris brunnea* | Brown Pomaderris | V | V | The species is expected to live for 10 - 20 years, while the minimum time to produce seed is estimated to be 4 - 6 years. Found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area. It also occurs at Walcha on the New England Tableland and in far eastern Gippsland in Victoria. | Moderate to High – close proximity to large population along Teatree Hollow Creek (Niche 2014) |
| *Pterostylis saxicola* | Sydney Plains Greenhood | E | E | Restricted to western Sydney between Freemans Reach in the north and Picton in the south. Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where Pterostylis saxicola occurs are sclerophyll forest or woodland on shale-sandstone transition soils or shale soils. | Moderate habitat along Matthews Creek, Cedar Creek and Stonequarry creek in north of study area. |
| *Pultenaea glabra* | | V | V | Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone. Restricted to the higher Blue Mountains. | None |
| *Rulingia prostrata* | | E | E | Occurs on sandy, sometimes peaty soils in a wide variety of habitats: snow gum woodland at Rose Lagoon; blue leaved stringybark open forest at Tallong; and in brittle gum low open woodland at Penrose; scribbly gum - swamp mahogany ecotonal forest at Tomago. | None |
| *Streblus pendulinus* | Siah's Backbone | - | E | Siah's Backbone is a tree or large shrub that grows to 6 m in height. Found in warmer rainforests, chiefly along watercourses. | Low – habitat not suitable. |
| *Tetratheca glandulosa* | Tetratheca glandulosa | V | V | Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone, with associated soil landscapes such as Lucas Heights, Gymea, Lambert and Faulconbridge. Topographically, the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils are generally shallow, consisting of a yellow, clayey-sandy loam. Stony lateritic fragments are also common in the soil profile on many of these ridgetops. Vegetation structure varies from heaths and scrub to woodlands-open woodlands, and open forest. Restricted to the following Local Government Areas: Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong. | Low - moderate |

| Scientific Name | Common Name | TSC Act | EPBC Act | Habitat | Likelihood of occurrence |
|---|---|---|---|---|---|
| *Thelymitra sp. Kangaloon* | Kangaloon Sun Orchid | CE | CE | Thelymitra sp. Kangaloon is only known to occur on the southern tablelands of NSW in the Moss Vale - Kangaloon - Fitzroy Falls area at 550-700 m above sea level. It is known to occur at three swamps that are above the Kangaloon Aquifer. It is found in swamps in sedgelands over grey silty grey loam soils | Low – no known populations in locality. No swamps or sedgelands. |
| *Thesium australe* | Austral Toadflax | V | V | Grows in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland. Grows on kangaroo grass tussocks but has also been recorded within the exotic coolatai grass. | Low – no known populations in locality |

# Appendix B. Flora species recorded

| Family | Botanical | Weed* | LB01 | LB1363 | LB1367 | LB1368 | LB1374 | LB1375 | LB1377 | LB383 | LB401 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Acanthaceae | *Pseuderanthemum variabile* | | | 2 | | | | 2 | 2 | | |
| Adiantaceae | *Adiantum formosum* | | | | | 2 | | | | 1 | |
| Apiaceae | *Centella asiatica* | | | 2 | 2 | | 3 | 2 | | | 2 |
| Apocynaceae | *Marsdenia suaveolens* | | | | | | | | 2 | | |
| Asparagaceae | *Asparagus asparagoides* | * | | | | | | | | 1 | |
| Asteraceae | *Ageratina riparia* | * | | | 2 | | | | | | 3 |
| Asteraceae | *Bidens pilosa* | * | 3 | | | | | | | 2 | |
| Asteraceae | *Conyza bonariensis* | * | 2 | | 2 | | | | 3 | | |
| Asteraceae | *Crassocephalum crepidioides* | * | 2 | | 2 | | | | | | |
| Asteraceae | *Gamochaeta calviceps* | * | | | 2 | | | | | | |
| Asteraceae | *Hypochaeris radicata* | * | | | 2 | | | | | | |
| Asteraceae | *Lactuca saligna* | * | 2 | | | | | | | | |
| Asteraceae | *Onopordum acanthium* | * | 2 | 2 | 2 | | | | 1 | | |
| Asteraceae | *Senecio madagascariensis* | * | 2 | | 2 | | | | | | |
| Asteraceae | *Sonchus oleraceus* | * | | | 2 | | | | | | |
| Asteraceae | *Cotula australis* | | | | 1 | | | | | | |
| Asteraceae | *Sigesbeckia orientalis* | | | 2 | | | | | | | |
| Bignoniaceae | *Pandorea pandorana* | | | | | | | | | 2 | |
| Blechnaceae | *Blechnum cartilagineum* | | | | | 2 | 2 | 3 | | | 2 |
| Caryophyllaceae | *Stellaria media* | * | 2 | | | | | | | | |
| Casuarinaceae | *Allocasuarina torulosa* | | | | 2 | 2 | | | | 2 | |
| Commelinaceae | *Tradescantia fluminensis* | * | 4 | 3 | | | | | 4 | 3 | |
| Commelinaceae | *Commelina cyanea* | | 3 | 3 | | | | | | 3 | |
| Convolvulaceae | *Dichondra repens* | | | | 2 | | 2 | | | | 2 |
| Cunoniaceae | *Callicoma serratifolia* | | | | | | 3 | 2 | | | 3 |

| Family | Botanical | Weed* | LB01 | LB1363 | LB1367 | LB1368 | LB1374 | LB1375 | LB1377 | LB383 | LB401 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cyperaceae | *Carex spp.* | | | | | | | 2 | | 2 | |
| Cyperaceae | *Cyperus spp.* | | | | 1 | | | | | | |
| Cyperaceae | *Gahnia aspera* | | | 2 | | | | | | | |
| Davalliaceae | *Nephrolepis cordifolia* | | | | | | | 2 | 3 | 3 | |
| Dennstaedtiaceae | *Pteridium esculentum* | | | 2 | | | 2 | | | | |
| Dilleniaceae | *Hibbertia aspera* | | | | | 2 | | | | | |
| Ericaceae | *Leucopogon lanceolatus* | | | | | | 2 | | | | |
| Ericaceae | *Lissanthe strigosa* | | | | | 2 | | | | | |
| Fabaceae (Faboideae) | *Glycine tabacina* | | | | | | | | | 2 | |
| Fabaceae (Faboideae) | *Indigofera australis* | | | | 2 | | | | | | |
| Fabaceae (Mimosoideae) | *Acacia falciformis* | | | | | | | 2 | | | |
| Fabaceae (Mimosoideae) | *Acacia floribunda* | | | 2 | 3 | | | | | | |
| Fabaceae (Mimosoideae) | *Acacia parramattensis* | | 3 | 3 | 3 | | | | | | |
| Geraniaceae | *Geranium solanderi* | | 2 | | 2 | | 2 | 2 | | | 2 |
| Juncaceae | *Juncus usitatus* | | | | 1 | | | | | | |
| Lamiaceae | *Plectranthus parviflorus* | | | | | | 2 | 2 | | | |
| Lobeliaceae | *Pratia purpurascens* | | | | | 2 | | 2 | | | 2 |
| Lomandraceae | *Lomandra longifolia* | | | 3 | 3 | | 3 | 4 | | 2 | 3 |
| Luzuriagaceae | *Geitonoplesium cymosum* | | 1 | | | 2 | 1 | | 2 | | |
| Malvaceae | *Modiola caroliniana* | * | 2 | | | | | | | | |
| Malvaceae | *Sida rhombifolia* | * | | | 2 | | | | | | |
| Myrtaceae | *Angophora floribunda* | | | | | 1 | | | | | |
| Myrtaceae | *Backhousia myrtifolia* | | | | | 4 | 4 | 4 | 4 | 3 | 4 |
| Myrtaceae | *Eucalyptus crebra* | | | | | | | | | 2 | |
| Myrtaceae | *Eucalyptus moluccana* | | | 2 | | | | | | | |
| Myrtaceae | *Eucalyptus piperita* | | | | | | | | | | 3 |
| Myrtaceae | *Eucalyptus punctata* | | | | | 3 | 3 | 3 | | 2 | |
| Myrtaceae | *Eucalyptus radiata* | | | | 2 | | | | | | |
| Myrtaceae | *Eucalyptus tereticornis* | | 2 | | | | | | | | |

| Family | Botanical | Weed* | LB01 | LB1363 | LB1367 | LB1368 | LB1374 | LB1375 | LB1377 | LB383 | LB401 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Myrtaceae | *Leptospermum polygalifolium* | | | | 2 | | | | | | |
| Myrtaceae | *Tristaniopsis laurina* | | | | | 2 | 3 | 3 | | | 3 |
| Oleaceae | *Ligustrum lucidum* | * | 4 | 4 | 2 | 1 | | 2 | 3 | 3 | |
| Oleaceae | *Ligustrum sinense* | * | 4 | 3 | 2 | 2 | | | 2 | 2 | |
| Oleaceae | *Notelaea longifolia* | | | | | | 3 | 2 | 2 | 2 | |
| Osmundaceae | *Todea barbara* | | | | | | 1 | | | 1 | 1 |
| Oxalidaceae | *Oxalis perennans* | | 2 | | | 2 | | | | 2 | |
| Phormiaceae | *Dianella caerulea* | | | | 2 | | | | | | |
| Phyllanthaceae | *Glochidion ferdinandi* | | | | | | | 2 | | | 2 |
| Pittosporaceae | *Bursaria spinosa* | | | 2 | 2 | | | | | 3 | |
| Pittosporaceae | *Pittosporum undulatum* | | | | | | | | 2 | | |
| Plantaginaceae | *Plantago lanceolata* | * | | | 3 | | | | | | |
| Poaceae | *Ehrharta erecta* | * | 3 | 3 | | | | | 2 | 2 | |
| Poaceae | *Anisopogon avenaceus* | | | 2 | | | | | | | |
| Poaceae | *Austrostipa scabra* | | | | 2 | | | | | | |
| Poaceae | *Cynodon dactylon* | | | | 2 | | | | | 2 | |
| Poaceae | *Entolasia marginata* | | | | | | 3 | 2 | | | |
| Poaceae | *Entolasia stricta* | | | | 2 | 2 | | | | 2 | |
| Poaceae | *Microlaena stipoides* | | 2 | 3 | 2 | 2 | 3 | | 2 | 3 | 3 |
| Poaceae | *Oplismenus aemulus* | | 3 | | | 2 | | | 2 | 2 | |
| Poaceae | *Themeda australis* | | | 2 | 2 | | | | | | |
| Polygonaceae | *Acetosa sagittata* | * | 3 | 4 | | | | | 2 | | |
| Polygonaceae | *Persicaria decipiens* | | | | | 2 | | | | | |
| Proteaceae | *Banksia spinulosa* | | | | | 3 | | | | | |
| Proteaceae | *Persoonia linearis* | | | 2 | | 2 | | | | | |
| Ranunculaceae | *Clematis aristata* | | | | | | 2 | 2 | | | |
| Rubiaceae | *Coprosma repens* | * | | | | | | | | | 2 |
| Rutaceae | *Boronia ledifolia* | | | | | | | | | 2 | |
| Santalaceae | *Exocarpos cupressiformis* | | | | | | | | | 2 | |

| Family | Botanical | Weed* | LB01 | LB1363 | LB1367 | LB1368 | LB1374 | LB1375 | LB1377 | LB383 | LB401 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Solanaceae | *Solanum nigrum* | * | 3 | | | | | | | | |
| Solanaceae | *Solanum prinophyllum* | | | | 1 | 1 | 2 | | | | 2 |
| Urticaceae | *Urtica incisa* | | 3 | 3 | | | | | | | |
| Verbenaceae | *Lantana camara* | * | 3 | | 1 | | | | | 1 | |
| Violaceae | *Viola hederacea* | | | 2 | 2 | | 2 | | | | 2 |

# Appendix C. Fauna species recorded

| Family | Scientific Name | Exotic | Common Name |
|---|---|---|---|
| Myobatrachidae | *Crinia signifera* | | Common Eastern Froglet |
| Myobatrachidae | *Limnodynastes dumerilii* | | Eastern Banjo Frog |
| Myobatrachidae | *Limnodynastes peronii* | | Striped Marsh Frog |
| Hylidae | *Litoria peronii* | | Peron's Tree Frog |
| Chelidae | *Chelodina longicollis* | | Eastern Snake-necked Turtle |
| Agamidae | *Intellagama lesueurii lesueurii* | | Eastern Water Dragon |
| Elapidae | *Pseudechis porphyriacus* | | Red-bellied Black Snake |
| Anatidae | *Chenonetta jubata* | | Australian Wood Duck |
| Columbidae | *Ocyphaps lophotes* | | Crested Pigeon |
| Cacatuidae | *Cacatua galerita* | | Sulphur-crested Cockatoo |
| Cacatuidae | *Eolophus roseicapillus* | | Galah |
| Psittacidae | *Platycercus elegans* | | Crimson Rosella |
| Psittacidae | *Platycercus eximius* | | Eastern Rosella |
| Meliphagidae | *Manorina melanocephala* | | Noisy Miner |
| Meliphagidae | *Manorina melanophrys* | | Bell Miner |
| Meliphagidae | *Meliphaga lewinii* | | Lewin's Honeyeater |
| Meliphagidae | *Phylidonyris novaehollandiae* | | New Holland Honeyeater |
| Neosittidae | *Daphoenositta chrysoptera* | | Varied Sittella |
| Artamidae | *Cracticus tibicen* | | Australian Magpie |
| Artamidae | *Strepera graculina* | | Pied Currawong |
| Rhipiduridae | *Rhipidura leucophrys* | | Willie Wagtail |
| Corvidae | *Corvus coronoides* | | Australian Raven |
| Sturnidae | *Sturnus tristis* | * | Common Myna |
| Passeridae | *Passer domesticus* | * | House Sparrow |

# Appendix D. Seven-Part Tests

Assessments of significance (Seven Part Tests) have been conducted below for the following items of threatened biodiversity under the TSC Act:

Threatened flora:

- *Epacris purpurascens* var. *purpurascens*;
- *Pomaderris brunnea*.

Threatened fauna:

- Frogs: Red-crowned Toadlet;
- Mammals: Large-eared Pied Bat, Eastern False Pipistrelle, Eastern Bent-wing Bat, Eastern Freetail.

Note: Unless otherwise stated – the habitat and general ecological information contained in these assessments of significance has been taken from the NSW Office of Environment and Heritage (OEH) Threatened Species Profiles database (DECC 2008) and/or the Commonwealth SPRAT database (DoE 2012):

http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/

http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

**Definitions**

The following definitions are taken from the OEH Threatened Species Assessment Guidelines: The Assessment of Significance (DECC 2007a) and have been adopted for this assessment.

**Subject site**: the area to be directly affected by the proposal.

**Project Area**: the subject site and any additional areas which may potentially be affected by the proposal either directly or indirectly.

**Direct impacts**: those that directly affect the habitat and/or individual plants and animals and cannot be avoided or mitigated.

**Indirect impacts**: those that affect species, populations or ecological communities in a manner other than through direct loss or disturbance. These can usually be avoided or mitigated.

**Local population**: the population of a particular species that occurs in the locality.

**Locality**: the area within 10 km of the Project Area.

| ***Epacris purpurascens* var. *purpurascens*** | |
|---|---|
| **Assessment of Significance criteria (Seven Part Test)** | **Address of criteria** |
| a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction | The following is known about the lifecycle of *Epacris purpurascens* var. *purpurascens* (DEC 2005):<br>• Found in a range of habitat types, most of which have a strong shale soil influence.<br>• Lifespan is recorded to be 5-20 years, requiring 2-4 years before seed is produced in the wild.<br>• Killed by fire and re-establishes from soil-stored seed.<br>The proposal is unlikely to have an adverse impact of *Epacris purpurascens* var. *purpurascens* such that a viable population is likely to be placed at risk of extinction due to the following:<br>• The proposal is unlikely to result in the loss of any known individuals.<br>• The proposal is unlikely to result in the loss of any known pollinators of the species.<br>• The species can grown in a variety of habitat types. Not all habitat types will be impacted by subsidence. |
| b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction | N/A |
| c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:<br>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or<br>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction | N/A |
| d) In relation to the habitat of a threatened species, population or ecological community:<br>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and<br>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and<br>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. | <u>Extent of habitat</u><br>Approximately 164.3 hectares of potential habitat occurs within the study area. However, only marginal habitat along watercourses may be subjected to impacts from subsidence.<br><br><u>Fragmentation</u><br>Fragmentation of habitat is unlikely to occur as a result of the proposal. Should any vegetation die back occur within areas of potential habitat, these areas are likely to naturally regenerate.<br><br><u>Importance of habitat</u><br>The proposal may impact on a very small localised portion of potential habitat for the species though gas emissions. Should gas emissions occur they are likely to be along the watercourses. Given the relatively small area of potential, and the species ability to occur within a range of habitat types, the area to be potentially disturbed is not important to the long-term survival of the species in the locality. |

| | |
|---|---|
| ***Epacris purpurascens* var. *purpurascens*** | |
| e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly) | No areas of critical habitat for *Epacris purpurascens* var. *purpurascens* have been recommended or declared in NSW. |
| f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or TAP | There is currently no recovery plan for *Epacris purpurascens* var. *purpurascens.* Further there are no Threat Abatement Plans relevant to the species or proposal. However, the OEH profile for *Epacris purpurascens* var. *purpurascens* lists the following activities to assist the species:<br>• Monitor known populations so that potential local extinctions are detected before they occur and mechanisms can be put in place to reverse trends.<br>• Identify and survey potential habitat to detect new populations.<br>• Liaise with land managers to encourage the preparation of site management plans and the implementation of appropriate threat abatement measures, such as weed control/bush regeneration, site protection (fencing/signage) and fire management.<br>• Identify priority sites for formal habitat protection and seek to implement measures such as JMAs or VCAs.<br>• Monitor impact of fire on populations to inform DECC/ RFS/ local government planning.<br>• Undertake targeted bush regeneration works, where required.<br>The proposal is not inconsistent with the above activities. |
| g) Whether the action proposed constitutes or is part of a KTP or is likely to result in the operation of, or increase the impact of, a KTP | The proposal will result in the following KTPs towards *Epacris purpurascens* var. *purpurascens*:<br>• Alteration of habitat following subsidence due to longwall mining (impacts to *Epacris purpurascens* var. *purpurascens* likely to be negligible). |
| **Conclusion:** The proposed action is unlikely to have a significant impact on *Epacris purpurascens* var. *purpurascens*. | |

| *Pomaderris brunnea* | |
|---|---|
| **Assessment of Significance criteria (Seven Part Test)** | **Address of criteria** |
| a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction | The following is known about the lifecycle of *Pomaderris brunnea* (DEC 2005):<br>• The species is expected to live for 10-20 years, while the minimum time to produce seed is estimated to be 4-6 years<br>• Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines.<br>• Flowers appear in September and October.<br>• The species is expected to live for 10 - 20 years, while the minimum time to produce seed is estimated to be 4 - 6 years.<br>The proposal is unlikely to have an adverse impact of *Pomaderris brunnea* such that a viable population is likely to be placed at risk of extinction due to the following:<br>• The proposal is unlikely to result in the loss of any known individuals.<br>• The proposal is unlikely to result in the loss of any known pollinators of the species.<br>• *Pomaderris brunnea* is not a strictly water dependent species. It does not occur in the watercourse. It occurs in moist forest communities and gullies often near water. Whilst there is the possibility that localised vegetation die back as a result of gas emissions could occur, based on previous experience in the Southern Coalfields, any impacts are likely to be localised and short-term. |
| b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction | N/A |
| c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:<br>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or<br>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction | N/A |
| d) In relation to the habitat of a threatened species, population or ecological community:<br>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and<br>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and<br>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. | <u>Extent of habitat</u><br>Approximately 31.6 hectares of potential habitat occurs within the limits of subsidence. However, only marginal habitat along watercourses may be subjected to impacts from subsidence.<br><br><u>Fragmentation</u><br>Fragmentation of habitat is unlikely to occur as a result of the proposal. Should any vegetation die back occur within areas of potential habitat, these areas are likely to naturally regenerate.<br><br><u>Importance of habitat</u><br>The proposal may impact on a very small localised portion of potential habitat for the species though gas emissions. Should gas emissions occur they are likely to be along the watercourses. Based on previous observations at Teatree Hollow Creek, the species tends to occur on the gully slopes and not within the watercourse. As such, given the relatively small area of potential, and the species ability to occur within a range of habitat types, the area to be potentially disturbed is not important to the long-term survival of the species in the locality. |

| ***Pomaderris brunnea*** | |
|---|---|
| e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly) | No areas of critical habitat for *Pomaderris brunnea* have been recommended or declared in NSW |
| f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or TAP | A National Recovery Plan for *Pomaderris brunnea* was developed in 2011. The overall objective of recovery is to minimise the probability of extinction of *Pomaderris brunnea* in the wild and to increase the probability of populations becoming self-sustaining in the long term. The proposal is unlikely to substantially reduce the extent of an important population in the Project Area. It is unlikely that subsidence will result in any significant impact to *Pomaderris brunnea* that would result in the extinction of the species. |
| g) Whether the action proposed constitutes or is part of a KTP or is likely to result in the operation of, or increase the impact of, a KTP | The proposal will result in the following KTPs towards *Pomaderris brunnea*:<br>• Alteration of habitat following subsidence due to longwall mining (impacts to *Pomaderris brunnea* likely to be negligible) |
| **Conclusion:** The proposed action is unlikely to have a significant impact on *Pomaderris brunnea*. | |

| ***Pseudophryne australis* (Red-crowned Toadlet)** | |
|---|---|
| **Assessment of Significance criteria (Seven Part Test)** | **Address of criteria** |
| a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction | The following is known about the life cycle of the Red-crowned Toadlet (NPWS 2001a):<br>• Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings.<br>• Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter.<br>• Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. The species has not been recorded breeding in waters that are even mildly polluted or with a pH outside the range 5.5 to 6.5.<br>• Eggs are laid in moist leaf litter and the tadpoles undertake a large proportion of the development in the eggs before hatching after the nest is inundated by rains.<br>• Tadpoles are washed into temporary pools within the creekline where they finalise development.<br>• Disperses outside the breeding period, when they are found under rocks and logs on sandstone ridges and forage amongst leaf-litter.<br>• Known prey are ants, termites, mites, pseudo-scorpions, collembolans and small cockroaches, although they are likely to eat most small invertebrates encountered.<br>• A localised species that appear to be largely restricted to the immediate vicinity of suitable breeding habitat. Usually found as small colonies scattered along ridges coinciding with the positions of suitable refuges near breeding sites. Due to this tendency for discrete populations to concentrate at particular sites, a relatively small localised disturbance may have a significant impact on a local population if it occurs on a favoured breeding or refuge site.<br>• Given the species specialised terrestrial reproductive strategy and reliance on ephemeral water flow, the Red-crowned Toadlet may be particularly vulnerable to activities that impact on hydrology or water quality.<br>• Red-crowned Toadlet habitat should not be subjected to planned fire frequencies of greater than once in a 10 year cycle.<br><br>The proposal will result in subsidence. Some localised changes in hydrology and water loss in pools may occur.<br>There is an abundance of potential habitat for the species within the Project Area and locality.<br>It is unlikely that subsidence will have a significant impact on ephemeral drainage lines where the species is known to occur, nor microhabitat features such as leaf litter and rocks. It is therefore unlikely that the proposal would adversely impact a viable population of the species such that it will be placed at risk of extinction. |
| b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction | N/A |
| c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:<br>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or<br>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction | N/A |

| ***Pseudophryne australis* (Red-crowned Toadlet)** | |
|---|---|
| d) In relation to the habitat of a threatened species, population or ecological community:<br>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and<br>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and<br>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. | <u>Extent of habitat</u><br>Habitat for the Red-crowned Toadlet occurs within ephemeral drainage lines and surrounding woodland. Outside the breeding period they are found under rocks and logs on sandstone ridges and forage amongst leaf-litter. The proposal may result in some minor drying of potential habitat along all creeks within the study area. However, the extent of habitat is relatively minor compared to potential habitat in the study area and locality. The proposal is unlikely to result in the loss of all existing potential habitat for the Red-crowned Toadlet.<br><u>Fragmentation</u><br>There is the potential for the proposal to cause some fragmentation of habitat if surface water results in changes to ephemeral drainage lines. However, ephemeral drainage lines go through phases of dryness and wetness. Subsidence is not likely to result in significant fragmentation to flow of ephemeral drainage lines.<br><u>Importance of habitat to be impacted</u><br>Suitable habitat for this species is widespread across the sandstone plateaux of the Sydney Basin Bioregion, with the major populations occurring in the upper Blue Mountains, around the mouth of the Hawkesbury River and the Woronora Plateau extending to Royal National Park. Throughout its range it has been recorded in numerous National Parks, including a number within the Sydney urban area (DEC 2005). DEC (now OEH) surveys in the Sydney Basin Bioregion in the period from 1999 to 2004 revealed that the species is perhaps more common in the region than previously thought (DEC 2005). Potential habitat within the Project Area is relatively extensive. It is extremely unlikely that the proposal would result in the removal or modification of all habitats to be impacted. |
| e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly) | No areas of critical habitat for Red-crowned Toadlet have been recommended or declared in NSW. |
| f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or TAP | To date, a recovery plan has not been developed for Red-crowned Toadlet. One TAP exists that is relevant to the species: Predation by *Gambusia holbrooki* (NPWS 2003a). The objectives of this TAP are (NSW 2003a):<br>• Minimise human dispersal of gambusia<br>• Reduce impacts of gambusia on threatened frogs at key sites<br>• Integrate this threat abatement plan with other aquatic restoration programs<br>• Increase knowledge of the general ecology of gambusia, it's impact on native frog species and mechanisms for its control<br>• Ensure effective implementation of the TAP<br>Gambusia is known to occur in the Project Area and it is unlikely that the proposal would lead to its spread as it is already present in any suitable habitat. The proposal is not inconsistent with this TAP.<br>The Threatened Species Profile for the species lists 14 priority actions to assist in the recovery of the species. Those relevant to the proposal include:<br>• Develop best practice management strategies that buffer and protect important headwater/ridge top breeding sites from changes to water flow, flow regimes and water quality changes.<br>• Develop best practice habitat management strategies that reduce bushrock removal from important habitat areas.<br>• Develop preferred mitigation measures to minimize impact of wildfire and/or suppression operations.<br>• Assess the threat of changed hydrological regimes on the habitat of this species. Include the impacts of increasing urbanisation, groundwater extraction, and climate change into this assessment. |

| ***Pseudophryne australis* (Red-crowned Toadlet)** | |
|---|---|
| g) Whether the action proposed constitutes or is part of a KTP or is likely to result in the operation of, or increase the impact of, a KTP | The proposal will result in the operation of a number of KTPs. Those relevant to Red-crowned Toadlet include:<br>• Alteration of habitat following subsidence due to longwall mining<br>• Alteration of the natural flow regimes of rivers, stream, floodplains and wetlands<br>• Infection of frogs by amphibian chytrid causing the disease chytridiomycosis. (Threat managed through mitigation measures such as appropriate hygiene when working near or crossing waterways). |
| **Conclusion:** The proposed action is unlikely to have a significant impact on the Red-crowned Toadlet. | |

| Hollow dependant bat species: *Large-eared Pied Bat, Eastern False Pipistrelle, Eastern Bent-wing Bat, Eastern Freetail Bat* | |
|---|---|
| **Assessment of Significance criteria (Seven Part Test)** | **Address of criteria** |
| a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction | The following is known about the lifecycle of these hollow dependant bat species (DEC 2005):<br><br>**Eastern False Pipistrelle**<br>• Prefers moist habitats, with trees taller than 20 m.<br>• Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.<br>• Hunts beetles, moths, weevils and other flying insects above or just below the tree canopy.<br>• Hibernates in winter.<br>• Females are pregnant in late spring to early summer.<br>**Eastern Freetail Bat**<br>• Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range.<br>• Roost mainly in tree hollows but will also roost under bark or in man-made structures.<br>• Usually solitary but also recorded roosting communally, probably insectivorous.<br>**Large-eared Pied Bat**<br>• Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (Petrochelidon ariel), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years.<br>• Found in well-timbered areas containing gullies.<br>• The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.<br>• Likely to hibernate through the coolest months.<br>• It is uncertain whether mating occurs early in winter or in spring.<br>**Eastern Bent-wing Bat**<br>• Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.<br>• Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.<br>• Maternity caves have very specific temperature and humidity regimes.<br>• At other times of the year, populations disperse within about 300 km range of maternity caves.<br>• Cold caves are used for hibernation in southern Australia.<br>• Breeding or roosting colonies can number from 100 to 150,000 individuals.<br>• Hunt in forested areas, catching moths and other flying insects above the tree tops.<br><br>All the species have potential habitat within the study area. Breeding habitat may occur to the north of the study area along Matthews Creek, Cedar Creek and Stonequarry Creek within the rock crevices and overhangs. Foraging habitat may occur throughout the study area.<br><br>The proposal is unlikely to have an adverse affect on the species life cycle due to the following:<br>• Not all areas of potential habitat within the locality will be impacted by the proposal.<br>• No local populations are known to occur in the study area.<br>• Subsidence may impact some rock crevices, however impacts are predicted to be minor and localised in occurrence.<br>• Tree hollows will not be impacted by subsidence.<br>• Previous experience in the Southern Coalfield indicates that the percentage of rock outcrops that are likely to be impacted by mining is very small.<br>• The case studies show that although very minor rock falls have been observed over solid coal outside the extracted goaf areas of longwall mining |

| Hollow dependant bat species: *Large-eared Pied Bat, Eastern False Pipistrelle, Eastern Bent-wing Bat, Eastern Freetail Bat* | |
|---|---|
| | in the Southern Coalfield, there have been no recorded large cliff instabilities outside the extracted goaf areas of longwall mining in the Southern Coalfield. |
| b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction | N/A |
| c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:<br>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or<br>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction | N/A |
| d) In relation to the habitat of a threatened species, population or ecological community:<br>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and<br>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and<br>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. | <u>Extent of habitat</u><br>Potential foraging habitat in the Project Area occurs within all dry sclerophyll forest communities. Potential roosting habitat occurs within trees hollows, rock crevices and some crevices of bridges/culverts/buildings. The area of greatest habitat occurs along the gullies of Cedar Creek, Stonequarry Creek and Matthews Creek. Subsidence may cause some minor and isolated rock falls and cracking. This may impact a minimal area of potential habitat for the species. Hollows which the species utilises will not be impacted by subsidence.<br><u>Fragmentation</u><br>Based on mine subsidence predictions and previous experience in the Southern Coalfields, it is unlikely that the subsidence impacts associated within the proposal would impact foraging habitat within Dry Sclerophyll Forest. However, some minor rock falls and cracking of potential habitat within surface rock and outcrops may occur. This is predicted to be minor and therefore any fragmentation would be localised. Subsidence will not impact tree hollows which the species use for roosting/breeding.<br><u>Importance of habitat</u><br>It is highly likely that these species utilise the wider locality for foraging. Tree hollows and rock overhangs were throughout the locality, and are not limited to the area to be impacted by the proposal. Given the extensive foraging habitat and availability of tree hollows in the wider locality, the habitat to be potentially impacted within the study area is not likely to be important to the long-term survival of these species. It is unlikely that the proposal will result in the loss of habitat to the extent that the species is likely to decline. |
| e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly) | No areas of critical habitat for any of these bat species have been recommended or declared in NSW. |
| f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or TAP | To date, no recovery plans have been prepared for these bat species. |
| g) Whether the action proposed constitutes or is part of a KTP or is likely to result in the operation of, or increase the impact of, a KTP | The proposal will result in the operation of a number of KTPs. Those relevant to these bat species include:<br>• Alteration of habitat following subsidence due to longwall mining (impacts to habitat of bats likely to be minimal). |
| **Conclusion:** The proposed action is unlikely to have a significant impact on the Large-eared Pied Bat, Eastern False Pipistrelle, Eastern Bent-wing Bat, Eastern Freetail Bat | |

# Appendix E. EPBC Act Assessments

EPBC Act Assessments of Significance have been carried out for the following species:

Threatened flora:

- *Pomaderris brunnea*.

Threatened fauna:

- Large-eared Pied Bat

Definitions

'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

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

| *Pomaderris brunnea* | |
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| **Vulnerable Species** | **Significant Assessment Criteria** |
| **An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:** | |
| Lead to a long-term decrease in the size of an important population of a species | Subsidence does has the potential to impact *Pomaderris brunnea*, however, based on previous studies in the Southern Coalfield It is unlikely that the population would be significantly impacted by subsidence based on the following:<br>• *Pomaderris brunnea* is not a strictly water dependent species. It does not occur in the watercourse. It occurs in moist forest communities and gullies often near water.<br>• Any vegetation die back from gas emissions is likely to be isolated and localised. Based on previous experience in the Southern Coalfields, it is unlikely that any gas emissions would cause significant impact to the vegetation.<br>The proposal is therefore unlikely to result in a long-term decrease in size of an important population. |
| Reduce the area of occupancy of an important population | An important population was not recorded in the study area. The proposal footprint would not reduce the important population. |
| Fragment an existing important population into two or more populations | An important population was not recorded in the study area. The proposal footprint would not fragment an important population. |
| Adversely affect habitat critical to the survival of a species | The proposal is unlikely to adversely affect habitat critical to the survival of the species as:<br>• No individuals will be impacted by the proposed surface works.<br>• Potential habitat for the species is unlikely to be significantly impacted by the proposal and associated subsidence.<br>• The species is found within the Wirrimbirra Sanctuary which occurs within the locality (DoE 2013). This population is unlikely to be impacted by the proposal.<br>• The species has been recorded during previous surveys conducted by Niche along Hornes Creek and Dog Trap Creek. These populations will not be impacted by the proposal. |
| Disrupt the breeding cycle of an important population | The following is known about the breeding cycle of *Pomaderris brunnea*:<br>• The species is expected to live for 10-20 years, while the minimum time to produce seed is estimated to be 4-6 years<br>• Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines.<br>• Flowers appear in September and October.<br>The proposal is unlikely to disrupt the breeding cycle of an important population as:<br>• Not all potential habitat will be impacted by subsidence.<br>• Proposal is unlikely to impact known dispersal or reproduction mechanisms;<br>• Proposal is unlikely to result in changes to the fire regime for the species. |
| Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | The species occurs in the Sydney region of the Central Coast of NSW, east of Tamworth on the Northern Tablelands of NSW, and in the East Gippsland region of Victoria. In NSW, the species was originally considered endemic to the Sydney Hawkesbury Sandstone region. It is found on the Colo River, the Nepean River floodplain at Menangle, in creeklines at Wirrimbirra Sanctuary (Bargo) and on the Hawkesbury River. The distribution may extend into the southern section of Yengo National Parks along major creeklines and floodplains. The species occurs in small populations. The Wirrimbirra population contained 900 plants in the late 1980s. The species was recently {no date cited} found in Tuggolo State Forest in Walcha/Nundle and Styx River. Management Areas, in the Northern Region of NSW. The forest type supporting this population also occurs in Nowendoc, Riamukka and Enfield State Forests, but it is not known if the species occurs in these areas. It is conserved in Wollemi National Park (north-west of Sydney), with an unknown number of individuals (source: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=16845)<br>The proposal may result in localised temporary impacts to potential habitat. When compared to the amount of similar vegetation in the locality that will not be impacted by subsidence, it is highly unlikely the proposal will result in a decrease in availability of habitat for the species. . |

| *Pomaderris brunnea* | |
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| **Vulnerable Species** | **Significant Assessment Criteria** |
| Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat | It is unlikely the proposal will result in invasive species that are harmful to a vulnerable species becoming established as a result of subsidence. |
| Introduce disease that may cause the species to decline, or | It is unlikely the proposal will Introduce disease that may cause the species to decline. |
| Interfere substantially with the recovery of the species. | A National Recovery Plan for *Pomaderris brunnea* was developed in 2011. The overall objective of recovery is to minimise the probability of extinction of *Pomaderris brunnea* in the wild and to increase the probability of populations becoming self-sustaining in the long term. The proposal would not impact any known individuals. It is unlikely that the potential impacts to *Pomaderris brunnea* as a result of the proposal would interfere substantially with the recovery of the species. |

| Large-eared Pied Bat | |
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| **Criteria (Vulnerable Species)** | **Address of Criteria** |
| | An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it would: |
| Lead to a long-term decrease in the size of an important population of a species | The Large-eared Pied bat was not recorded during the current surveys, however the species is assumed to be present given the availability of habitat.<br>Subsidence has the potential to cause cracking of rock outcrops and shelters which the species may utilize. Foraging habitat within the vegetation of the study area is unlikely to be impacted.<br>Based on previous experience, it is likely that the proposed development would result in minor, isolated rock falls and cracking (Section 3.4). Not all areas of potential habitat will be impacted by subsidence.<br>Given the relatively minor nature of predicted subsidence impacts, it is unlikely that a long-term decrease in the species would occur as a result of the proposed development. |
| Reduce the area of occupancy of an important population | Subsidence impacts as a result of the proposed development are likely to cause some minor and isolated rock falls and cracking. This may impact only a minimal area of potential habitat for the species. Tree hollows which the species utilises would not be impacted by the proposed development. It is highly unlikely isolated/minor subsidence impacts would reduce the area of occupancy of an important population. |
| Fragment an existing important population into two or more populations | Based on previous mine subsidence predictions (Section 3.4), subsidence impacts associated within the proposed development could cause large scale rock falls and surface cracking. Given the species has not been recorded during the current surveys and only one previous record occurs in the locality, it is unlikely fragmentation impacting an important population would occur. |
| Adversely affect habitat critical to the survival of a species | No critical habitat has been listed for the species on the EPBC Act Register of Critical Habitat. Given that the species has not been recorded in the Project Area despite targeted surveys and the lack of previous records in the locality, the Project Area is not likely to support habitat critical to the survival of Large-eared Pied Bat. |
| Disrupt the breeding cycle of an important population | The following is known about the breeding cycle of the Large-eared Pied Bat:<br>• Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (Petrochelidon ariel), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years.<br>• Found in well-timbered areas containing gullies.<br>• The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.<br>• Likely to hibernate through the coolest months.<br>• It is uncertain whether mating occurs early in winter or in spring.<br>The proposed development is unlikely to disrupt the breeding cycle of an important population due to the following:<br>• Subsidence impacts are likely to be minimal and isolated. Only small scale impacts to surface rock and potential habitat are assumed.<br>• The species has not been previously recorded in study area.<br>• Hollow bearing trees would not be impacted by subsidence.<br>• Food sources are unlikely to be impacted by the proposal. |
| Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | It is unlikely that the proposed development would result in the loss of habitat to the extent that the species is likely to decline. Based on previous subsidence predictions (Section 3.4) localised and isolated rock falls and surface cracking may occur. This is unlikely to significantly reduce the extent and quality of potential habitat such that the species is likely to decline. |
| Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' | It is unlikely the proposed development would introduce invasive species that are harmful to the species habitat. The potential habitat for the species is located away from proposed surface works. |

| Large-eared Pied Bat | |
|---|---|
| **Criteria (Vulnerable Species)** | **Address of Criteria** |
| habitat | |
| Introduce disease that may cause the species to decline, or | It is unlikely the proposed development would introduce disease that is harmful to the species. No vegetation clearing will occur. |
| Interfere substantially with the recovery of the species. | The proposed development is unlikely to substantially interfere with the recovery of the species. Degradation of breeding habitat through subsidence impacts is likely to be isolated and insignificant when compared to the availability of potential habitat in the Project Area. |
| **Conclusion:** The proposed action is unlikely to have a significant impact on the Large-eared Pied Bat | |

## Niche Environment and Heritage

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## Head Office

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