Angus Place Extension Project

Flora and Fauna Assessment Report

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Executive Summary

Introduction

RPS has been engaged by Centennial Angus Place Pty Limited (the Applicant) to prepare a Flora and Fauna Assessment for an Environmental Impact Statement (EIS) to be prepared for the proposed Angus Place Mine Extension Project (the Project). The Project is being assessed under Section 78A(8A) of the Environmental Planning and Assessment Act 1979 (State Significant Development).

This assessment examines the likelihood of the Project to have a significant effect on any threatened species, populations or ecological communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act). In addition, this report recognises the relevant requirements of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) as amended by the NSW *Environmental Planning and Assessment Amendment Act 1997*. The Project is also being assessed as an 'Accredited Assessment' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A Referral was submitted under the EPBC Act (2013/6889) with the Department of the Environment (DoE) (formerly the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPAC)) and the Action was determined to be a Controlled Action under the EPBC Act.

The components of Angus Place Mine's existing operations are an underground longwall mine, accessed via the Angus Place pit top, and supporting surface infrastructure within the pit top area and on Newnes Plateau within the Newnes State Forest. The Project will not significantly alter the nature of the existing operations at Angus Place Mine.

The Project Application Area is located in the Lithgow Local Government Area (LGA), 10 km north of the City of Lithgow. The majority portion of the Project Application Area is located within the Newnes State Forest; with the exception of a small area in the west that encompasses the land surrounding the current Angus Place pit top area. Areas surveyed for the Project include within the Project Application Area, as well as areas that extended outside the Project Application Area, with all areas referred to as the 'Study Area'.

Methods

Flora, Fauna and habitat surveys have been undertaken over the Study Area from November 2011 to September 2013. A variety of field survey techniques were employed over the course of fieldwork for this assessment to record a representative sample of flora species and fauna guilds across the Study Area. The surveys included site inspections to identify initial constraints to inform survey design, vegetation community surveys and various fauna survey methods including Elliott trapping, harp traps, hair tubes, bat echolocation, spotlighting, call playback, diurnal bird and herpetological surveys, opportunistic surveys and habitat assessments. Targeted searches for threatened flora and fauna species were also undertaken. Much of the survey efforts were deliberately focused around the predicted subsidence extents and 'Environmental Study Areas' (ESA). ESAs represent the boundaries within which surface facilities will be located and were subject to specific intensive targeted flora and habitat surveys. Only a proportion of an ESA would require clearing to accommodate required surface facilities, which allows flexibility in terms of mine design and avoidance of important ecological attributes, such as threatened species. The clearing required for surface facilities and access is referred to as the 'surface infrastructure footprint' within this report.

In addition to the ecological surveys undertaken by RPS, a review of surveys undertaken for other projects within the Study Area locality was undertaken. These surveys include the flora monitoring and fauna monitoring undertaken within the Angus Place, Springvale and Clarence mining lease areas. Monitoring has been ongoing since 2009 for flora and since 2004 for fauna.

Results

Thirty-two native and exotic vegetation communities have been mapped in line with the vegetation classification detailed in the Western Blue Mountains Vegetation Survey and Mapping Project (DEC 2006). Of these 32, five communities are listed as Endangered Ecological Communities (EEC). However, just two EECs are within the predicted subsidence extents, namely Newnes Plateau Shrub Swamp, listed under the TSC Act and Temperate Highland Peat Swamp on Sandstone (THPSS), listed under the EPBC Act. In addition to being listed under the TSC Act, the Newnes Plateau Shrub Swamp also forms a part of the THPSS along with Newnes Plateau Hanging Swamp. Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland, listed under the TSC Act, was recorded over the low-lying areas within the west of the Study Area. This community has been mapped along the water courses, which may be influenced by mine water discharge.

Consideration has been afforded to the potential for vegetation within the Study Area to constitute Groundwater Dependent Ecosystems (GDEs). The vegetation within the Study Area that is dependent on sub-surface flows (i.e. have rooting zones which overlap the sub-surface water interface such as floodplain vegetation) or are located such that surface flows originate from sub-surface flows are all classified as GDEs. The vegetation types within the Study Area that clearly fall into this category are Map Unit (MU) 50 – Newnes Plateau Shrub Swamp and MU 51 – Newnes Plateau Hanging Swamp.

Four threatened flora species were recorded during the present study, these being *Eucalyptus aggregata* (Black Gum), *Eucalyptus cannoniil* (Capertee Stringybark), *Persoonia hindii* and *Veronica blakelyi*. *E. cannonii*, *E. aggregata* and *V. blakelyi* are listed as Vulnerable under the TSC Act. *P. hindii* is listed as Endangered under the TSC Act.

Through desktop analysis and habitat assessments, an additional ten threatened flora species have been considered as potentially occurring within the Study Area and which may be impacted upon, namely *Caesia parviflora var. minor*, *Lastreopsis hispida* (Bristly Shield Fern), *Acacia bynoeana* (Bynoe's Wattle), *Boronia deanei* (Deane's Boronia), *Eucalyptus pulverulenta* (Silver-leaved Gum), *Genoplesium superbum*, *Prasophyllum fuscum* (Tawny Leek Orchid), *Persoonia acerosa* (Needle Geebung), *Prostanthera cryptandroides* subsp. *cryptandroides* (Wollemi Mintbush) and *Thesium australe* (Austral Toadflax).

Each of the above flora species have potential habitat within the predicted subsidence extents or ESAs, with the exception of *E. aggregata* (Black Gum) and *T. australe*. These species are regarded as having potential habitat along the water courses, which may be influenced by mine water discharge.

Habitats within the Study Area include dense low shrubby swamp vegetation along the drainage lines, eucalypt forest and woodland vegetation on the slopes and ridges and dry rocky heath along cliffs. These habitats support a variety of fauna species, including threatened fauna. In total, 111 fauna species were identified across the Study Area, including 23 threatened fauna species listed under the TSC and/or EPBC Acts. Of these 23 species, nine were recorded within the Study Area by RPS and an additional 14 have previously been recorded from fauna monitoring.

The enhanced protection from predators offered by the dense vegetation of shrub swamps and, to a lesser extent, the hanging swamps, provides habitat for small mammals and birds, including more reserved species, which forage in the dense shrubs and undergrowth. Shrub swamps provide potential habitat for specialist threatened fauna species, including the Giant Dragonfly (*Petalura gigantea*) and Blue Mountains Water Skink (*Eulamprus leuraensis*), however, these species have not been recorded within the Study Area. The wetter swamps and various creek lines also provide habitat for the Giant Burrowing Frog (*Heleioporus australiacus*) and Stuttering Frog (*Mixophyes balbus*). The Giant Burrowing Frog has been recorded by call recognition in previous surveys within the Study Area (BMS 2011b). The Stuttering Frog was not recorded, however, it has been recorded within the Springvale lease area by call recognition (MKES 2004b).

The drier woodland and rocky habitats have been identified as potential habitat for Rosenberg's Goanna (*Varanus rosenbergi*) and Broad-headed Snake (*Hoplocephalus bungaroides*). Although not recorded, Atlas of NSW Wildlife records and habitat assessment suggest that these species may occur.

Three threatened woodland birds were recorded during surveys, namely Gang-Gang Cockatoo (*Callocephalon fimbriatum*), Scarlet Robin (*Petroica boodang*) and Flame Robin (*Petroica pheonicea*). An additional four threatened woodland birds have previously been recorded during annual fauna monitoring, undertaken by MKES (2004 - 2008) and BMS (2009 -2012), namely Glossy Black-Cockatoo (*Calyptorhynchus lathami*), Brown Treecreeper (eastern subsp.) (*Climacteris picumnus victoriae*), Speckled Warbler (*Chthonicola sagittata*) and Black-chinned Honeyeater (*Melithreptus gularis gularis*. Nocturnal surveys revealed the presence of Powerful Owl (*Ninox strenua*), with Barking Owl (*Ninox connivens*) and Sooty owl (*Tyto tenebricosa*) having also been recorded during annual monitoring (MKES 2006a) and BMS 2010c). One bird of prey, namely Little Eagle (*Heiraaetus morphnoides*) has been recorded within the Angus Place mining lease area (MKES 2006a, 2007 and BMS 2011b) south of the Study Area.

No threatened terrestrial mammal species have been recorded during surveys or monitoring over the Study Area. However, due to the availability of habitats, species such as Spotted-tailed Quoll (*Dasyurus maculatus maculatus*) and Brush-tailed Rock-wallaby (*Petrogale penicillata*) may occur. Surveys recorded the presence of Eastern Pygmy Possum (*Cercartetus nanus*), with annual monitoring also having recorded Koala (*Phascolarctos cinereus*) (MKES 2008c) and Squirrel Glider (*Petaurus norfolcensis*) (MKES 2006a).

Three threatened microchiropteran bat species were recorded during RPS surveys, namely Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*), Large-eared Pied Bat (*Chalinolobus dwyeri*) and Eastern Bentwing Bat (*Miniopterus schreibersii* subsp. *oceanensis*). An additional two threatened microchiropteran bat species have been recorded during annual monitoring, namely Eastern Freetail-bat (*Mormopterus norfolkensis*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*).

Avoidance Measures

The Project includes the construction of surface facilities within the Study Area comprising infrastructure for dewatering bore facilities, ventilation facilities and power infrastructure and access. These facilities will be constructed within the boundaries of the ESAs. Dedicated targeted surveys were undertaken within the ESAs in order to identify threatened species and EECs, as well as gain a perspective of particular habitat attributes, including occurrence of hollow-bearing trees and animal burrows. This data was collected to inform avoidance measures and any unavoidable impacts that follow.

Following targeted surveys, an avoidance mapping exercise was undertaken to identify significant ecological features within the proposed footprint. This was provided to the Applicant such that ecological constraints could be analysed and avoided as required. Amongst the achievements of the avoidance considerations was the complete avoidance from direct clearing of all recorded *P. hindii* and all recorded *V. blakelyi*. The targeted surveys also identified and confirmed the presence of a hanging swamp within the ESAs and alterations to the design of surface facilities were also enacted to avoid this feature.

Impact Assessment

In addressing the potential for impacts of the Project, the following causes of potential direct and indirect impacts were considered:

- habitat removal within ESAs to accommodate surface facilities;
- subsidence related impacts; and
- mine water discharge, potentially affecting the quantity and chemistry of surface water.

Approximately 23.24 ha of woodland vegetation is proposed to be removed for surface facilities. The dominant vegetation types proposed to be removed are the open woodland and forest habitats found along the ridge lines of the Project Application Area. The combined total native vegetation proposed to be removed is approximately 0.14% of the combined total commensurate vegetation communities mapped by *Vegetation of the Western Blue Mountains* (DEC 2006). No areas of EEC are proposed to be cleared for the Project and mitigation measures have been recommended to avoid indirect impacts to EECs and vegetation in general.

The Study Area occurs predominately within the Newnes State Forest and is connected to the Ben Bullen State Forest in the west, Gardens of Stone National Park and Wollemi National Park to the north, and additional areas of Newnes State Forest to the east and south. The habitats and species within the Study Area are wide ranging and diverse, offering habitat for threatened flora and fauna species both within the Study Area and beyond into large protected areas. The likelihood of potential impacts on species listed under the TSC Act and/or EPBC Act has been considered with regard to the proposed clearing of native vegetation. As a result of the avoidance and mitigation measures proposed and the large areas of available habitat surrounding the Study Area, the small amount of vegetation to be cleared for the Project is unlikely to have a significant impact on threatened species.

The mining layout has been designed such that the majority of the cliffs and pagoda complexes are located outside the 26.5 degree angle of draw line from the extents of the proposed longwalls. It is unlikely that the cliffs and pagoda complexes would experience any adverse impacts resulting from the extraction of the proposed longwalls (MSEC 2014 section 5.7.3.). Therefore, no impacts are expected to these features and subsequently no impacts would be expected to potential habitats of those threatened species that may utilise these habitats, such as Brush-tailed Rock-wallaby, Broad-headed Snake and cave-dwelling bats.

No significant impacts to the dry woodland and forest habitats are predicted as a result of subsidence. Localised changes in soil on steeper slopes may result from the downslope movement of the soil, resulting in tension cracks appearing at the tops and along the sides of the steep slopes and compression ridges forming at the bottoms of the steep slopes. Destabilisation of slopes is unlikely to be substantial such that it would significantly affect threatened flora or fauna that may occupy woodland environments.

Impact assessments of subsidence (MSEC 2014) and groundwater impact assessments (RPS 2014a) have been undertaken in relation to swamps. The Subsidence Impact Assessment has concluded that there is unlikely to be an impact that would cause ponding or scouring (MSEC 2014) and monitoring of swamp water levels and surface water gauging in previously undermined areas has shown over the life of the current mining operations that no impacts to the swamps or surface water flows have occurred as a result of mining to date at either the Springvale or Angus Place Collieries (RPS 2014a section 7.3.13).

Projected changes to baseflow and maximum average standing water levels in shrub swamps are predicted to occur at varying degrees as detailed within Adhikary and Wilkins (2013) and summarised within the Groundwater Impact Assessment (RPS 2014a). Projections are considered conservative based on model scenario design, and the hydrology within the majority of shrub swamps assessed is not predicted to be significantly impacted upon under model scenarios. However, projected values need to be considered within the realm of possibility, and consequentially, a decrease in baseflows and associated standing water levels within several shrub swamps may therefore occur.

The most significant reductions to average standing groundwater levels are predicted in Twin Gully Swamp. This swamp has a projected drop in average standing water levels from 12.4 cm to 10.6 cm above the soil surface. The post mining values predicted at Twin Gully Swamp therefore suggest that soil saturation would persist, maintaining water availability for flora and fauna, as well as soil anoxia, allowing for continued peat formation. All other monitored swamps have smaller projected decreases in average standing water levels and monitored swamps are projected to maintain average standing water levels above the surface. Additionally, highly organic peat soils with low bulk density capillary forces are likely to be saturated for some

distance above the water table itself (Hose *et al*., 2014). Natural decreases in water levels, in addition to the small predicted decreases from the CSIRO model are still likely to enable capillary forces to saturate the peat layer. Therefore, a possible reduction in the average standing water levels, by the magnitudes predicted in Adhikary and Wilkins (2013), is unlikely to result in drying of the peat layer.

The Project is not expected to have a significant impact upon the hydrology of any hanging swamps. The reliance of these areas on perched aquifer systems effectively isolate them from any hydrological changes that may occur to the regional water table as a result of mining operations.

Assessments of impacts have been undertaken for those species that are dependent upon the swamp habitats. These species include *B. deanei*, Giant Dragonfly and Blue Mountains Water Skink. Assessment of impacts have concluded that the predicted changes in baseflow and average standing water levels are not of a magnitude that would cause the swamp habitats to become unsuitable for these species. Consequently, the Project is unlikely to significantly impact upon those threatened species that rely on the swamp habitats.

The Applicant has invested considerable time and money in monitoring and undertaking specialist studies in relation to their mining activities. From specialist studies, major geological structural zones can be confidently identified within the Angus Place mining and exploration leases. The Project has further reduced the impact risks with the addition of those mitigation measures listed above. Regular seasonal ecological monitoring since 2004 has also revealed no observable impacts on the flora and fauna recorded within undermined areas, including THPSS. The Project is not expected to have a significant impact upon any shrub swamps or hanging swamps, such that their ecosystem functioning may be impaired. This prediction is supported by a high level of confidence in subsidence predictions as shown by post-mining subsidence monitoring data. Additionally, ongoing ground-water, surface water, flora and fauna monitoring of previously undermined swamps at Springvale have revealed no impacts to GDEs and associated habitats as a result of undermining these areas.

The potential impacts from increased mine water discharge include increases in flow and changes to water quality, particularly increases in salinity. A review of the regional water balance has been prepared by RPS (2014b). It found that the expected increase in flow is small compared to the 1 y ARI peak flood flow. Accordingly, the potential impact on geomorphology is low compared to the streambed velocity experienced in a typical large rainfall event.

RPS (2014b) has determined that there is a median salinity of 1,010µS/cm at LDP001 and a median salinity of 314µS/cm at LDP002. Salt mass balance modelling undertaken by RPS indicates that predicted peak in average salinity in the Coxs River, downstream of the confluence with Kangaroo Creek, is 717µS/cm in 'normal' conditions and is 968µS/cm in 'drought' conditions. These salinity levels that may occur within receiving waters are well below salinity tolerance limits of *E. aggregata*, as well as *E. stellulata* and *E. viminalis*, which are all common canopy species within the Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland EEC. Therefore, *E. aggregata* or the Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland EEC are unlikely to be affected by changes to salinity as a result in mine water discharge.

Habitats for *T. australe* may be found along the low lying areas adjacent to watercourse that may be affected by mine water discharge. However, expected increases in flows are below flood levels and will remain in bank. Therefore, potential habitats for this species would remain largely unaffected and salinity levels would be particularly low during natural flood events. Predicted salinity changes are therefore unlikely to significantly alter habitats for *E. aggregata*, *T. australe* and Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland.

The current pH levels at the Springvale discharge points are not expected to change as a result of the mine water discharge, remaining between 6.5 and 8.0. Therefore, pH is not expected to affect habitats for *E.*

aggregata, *T. australe* and Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland.

An EPBC Act Protected Matters Search was undertaken to generate a list of those Matters of National Environmental Significance (MNES) from within 10 km of the Survey Area. In addition to threatened, migratory species and ecological communities, World Heritage Properties and National Heritage Places were assessed for potential impacts. NSW Greater Blue Mountains Area (GBMA) is a World Heritage Property and National Heritage Place, which occurs to the immediate north of the Project Application and also occurs approximately 6 km to the east. The proposed mine design criteria has included consideration of potential impacts to the GBMA and has been designed to avoid and reduce potential impacts.

The closest point of any potential vegetation clearing is approximately 100 m from the GBMA. The proposed borehole compound that is closest to the GBMA will require just 1 ha to be cleared. The proposed clearing of 23.24 ha, at this proximity is unlikely to reduce the diversity or modify the composition of plant and animal species within the GBMA. The GBMA is located immediately to the north of the Extension Area, at a distance of 170 m from LW1014A, at its closest point to the proposed longwalls. Whilst the area closest to the proposed longwalls could experience very low levels of vertical subsidence (i.e. less than 20 mm), it is not predicted to experience any measureable conventional tilts, curvatures or strains. It is also unlikely, that there would be any significant changes in the levels of ponding, flooding or scouring of the river banks resulting from the extraction of the proposed longwalls. The potential impact to Carne Creek due to extension of mining at Angus Place is also regarded as insignificant. Consequently, no impacts to water quality are anticipated to occur downstream within the GBMA.

Conclusion

Potential impacts under the TSC Act and EPBC Act have been assessed with regard to the proposed longwall mining and surface infrastructure establishment and mine water discharge. A high level of confidence exists in subsidence predictions for the proposal and the results of ongoing monitoring show no significant subsidence related impacts within undermined areas. The clearing of 23.24 ha is proposed to occur within areas, which are predominately along existing tracks and surrounded by vast extents of commensurate habitat. Mine water discharge will not be of a magnitude such that it would alter the morphology of the affected water courses and changes to water quality are within the tolerance limits of the species and habitats that are associated with these water courses. Consequently, the Project is unlikely to have a significant impact upon threatened species, EECs or other MNES.

Terms & Abbreviations

Abbreviation	Meaning
API	Aerial Photograph Interpretation
DEC	Former Department of Environment and Conservation – now known as OEH
DECCW	Former Department of Environment, Climate Change and Water – now known as OEH
DEWHA	Former Commonwealth Department of Environment, Water, Heritage and the Arts – now known as DoE
DoE	Department of the Environment
DP&I	NSW Department of Planning and Infrastructure
DTIRIS	NSW Department of Trade and Investment, Regional Infrastructure and Services
EEC	Endangered Ecological Communities
EPA	NSW Environmental Protection Authority (formerly part of OEH)
EP&A Act 1979	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act 1999	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmental Study Area
GIS	Geographic Information System
GDE	Groundwater Dependent Ecosystems
GPS	Global Positioning System
I&I NSW	Former Industry and Investment NSW – Now DTIRIS
KTP	Key Threatening Process
LGA	Local Government Area
OEH	NSW Office of Environment and Heritage
ML	Megalitre
MNES	Matter of National Environmental Significance
PFC	Projected Foliage Cover
ROTAP	Rare or Threatened Australian Plants
RPS	RPS Australia East Pty Ltd
SEPP	State Environmental Planning Policy
TSC Act 1995	*Threatened Species Conservation Act 1995*
SEWPAC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities – now known as DoE

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1.0 Introduction

RPS has been engaged by Centennial Angus Place Pty Limited (the Applicant) to prepare a Flora and Fauna Assessment for an Environmental Impact Statement (EIS) to be prepared for the proposed Angus Place Mine Extension Project (the Project). The Project is being assessed under Section 78A(8A) of the Environmental Planning and Assessment Act 1979 (State Significant Development).

This assessment examines the likelihood of the Project to have a significant effect on any threatened species, populations or ecological communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act). In addition, this report recognises the relevant requirements of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) as amended by the NSW *Environmental Planning and Assessment Amendment Act 1997*. The Project is also being assessed as an 'Accredited Assessment' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A Referral was submitted under the EPBC Act (2013/6889) to the Department of the Environment (DoE) (formerly Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPAC)) and the Action was determined to be a Controlled Action under the EPBC Act.

1.1 The Project Application Area

The Project Application Area is located in the Lithgow Local Government Area (LGA), 10 km north of the City of Lithgow. The majority portion of the Project Application Area is located within the Newnes State Forest, with the exception of a small area in the west that encompasses the land surrounding the current Angus Place pit top area. The Project Application Area measures approximately 10,470 hectares.

The location and extent of the Project Application Area are shown in **Figure 1**.

1.2 Study Areas

Much of the survey efforts were deliberately focused around the predicted subsidence extents and Environmental Study Areas (ESA). Therefore, the survey area extends outside the Project Application Area and is referred to herewith as the 'Study Area' (see **Figure 2**).

ESAs represent the boundaries within which surface facilities will be located and were therefore subject to intensive targeted flora and habitat surveys in order to inform avoidance measures (see **Section 5.1)**. Only a proportion of an ESA would require clearing to accommodate required surface facilities, which allows flexibility in terms of mine design and avoidance of important ecological attributes, such as threatened species. Some track edges of chosen access tracks may require widening. Therefore, a 20 m wide corridor incorporating any likely access track (10 m either side of the centre of each track) was included in the ESAs. Impact assessments **(Section 6)** have used the worst case scenario locations (i.e. furthest distance from existing tracks, requiring greatest amount of clearing) of surface facilities and track alignments, following due consideration of appropriate avoidance measures **(Section 5.1)**. The clearing required for surface facilities and access is referred to as the 'surface infrastructure footprint' within this report. The ESA design is presented in **Figure 2**.

1.3 Project Description

The components of Angus Place Mine's existing operations are an underground longwall mine, accessed via the Angus Place pit top, and supporting surface infrastructure within the pit top area and on Newnes Plateau within the Newnes State Forest.

The Project will not significantly alter the nature of the existing operations at Angus Place Mine. The Project will:

- continue to extract up to 4 million tonnes per annum (Mtpa) of ROM coal from the Lithgow Seam underlying the Project Application Area;
- develop underground access headings and roadways from the current mining area to the east to allow access to the proposed mining area;
- undertake secondary extraction by retreat longwall mining for the proposed longwall panels LW1001 to LW1019;
- continue to use the existing ancillary surface facilities at the Angus Place pit top;
- continue to manage the handling of ROM coal through a crusher and screening plant at the Angus Place pit top, and the subsequent loading of the coal onto the existing road haulage trucks for dispatch to offsite locations;
- continue to operate and maintain the existing ancillary surface infrastructure for ventilation, electricity, water, materials supply, and communications at the Angus Place pit top and on Newnes Plateau;
- install and operate seven additional dewatering borehole facilities on Newnes Plateau and the associated power and pipeline infrastructure;
- upgrade and extend the existing access tracks from Sunnyside Ridge Road to the dewatering borehole facilities;
- install and operate dewatering reinjection boreholes and pipeline infrastructure at the existing Ventilation Facility site (APC-VS2);
- construct and operate a downcast ventilation shaft (APC-VS3) and upgrade the existing access track to the proposed facility from Sunnyside Ridge Road;
- manage mine inflows using a combination of direct water transfer to the Wallerawang Power Station, via the SDWTS, and discharge through Angus Place Colliery's licensed discharge point LDP001 and Springvale Colliery's LDP009;
- continue to undertake existing and initiate new environmental monitoring programs;
- continue to operate 24 hours per day, seven days per week;
- continue to provide employment to a full time workforce of up to 225 persons and 75 contractors;
- progressively rehabilitate disturbed areas at infrastructure sites no longer required for mining operations;
- undertake life-of-mine rehabilitation at the Angus Place pit top and the Newnes Plateau infrastructure disturbance areas to create final landforms commensurate with the surrounding areas and the relevant zonings of the respective areas; and

  transfer the operational management of coal processing and distribution infrastructure to the proposed Centennial Western Coal Services Project.

1.4 Site Particulars

Locality – The Angus Place Colliery pit top is located 5 km north of the village of Lidsdale, 8 km northeast of the township of Wallerawang and 10 km northwest of the city of Lithgow. The underground longwall mine is below the Newnes State Forest.

Area – The Project Application Area is approximately 10,470 ha in total. The Study Area is approximately 10,760 ha in total.

Boundaries – The west of the Study Area is bordered by cleared rural land and Ben Bullen State Forest beyond. The Newnes State Forest continues to the east and south of the Study Area. The northern boundary consists of Gardens of Stone National Park and Wollemi National Park. The southern boundary borders the Springvale mine, predominately situated within the Newnes State Forest.

Current Land Use – Angus Place Mine is situated directly below a sandstone plateau of undulating unpopulated bushland which is part of the Newnes State Forest. Collectively, existing land uses in the vicinity include pastoral farming, open cut and underground coal mining, power generation, commercial forestry and residential.

Topography – The lands adjacent to and above the Angus Place underground workings are situated on the Newnes State Forest, which comprises narrow gorges with high ridgelines, steep sided slopes and sandstone cliffs above incised valleys, hilly areas with relatively flat crests and spurs and moderately sloped ephemeral drainage lines. Streams, such as Kangaroo Creek, the Wolgan River, Carne Creek and their tributaries can be found in the vicinity. The Coxs River and Lambs Creek exist within the western portion of the Colliery Holding Boundary.

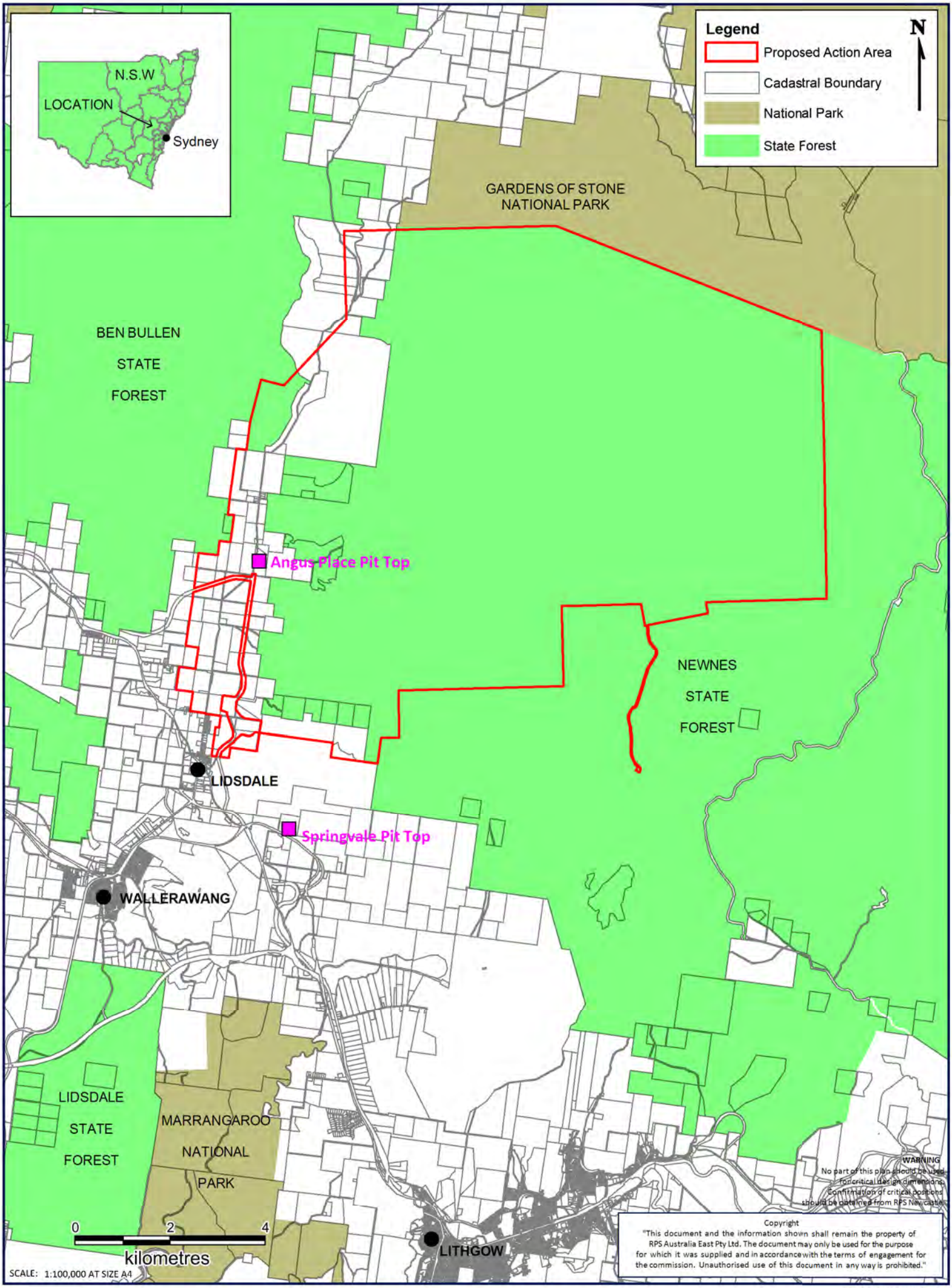
Soils - The Study Area is situated over a number of soil landscapes including; Hassans Walls, Warragamba, Wollongambe, Cullen Bullen, Lithgow, Medlow Bath, Mount Sinai, Newnes Plateau, Deanes Creek, and Long Swamp. These soil landscapes occur in relation to specific landform elements such as swamps, cliffs, outcrops or terrace plains, and are associated with the natural geological processes that formed them.

Colluvial soil landscapes present in the Study Area include the Hassans Walls and Warragamba soil landscapes. Topsoil in these landscapes can be either loamy sand, sand, or clayey sand, and can be between 35 and 100 cm deep, depending on the landforms with which they are associated (King 1992). They occur in association with alcoves, cliffs, cliff footslopes and scarps.

Erosional soil landscapes of Cullen Bullen and Wollongambe are associated with the steep to undulating hillslopes; benches; areas of rock outcrop; and generally shallow sandy soils (King 1992). Residual soil landscapes of Medlow Bath and Lithgow occupy much of the Study Area and are associated with summit surfaces and terrace plains. Medlow Bath is comprised of sandy loam, clay loam, or organic-rich sand topsoils that overlie bedrock or clay subsoils, depending on associated landforms. This topsoil can reach a depth of approximately 40 cm (King 1992). This soil landscape comprises a loose quartz-rich sand A_1 horizon, reddish brown clayey sand A_2 horizon, and earthy sandy clay loam B horizon subsoil (King 1992). Topsoil in this soil landscape, which encompasses both A_1 and A_2 horizon soils, can reach a depth of up to 100 cm.

Swamp soil landscapes are characterised by seasonally wet soils, large amounts of decayed organic matter, and shallow water tables. They occur in association with swamps, abandoned channels and lagoons or swales, and are susceptible to waterlogging and high run-on (King 1992). Swamp soil landscapes present in the Study Area include Deanes Creek and Long Swamp. In these soil landscapes, topsoil is typically 30 to 40 cm deep, and can either be a peaty loam, sandy clay loam, or sandy loam. Subsoil can be either sandy clay loam or coarse sand (King 1992).

Vegetation – Vegetation within the Study Area is dominated by three distinct vegetation types; dense low shrubby swamp vegetation along the drainage lines, eucalypt forest and woodland vegetation on the slopes and ridges and dry rocky heath along cliffs.



TITLE: FIGURE 1: STUDY LOCALITY	LOCATION: ANGUS PLACE	DATUM: GDA 94 PROJECTION: MGA ZONE 56	DATE: 20/01/2014 PURPOSE: REPORT	J:\JOBS\Centennial\All Jobs\ LAYOUT REF: 110328 Angus Place - Major Extension\ 10. Drafting\Mapinfo\Workspaces VERSION (PLAN BY): JS (C A4)

CLIENT: CENTENNIAL
JOB REF: 110328

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
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RPS

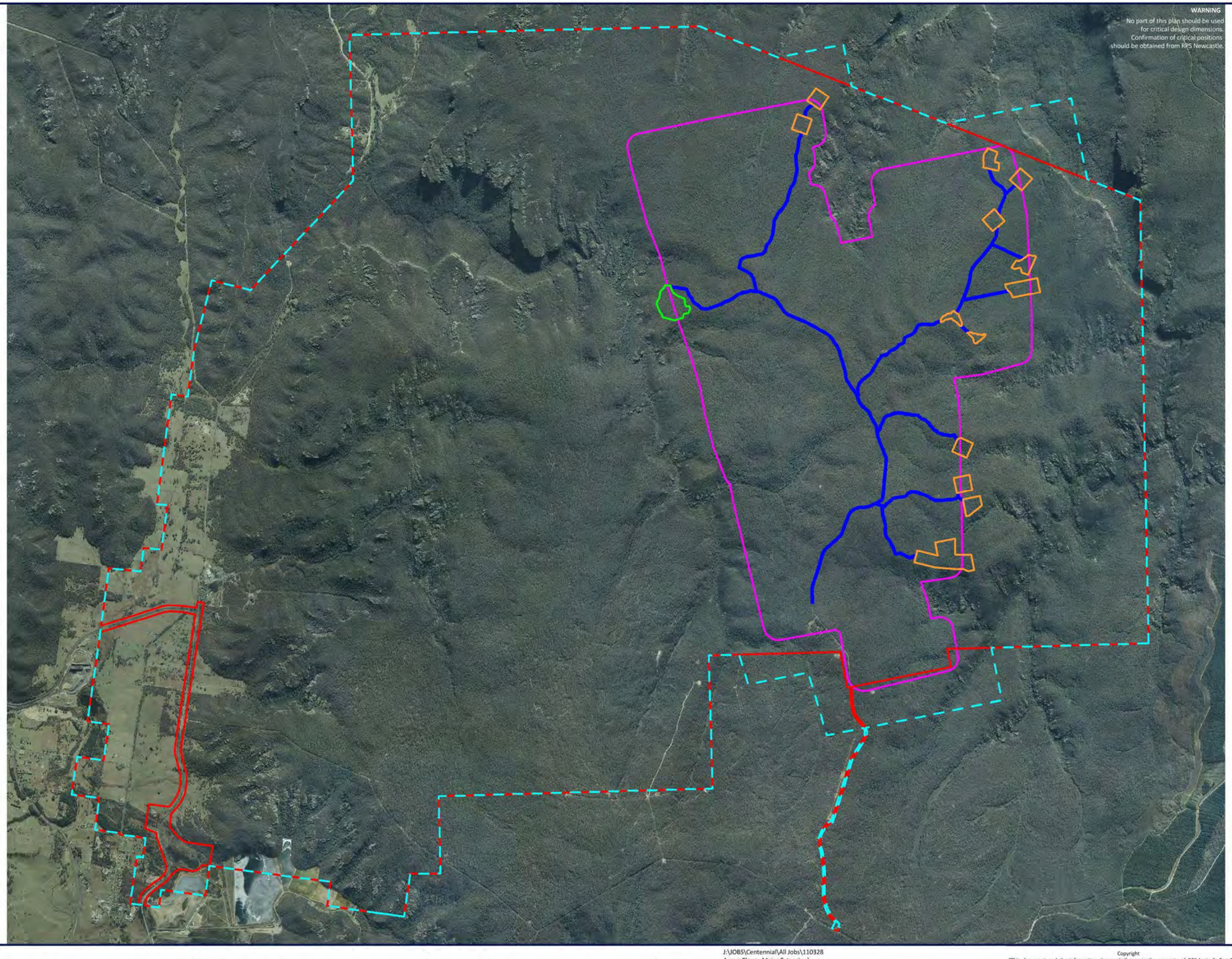
Legend

- Project Application Area
- RPS Study Area
- 26.5 Degree Angle Of Draw

Environmental Study Area

- Dewatering Bore
- Vent Facility
- Access Track

N



WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

0 1 2
kilometres

SCALE: 1:48,000 AT SIZE A3

TITLE: FIGURE 2: ENVIRONMENTAL STUDY AREA DESIGN

LOCATION: ANGUS PLACE

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 20/01/2014
PURPOSE: REPORT

LAYOUT REF: J:\JOBS\Centennial\All Jobs\110328 Angus Place - Major Extension\ 10. Drafting\Mapinfo\Workspaces
VERSION (PLAN BY): JS (D A3)

CLIENT: CENTENNIAL
JOB REF: 110328

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1.5 Scope of the Study

The scope of this flora and fauna assessment report is to:

- undertake a desktop assessment of relevant ecological assessments within and adjacent to the Study Area;
- update relevant database searches of threatened flora and fauna species, populations and ecological communities within a 10 km radius of the Study Area;
- identify threatened flora and fauna species, populations and ecological communities known or likely to occur within the Study Area;
- identify vascular plant species found within the Study Area;
- identify and map existing vegetation communities;
- undertake 7-Part Tests under the TSC Act to assess the potential of the Project to have a significant impact on any threatened species, populations or ecological communities (listed under the TSC Act) known or likely to occur;
- assess the potential of the Project to have a significant impact on any threatened species, populations or ecological communities (listed under the EPBC Act) known or likely to occur; and
- provide all relevant information as required by government agencies and stakeholders, specifically Department of Planning and Infrastructure (DP&I) (Director General's Requirements), DoE, NSW Office of Environment and Heritage (OEH) and Forests NSW.

1.6 Information Requirements

Assessment requirements were issued for the Project by the Director-General for the Department of Planning and Infrastructure (DP&I) on 6 November 2012, The Office of Environment and Heritage (OEH) issued information requirements for the project on 26 October 2012 and Forests NSW provided an information request on 31 October 2012. Supplement to the DGRs, following a Controlled Action decision by SEWPAC, were released on 30 August 2013. **Table 1** below details the information requirements relevant to this assessment and where they have been addressed.

Table 1 Angus Place Extension Project – Information Requirements

Requirements	Addressed in this Report
Director General Requirements	
Accurate estimates of direct vegetation impacts, such as clearing and subsidence and indirect impacts such as 'edge effects'.	Section 6.1.1
A detailed assessment of potential impacts of the development on: ▪ Temperate Highland Peat Swamps; ▪ Other terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities and groundwater dependent ecosystems; and ▪ Regionally significant remnant vegetation, or vegetation corridors.	Section 6
Measures that would be taken to avoid, reduce or mitigate impacts on biodiversity, particularly Temperate Highland Peat Swamps.	Section: 5 Section 7
An offset strategy, which is clearly quantified, to ensure that the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term.	Refer to EIS
Director General Requirements - Policies, Guidelines and Plans	
Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna - Amphibians (DECC 2009).	Section 2.6
Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities -	Section 2.6

Requirements	Addressed in this Report
Working Draft (DEC 2004).	
BioBanking Assessment Methodology and Credit Calculator Operational Manual (DECC 2008).	Refer to EIS
The Threatened Species Assessment Guideline - The Assessment of Significance (DECC 2007).	Appendix 1
NSW State Groundwater Dependent Ecosystem Policy (DLWC).	Section 3.2.4
Policy & Guidelines - Aquatic Habitat Management and Fish Conservation (NSW Fisheries).	Section 3.1.3
Principles of the Use of Biodiversity Offsets in NSW (OEH).	Refer to EIS
State Environmental Planning Policy No. 44 - Koala Habitat Protection.	Section 3.6
NSW OEH General Requirements	
The EIS will need clearly identify all natural features, and detail how impacts to these will be avoided, mitigated and offset.	Section 5 Section 6 Section 7
Proponent should also demonstrate consideration of the contribution of these proposals to the cumulative impacts of mining in the region.	Section 6.5
Natural features of particular concern that will need to be specifically addressed include (but not restricted to): Swamps (including Newnes Plateau Shrub Swamps and Hanging Swamps); Pagodas; Overhangs; Art sites; Talus slopes; and Bird rock and Snow Gum State Forest Flora Reserves.	Section 6
NSW OEH Requirements for Biodiversity: Scenario 2 – Where a proposal is assessed outside the BioBanking Assessment Methodology	
The EIS should include a detailed biodiversity assessment, including assessment of impacts on threatened biodiversity, native vegetation and habitat. This assessment should address the matters included in the following sections.	Section 6
A field survey of the site should be conducted and documented in accordance with the relevant guidelines, including: ▪ Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians (DECC, 2009); ▪ Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC, 2004); ▪ Threatened species survey and assessment guideline information on www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm; and ▪ Commonwealth survey requirements (birds, bats, reptiles, frogs, fish and mammals): http://www.environment.gov.au/epbs/publications/guidelines.html. These are relevant when species or communities listed under the Environment Protections and Biodiversity Conservation Act are present.	Section 2.6.1
It is preferable for proponents to use the Interim Veg Mapping Standard data form to collect the vegetation plot data for the project site, and any offset site associated with the project. This will provide data that is useful for vegetation mapping as well as in the BioBanking Assessment Methodology. This is available at http://www.environment.nsw.gov.au/research/VISplot.htm.	2.3.1
If a proposed survey methodology is likely to vary significantly from the above methods, the proponent should discuss the proposed methodology with the OEH prior to undertaking the EIS, to determine whether the OEH considers that it is appropriate.	Section 2.6.1
Recent (less than five years old) surveys and assessments may be used. However, previous surveys should not be used if they have: ▪ been undertaken in seasons, weather conditions or following extensive disturbance events when the subject species are unlikely to be detected or present; or ▪ utilised methodologies, survey sampling intensities, timeframes or baits that are not the most appropriate for detecting the target subject species.	Section 2
Determining the list of potential threatened species for the site must be done in accordance with the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC, 2004) and the *Guidelines for Threatened Species Assessment* (Department of Planning, July 2005). The OEH Threatened Species website http://www.enfironment.nsw.gov.au/threatenedspecies/ and the *Atlas of NSW Wildlife* database must be the primary information sources for the list of threatened species present. The BioBanking	Section 2.1

Requirements	Addressed in this Report
Threatened Species Database, the Vegetation Types databases (available on OEH website at http://www.enfironment.nsw.gov.au/biobanking/biobankingtspd.htm and http://www.enfironment.nsw.gov.au/biobanking/vegtypedatabase.htm, respectively) and other data sources (e.g., PlantNET, Online Zoological Collections of Australian Museums (http://www.ozcam.org/), previous or nearby surveys etc.) may also be used to compile the list.	
The EIS should contain the following information as a minimum: ▪ the requirements set out in the Guidelines for Threatened Species Assessment (Department of Planning, July 2005); ▪ description and geo-referenced mapping of study area (and associated spatial data files), e.g., overlays on topographic maps, satellite images and/or aerial photos, including details of map datum, projection and zone, all survey locations, vegetation communities (including classification and methodology used to classify), key habitat features and reported locations of threatened species, populations and ecological communities present in the subject site and study area. Separate spatial files (.shp format) to be provided to the OEH should include, at a minimum, shapefiles of the project site, impact footprint, vegetation mapping and classification for both the impact and any offset site(s); ▪ description of survey methodologies used, including timing, location and weather conditions; ▪ detailed description of vegetation communities (including classification and methodology used to classify) and including all plot data. The vegetation classification used needs to be matched with Biometric and Endangered Ecological Community classifications. The condition of vegetation needs to be documented included in areas of derived grassland. Plot data should be supplied to the OEH in electronic format (eg MS-Excel) and organised by vegetation community; ▪ details, including qualifications and experience of all staff undertaking the surveys, mapping and assessment of impacts as part of the EIA; ▪ identification of national and state listed threatened biota known or likely to occur in the study area and their conservation status; ▪ description of the likely impacts of the proposal on biodiversity and wildlife corridors, including direct and indirect and construction and operation impacts. Wherever possible, quantify these impacts such as the amount of each vegetation community or species habitat to be cleared or impacted, or any fragmentation of a wildlife corridor; ▪ identification of the avoidance, mitigation and management measures that will be put in place as part of the proposal to avoid or minimise impacts, including details about alternative options considered and how long term management arrangements will be guaranteed; ▪ description of the residual impacts of the proposal. If the proposal cannot adequately avoid or mitigate impacts on biodiversity, then a biodiversity offset package is expected; and ▪ provision and specific Statement of Commitments relating to biodiversity.	Section 2.6 Figures 3 Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Section 2.2 Section 3.2 Section 2 Section 4 Section 6 Appendix 1 Appendix 2 Section 5 Section 7 Section 6 Refer to EIS
An assessment of the significance of direct and indirect impacts of the proposal must be undertaken for threatened biodiversity known or considered likely to occur in the study area based on the presence of suitable habitat. This assessment must take into account: ▪ the factors identified in s.5A of the EP&A Act; and ▪ the guidance provided by The Threatened Species Assessment Guideline – The Assessment of Significance (DECC, 2007) which is available at: http://www.environment.nsw.gov.au/resources/threatenedspecies/tsaguide07393.pdf	Appendix 1
Where an offsets package is proposed by a proponent for impacts to biodiversity (and a BioBanking Statement has not been sought), this package should: ▪ meet either the OEH's Principles for the use of biodiversity offsets in NSW, which are available at; www.enfironment.nsw.gov.au/biocertification/offsets.htm, or the OEH Interim policy on assessing and offsetting biodiversity impacts of part 3A developments; ▪ take account of landscape design principles such patch size and building onto and connecting existing remnants;	Refer to EIS

Requirements	Addressed in this Report
▪ identify the conservation mechanisms to be used to ensure the long term protection and management of the offset sites; and ▪ include an appropriate Management Plan (such as vegetation or habitat) that has been developed as a key amelioration measure to ensure any proposed compensatory offsets, retained habitat enhancement features within the development footprint and/or impact mitigation measures (including proposed rehabilitation and/or monitoring programs) are appropriately managed and funded.	
Where appropriate, likely impacts (both direct and indirect) on any adjoining and/or nearby OEH estate reserved under the *National Parks and Wildlife Act 1974* or any marine and estuarine protected areas under the *Fisheries Management Act 1994* or the *Marine Parks Act 1997* should be considered. Refer to the *Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water* (DECCW,2010).	Section 6.6
With regard to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the assessment should identify any relevant Matters of National Environmental Significance and weather the proposal has been referred to the Commonwealth or already determined to be a controlled action.	Section 6.6
NSW Forestry Requirements	
All maps showing proposed developments must include tenure information, particularly that of legal boundary with Forests NSW.	Refer to EIS
All associated developments/infrastructure (e.g. powerlines, roads, monitoring sites) must be indentified in the EIA. Forest NSW requests that such development be kept to a minimum and where possible are located or confined to existing infrastructure.	Refer to EIS
Supplement to the Director General's Requirements	
The background of the action, including: ▪ the title of the action; ▪ the full name and postal address of the designated proponent; ▪ a clear outline of the objective of the action; ▪ the location of the action; ▪ the background to the development of the action; ▪ how the action relates to any other actions (of which the proponent should reasonably be aware) that have been, or are being, taken or that have been approved in the region affected by the action; ▪ the current status of the action; and ▪ the consequences of not proceeding with the action.	Refer to EIS
A description of the action, including: ▪ all the components of the action; ▪ the precise location (including coordinates) of any works to be undertaken, structures to be built, or elements of the action that may have relevant impacts; ▪ how the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts; ▪ the timing and duration of the works to be undertaken; and ▪ to the extent reasonably practicable, a description of any feasible alternatives to the controlled action that have been identified through assessment, and their likely impact, including: » if relevant, the alternative of taking no action; » a comprehensive description of the impacts of each alternative on the matters protected by the controlling provisions for the action; and » sufficient detail to clarify why any alternative is preferred to another.	Refer to EIS

Requirements	Addressed in this Report
Short, medium, and long-term advantages and disadvantages of the options should be discussed.	
A description of the existing environment of the proposal location and the surrounding areas that may be affected by the action, including but not limited to: ▪ surveys using accepted methodology for targeting listed threatened species, ecological communities, and their respective habitat, including but not limited to OEH's *Survey and assessment guidelines (2009)*, available at: www.environment.nsw.gov.au/threatenedspecies/surveymethodsfauna.htm and the Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC) species-specific survey guidelines for nationally threatened species, available at: www.environgment.gov.au/cgi-bin/sprat/public/sprat.pl; ▪ a description of the distribution and abundance of threatened species and ecological communities, as well as suitable habitat (including breeding, foraging, roosting habitat, habitat critical to the survival of threatened species) within the site and in surrounding areas that may be impacted by the proposal. Specifically, this must include but not be limited to the species at Attachment A; ▪ the regional distribution and abundance of suitable and potential habitat for threatened species and ecological communities surrounding the site. ▪ a description of the important water resources within the site and in surrounding areas, including detailed information addressing the department's Water Resources Terms of Reference, currently in preparation. ▪ a description of water related assets that are dependent on any important water resources, including an estimation of the water requirements of those assets (i.e. regional water use).	Section 2 Appendix 2 Appendix 2 Refer to EIS Refer to EIS
An assessment of all relevant impacts with reference to the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines Matters of National Environmental Significance (2009)* and species specific guidelines as relevant (available at: www.environment.gov.au/epbc/guidelines-policies.html) that the controlled action has, will have or is likely to have. Information must include: ▪ a description of the relevant impacts of the action on matters of national environmental significance; ▪ a detailed assessment of the nature and extent of the likely short term and long term relevant impacts; ▪ a statement whether any relevant impacts are likely to be unknown, unpredictable, or irreversible; ▪ analysis of the significance of the relevant impacts; ▪ any technical data and other information used or needed to make a detailed assessment of the relevant impacts.	Section 6.6 Appendix 2
Where there is a potential habitat for EPBC Act listed species (see Appendix A), surveys must be undertaken. These surveys must be timed appropriately and undertaken for a suitable period of time by a qualified person. A subsequent description of the relevant impacts on such EPBC Act listed species should include, inter alia, direct, indirect, cumulative, and facilitative impacts on the: ▪ population of the species at the site; ▪ area of occupancy of the species; ▪ habitat critical to the survival of the species; ▪ breeding cycle of the population; and ▪ availability or quality of habitat for the species. If an endangered ecological community or threatened species listed at Appendix A is not believed to be present on the proposed site, detailed information must be included in the Environmental Impact Assessment to demonstrate that this community will not be impacted.	Section 2 Appendix 2

Requirements	Addressed in this Report
A description of the relevant impacts on the Temperate Highland Peat Swamps on Sandstone (THPSS) should include a detailed description of the potential and likely hydrological changes that may occur as a result from the proposed action, including from subsidence. Direct and indirect impacts must be included. Cumulative and facilitative impacts should also be included. Please include impacts on the: ▪ extent of the THPSS, including hydrological connectivity with other areas of the ecological community; ▪ quality or integrity of the THPSS including, but not limited to, assisting invasive species that are harmful to the ecological community to become established; ▪ EPBC Act listed species in, or in any way dependent upon, the THPSS; ▪ composition of the THPSS; ▪ habitat present on site critical to the survival of the THPSS; and ▪ abiotic (non-living) factors (such as water, nutrients, or soil) necessary for peat swamp integrity and survival, for example subsidence related impacts, altering groundwater levels, soil disturbance or substantial alteration of surface water drainage patterns. These impacts should be described for the construction, operational and decommissioning phases of the controlled action. This information should be provided with reference to the ecological community as it is defined and listed under the EPBC Act.	Section 6.2.2 Appendix 2
An assessment of all relevant impacts of the World and National listed values of the Greater Blue Mountains World Heritage Area (GBMWHA). The assessment should include: ▪ a detailed description of the potential and likely hydrological change, including changes to water quality and quantity entering the heritage area, that may occur as a result of the proposed action. Direct and indirect impacts must be included. Cumulative and facilitative impacts should also be included; ▪ a detailed description of the impact of the proposed action on the wilderness quality (as determined by the National Wilderness Inventory) of the GBMWHA.	Section 6.2.2
An assessment of all relevant impacts on water resources and water related values, including: ▪ detailed information addressing the Independent *Expert Scientific Committee Information Guidelines for Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources*, available at: www.environment.gov.au/coal-seam-gas-mining/pubs/iesc-information-guidelines.pdf; and ▪ detailed information addressing the department's Water Resources Terms of Reference, currently in preparation.	Refer to EIS
A description of feasible mitigation measures, changes to the action or procedures, which have been proposed by the proponent or suggested in public submissions, and which are intended to prevent or minimise relevant impacts. Information must include: ▪ a description of the mitigation measures that will be undertaken to prevent or minimise the relevant impacts of the action. These mitigation measures should be justified and based on best available practices; ▪ an assessment of the expected or predicted effectiveness of the mitigation measures including the effect on abundance and condition of species, suitable habitat and ecological communities, heritage values and/or water resources or water related values; ▪ any statutory or policy basis for the mitigation measures; ▪ the cost of the mitigation measures;	Section 7

Requirements	Addressed in this Report
▪ an environmental management plan that sets out the framework for continuing management, mitigation, and monitoring programs (including any relevant thresholds for corrective actions) for the relevant impacts of the action. Include the person or agency responsible for implementing these programs and the effectiveness of all mitigation measures, including any provisions for independent environmental auditing; ▪ the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program; ▪ identification of mitigation measures proposed to be undertaken by State governments, local governments, or the proponent; and ▪ any changes to the action which prevent or minimise relevant impacts on listed threatened species and communities.	
Where impacts cannot be avoided or mitigated, an offset package to compensate for any predicted or potential residual significant impacts on matters of national environmental significance. Offsets should demonstrate consistency with the Commonwealth EPBC Act Environmental Offsets Policy (October 2012, or subsequent versions), available at www.environment.gov.au/epbc/publications/environmental-offsets-policy.html. The department's information requirements in relation to EPBC Act offset proposals is provided at Appendix B. Information must include: ▪ the description of any offset package should include how the offset compensates for the residual impacts, when the offset will be delivered, and how the offset will be managed; ▪ an assessment of the impact of the offsets on other matters of environmental, economic, or social significance; and ▪ analysis of cost, both financial and other, related to offsets.	Refer to EIS
Any other requirements for approval or conditions that apply, or that the proponent reasonably believes are likely to apply, to the proposed action. Information must include: ▪ details of any local or State government planning scheme, or plan or policy under any local or State government planning system that deals with the proposed action, including: » what environmental assessment of the proposed action has been, or is being, carried out under the scheme, plan or policy; and » how the scheme provides for the prevention, minimisation and management of any relevant impacts; ▪ a description of any approval that has been obtained from a State, Territory, or Commonwealth agency or authority (other than an approval under the EPBC Act), including any conditions that apply to the action; ▪ a statement identifying any additional approval that is required; ▪ a description of the monitoring, enforcement, and review procedures that apply, or are proposed to apply, to the action.	Refer to EIS
A description of the short-term and long-term social and economic implications and/or impacts of the project.	Refer to EIS
Details of any proceedings under a Commonwealth, State, or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against: ▪ the proponent; and ▪ for an action for which a person has applied for a permit, the person making the application.	Refer to EIS
Details of the proponent's environmental policy and planning framework.	Refer to EIS
For information given in an environment assessment, the draft must state:	Section 9

Requirements	Addressed in this Report
▪ the source of the information; ▪ how recent the information is; ▪ how the reliability of the information was tested; and ▪ what uncertainties (if any) are in the information.	
Any consultation about the action, including: ▪ any consultation that has already taken place; ▪ proposed consultation about relevant impacts of the action; and ▪ if there is has been consultation about the proposed action – any documented response to, or result of, the consultation.	Refer to EIS
Identification of affected parties, including a statement mentioning any communities that may be affected and describing their views.	Refer to EIS

1.7 Licensing

Surveys were conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S100536 (Valid 31 December 2014);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2014);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2016); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 22 May 2014).

1.8 Certification

As the principal author, I, Paul Hillier, make the following certification:

- the results presented in the report are, in the opinion of the principal author and certifier, a true and accurate account of the species recorded, or considered likely to occur;
- commonwealth, state and local government policies and guidelines formed the basis of project surveying methodology, or where the survey work has been undertaken with specified departures from industry standard guidelines, details of which are discussed and justified in **Section 2.6**; and
- all work has complied with relevant laws and codes relating to the conduct of flora and fauna research, including the Animal Research Act 1995, National Parks and Wildlife Act 1974 and the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes.

Principal Author and Certifier:

Paul Hillier
Senior Ecologist – Senior Project Manager
March 2014

2.0 Methodology

A variety of field survey techniques were employed over the course of fieldwork for this assessment to record a representative sample of flora species and fauna guilds across the Study Area. The surveys included site inspections to identify initial constraints to inform survey design, vegetation community surveys and various fauna survey methods including Elliott trapping, harp traps, hair tubes, bat echolocation, spotlighting, call playback, diurnal bird and herpetological surveys, opportunistic surveys and habitat assessments. Targeted searches for threatened flora and fauna species were also undertaken.

In addition to the ecological surveys undertaken by RPS, a review of surveys undertaken for other projects within the Study Area locality have been used in consideration of adequacy of survey effort and potential for occurrence of threatened species.

Key staffs used for this project were Paul Hillier BEnvSc (Principal Author), Joel Stibbard BSc (Author), David Tierney PhD (Flora) and Lauren Vanderwyk BSc (Fauna). These staff members were supported by other members of the RPS team. The dates of all field work undertaken and associated weather conditions are provided in **Section 2.2**.

2.1 Desktop Assessment

A review of relevant information was undertaken to provide an understanding of ecological values occurring or potentially occurring within the Study Area and locality (i.e. within 10 km of the Study Area). Reports prepared for the Study Area and nearby sites have been reviewed for the purpose of assessing the likelihood of threatened species or ecological communities to occur within the Study Area. Information sources reviewed included:

- Aerial Photograph Interpretation (API) and literature reviews to determine the broad categorisation of vegetation within the Study Area;
- review of the Vegetation of the Western Blue Mountains – including the Capertee, Coxs, Jenolan and Gurnang Areas (DEC 2006);
- review of fauna and flora records contained in the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife (Accessed January 2014) within a 10 km radius of the Study Area;
- review of fauna and flora records contained in the SEWPAC Protected Matters Search (Accessed January 2014) within a 10 km radius of the Study Area;
- fauna monitoring reports for the subsidence management plan area at Springvale Colliery (2004 - 2012). Unpublished reports to Springvale Coal Pty Limited from Mount King Ecological Surveys (MKES) (2004 - 2008) and Biodiversity Monitoring Services (BMS) (2009 -2012);
- Fauna monitoring within the subsidence management plan area at Angus Place Colliery from 2004 to 2012. Unpublished reports to Centennial Coal by Mount King Ecological Surveys (2004-2009) and Biodiversity Monitoring Services (2010-2012);
- Fauna monitoring within the subsidence management plan area at Clarence Colliery from 2004 to 2012. Unpublished reports to Centennial Coal by Mount King Ecological Surveys (2008) and Biodiversity Monitoring Services (2009-2010);
- RPS (2010) Flora and Fauna Assessment - Proposed Longwalls 910 and 900W, Angus Place Colliery. Prepared for Centennial Angus Place Pty Limited;
- RPS (2012) Flora and Fauna Assessment Angus Place Colliery Ventilation Facility Project. Prepared for Centennial Angus Place Pty Limited; and
- Draft Temperate Highland Peat Swamps on Sandstone Monitoring and Management Plan for LWs 415 -

417, Springvale Mine, April 2013.

2.2 Weather Conditions

The prevailing weather conditions during the survey period are presented in **Table 2** below. These results were sourced from a weather station based in Lithgow town centre.

Table 2 Prevailing Weather Conditions

Date	Temp Min-Max (°C)	Rain (24 hrs to 9:00am) (mm)	Sun Rise - Sun Set	Surveys Undertaken								
				Vegetation & Targeted Flora Surveys	Elliot Traps / Cages / Hair Tubes	Harp Trapping	AnaBat	Bird Census	Herpetofauna Search	Spotlighting	Call Playback	General Fauna / Opportunistic Surveys
23 Nov 2011	9.9–12.1	42.4 mm	05:15-19:16	x								
5 Dec 2011	4.3–13.1	0.0 mm	05:12-19:27	x								
6 Dec 2011	6.1–12.8	0.6 mm	05:12-19:28	x								
7 Dec 2011	3.9–15.3	0.0 mm	05:12-19:29	x								
8 Dec 2011	10.2–14.4	7.6 mm	05:12-19:30	x								
19 Dec 2011	12.5–19.1	1.6 mm	05:12-19:37	x								
20 Dec 2011	10.2–21.1	22.2 mm	06:03-19:25	x								
6 Feb 2012	13.4–26.6	0.0 mm	05:26-19:01	x								
7 Feb 2012	14.4–18.9	0.2 mm	05:27-19:00	x								
8 Feb 2012	13.2–16.7	1.4 mm	05:28-18:59	x								
9 Feb 2012	13.0–19.6	5.0 mm	05:29-18:58	x								
10 Feb 2012	13.3–20.9	16.6 mm	05:30-18:57	x								
13 Feb 2012	10.2–22.2	0.0 mm	05:33-18:55		x	x	x			x	x	
14 Feb 2012	12.0–21.5	18.0 mm	06:03-19:24		x	x	x					
15 Feb 2012	10.3–22.1	0.0 mm	06:04-19:23	x	x	x	x					
16 Feb 2012	9.1–24.3	0.0 mm	06:05-19:22	x	x	x	x					
17 Feb 2012	10.6–24.5	0.0 mm	06:06-19:20									x
27 Feb 2012	16.9–23.2	7.0 mm	06:15-19:09		x	x	x					
28 Feb 2012	17.3–23.5	0.4 mm	06:16-19:08		x	x	x			x		
29 Feb 2012	17.7–20.7	1.8 mm	06:17- 19:07		x	x	x		x			
1 Mar 2012	15.6–24.6	49.6 mm	06:18-19:06		x	x	x					
2 Mar 2012	12.9–13.6	32.0 mm	06:18-19:04									x
16 Aug 2012	0.4–12.1	0.0 mm	07:06-18:01	x								
21 Aug 2012	-1.2–14.9	0.0 mm	07:01-18:04	x								
22 Aug 2012	-0.2–17.7	0.0 mm	07:00-18:05	x								
23 Aug 2012	10.1–18.2	1.4 mm	06:58-18:06	x								
4 Oct 2012	2.4–22.4	0.0 mm	06:02-18:34	x								
16 Oct 2012	4.4–24.6	0.0 mm	05:40-18:43	x								
18 Oct 2012	7.2–21.8	0.0 mm	05:44-18:45	x								
22 Oct 2012	2.2–14.6	1.2 mm	05:40-18:48	x								
23 Oct 2012	5.2–15.4	0.2 mm	05:39-18:49	x								

Date	Temp Min-Max (°C)	Rain (24 hrs to 9:00am) (mm)	Sun Rise - Sun Set	Surveys Undertaken								
				Vegetation & Targeted Flora Surveys	Elliot Traps / Cages / Hair Tubes	Harp Trapping	AnaBat	Bird Census	Herpetofauna Search	Spotlighting	Call Playback	General Fauna / Opportunistic Surveys
24 Oct 2012	0.4–24.0	0.0 mm	05:38-18:50	x								
25 Oct 2012	3.4–25.5	0.0 mm	05:37-18:50	x								
5 Nov 2012	7.5–28.1	0.0 mm	05:26-19:00	x								
6 Nov 2012	12.0–28.2	0.0 mm	05:25-19:01						x	x	x	x
19 Nov 2012	2.1–15.8	0.0 mm	05:16-19:13		x	x	x					x
20 Nov 2012	9.1–17.4	2.2 mm	05:16-19:14		x	x	x	x	x	x	x	x
21 Nov 2012	2.3–25.9	0.0 mm	05:15-19:15		x	x	x	x	x	x	x	x
22 Nov 2012	8.5–19.5	0.0 mm	05:15-19:16		x	x	x	x	x			x
23 Nov 2012	9.9–22.4	0.0 mm	05:14-19:17									x
3 Dec 2012	14.0–27.6	1.0 mm	05:12-19:26		x	x	x					x
4 Dec 2012	11.7–20.8	0.0 mm	05:12-19:27		x	x	x			x	x	x
5 Dec 2012	6.4–17.7	0.0 mm	05:12-19:28		x	x	x	x		x	x	x
6 Dec 2012	2.4–23.3	0.0 mm	05:12-19:29		x	x	x	x	x			x
7 Dec 2012	8.8–20.8	0.0 mm	05:12-19:29									x
10 Dec 2012	9.7–13.1	0.6 mm	05:13-19:32		x	x	x					x
11 Dec 2012	9.3–16.7	0.2 mm	05:13-19:32		x	x	x	x		x	x	x
12 Dec 2012	10.9–20.7	1.2 mm	05:13-19:33		x	x	x	x	x	x	x	x
13 Dec 2012	6.1–26.5	0.0 mm	05:13-19:34		x	x	x	x	x			x
14 Dec 2012	N/A–28.2	0.0 mm	05:14-19:34									x
7 Jan 2013	16.2–32.6	0.0 mm	05:28-19:43	x								x
10 Jan 2013	12.5–23.3	0.0 mm	05:01-19:13	x								
15 Jan 2013	11.1–25.6	0.2 mm	05:05-19:12	x								
16 Jan 2013	10.7–31.4	0.0 mm	05:06-19:12	x								
17 Jan 2013	11.2–34.1	0.0 mm	05:07-19:12	x								
21 Jan 2013	14.3–26.2	0.0 mm	05:41-19:40		x	x	x					x
22 Jan 2013	13.7–29.3	0.0 mm	05:42-19:40		x	x	x			x	x	x
23 Jan 2013	12.8–23.1	10.4 mm	05:43-19:39		x	x	x			x	x	x
24 Jan 2013	14.7–25.8	0.2 mm	05:44-19:39		x	x	x	x				x
25 Jan 2013	15.7–29.5	0.0 mm	05:45-19:38		x	x	x					x
29 Jan 2013	15.3–26.2	47.2 mm	05:19-19:06	x								
30 Jan 2013	13.6–26.1	0.2 mm	05:20-19:05	x								
31 Jan 2013	13.5–29.1	0.0 mm	05:21-19:05	x								
1 Feb 2013	15.7–27.0	0.0 mm	05:22-19:04	x								
5 Feb 2013	9.2–22.2	0.0 mm	05:26-19:01	x								x
6 Feb 2013	10.8–23.8	0.0 mm	05:27-19:00	x								x
7 Feb 2013	10.0–27.6	0.0 mm	05:28-18:59	x								x
8 Feb 2013	11.4–29.8	0.0 mm	05:29-18:59	x								x

Date	Temp Min-Max (°C)	Rain (24 hrs to 9:00am) (mm)	Sun Rise - Sun Set	Surveys Undertaken								
				Vegetation & Targeted Flora Surveys	Elliot Traps / Cages / Hair Tubes	Harp Trapping	AnaBat	Bird Census	Herpetofauna Search	Spotlighting	Call Playback	General Fauna / Opportunistic Surveys
27 Feb 2013	15.3–26.2	0.0 mm	05:46-18:38	x								x
28 Feb 2013	15.8–20.7	0.0 mm	05:47-18:37	x								x
1 Mar 2013	12.1–13.7	33.0 mm	05:48-18:36	x								x
13 Mar 2013	8.5–24.5	0.0 mm	06:27-18:51	x								x
14 Mar 2013	10.2–22.5	0.0 mm	06:28-18:49	x								x
26 Sep 2013	5.4–14.0	0.0 mm	06:13-18:28	x								x

Source: Bureau of Meteorology website: http://www.bom.gov.au/climate/dwo/IDCJDW2075.latest.shtml information for Lithgow, and the Geoscience website: http://www.ga.gov.au/bin/geodesy/run/gazmap_sunrise?placename=lithgow&placetype=0&state=0#loc

2.3 Flora Survey

2.3.1 Vegetation Mapping

Desktop analysis of regional mapping of the Study Area and its surrounds was informed by large-scale vegetation mapping projects and aerial photography, including:

- Aerial Photograph Interpretation (API) and consultation of topographic map (Scale1:25000) of the Study Area;
- review of the *Vegetation of the Western Blue Mountains – including the Capertee, Coxs, Jenolan and Gurnang Areas* (DEC 2006);
- confirmation of the community type(s) present (dominant species) via undertaking flora surveys and identification;
- consideration of the potential for the derived vegetation communities to constitute 'Endangered Ecological Communities' (EECs) as listed under the TSC Act and/or EPBC Act; and
- mapping the type and general extent of the communities present into definable map units where appropriate using a combination of API and ground-truthing surveys.

Flora survey effort within the Study Area was deliberately focused on the predicted subsidence extents and ESAs. However, surveys also occurred outside of these areas. The data collected informed any revisions to DEC (2006) mapping and, where applicable, alterations to this vegetation mapping occurred using the collected floristic data and API. The final vegetation map produced utilises the original DEC (2006) mapping in areas of the Study Area where no data was collected that may otherwise have informed possible mapping revisions.

The methodology first used API to construct a map template using GIS where visible changes in the vegetation and landscape were separately mapped into definable map units. Vegetation surveys were then undertaken and consisted of Rapid Data Point (RDP) and Quadrat surveys undertaken within the Study Area (see **Figure 3**). A total of 39 full floristic quadrats and 193 RDPs were undertaken within the Study Area. Additionally, further flora inspections, vegetation delineation and threatened flora searches were undertaken while conducting diurnal fauna surveys and while otherwise traversing throughout the Study Area on foot or within a vehicle.

Due to their specific conservation value, all shrub swamps and most hanging swamps were visited within the predicted subsidence extents and ESAs. These swamps were sampled via either RDPs or Quadrats. Where swamps could not be accessed, the extents of these relied on that mapped by DEC (2006).

The vegetation surveys were undertaken to define and map vegetation communities and to search for threatened flora species.

2.3.2 Significant Flora Survey

A list of potentially occurring significant flora species from the locality (10 km radius) was compiled, which included threatened species and EECs listed under the TSC Act and/or EPBC Act. Opportunistic and targeted flora surveys were undertaken during all vegetation field work.

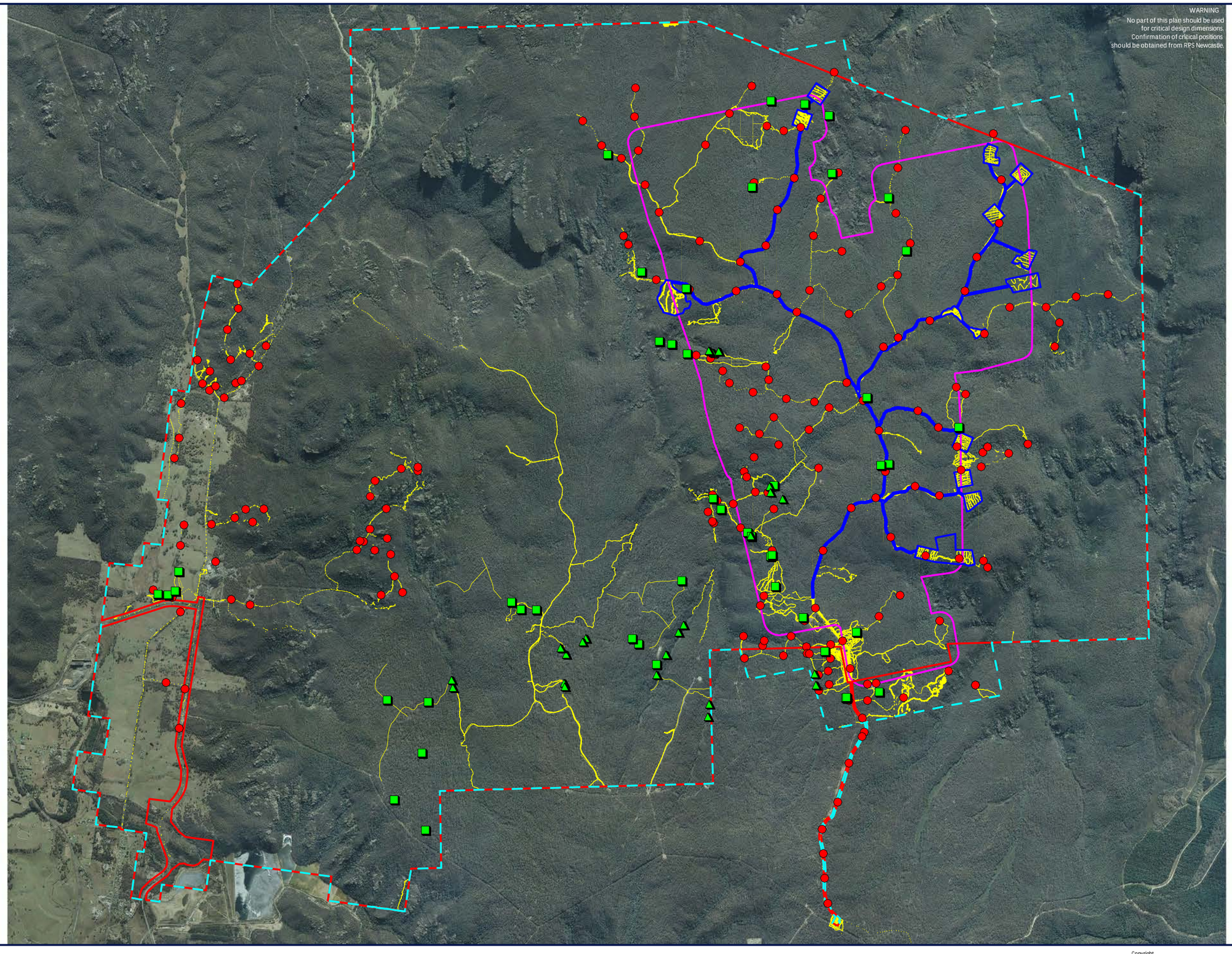
Two ecologists undertook targeted flora searches across the ESAs within the Study Area, including existing track edges on the 7 January 2013, 29–31 January, 1 February 2013, 5–8 February 2013, 27–28 February 2013, 1 March 2013 and 26 September 2013. Targeted flora surveys were also undertaken during all vegetation survey work. Opportunistic records were also made during all fauna survey work.

The locations of any threatened flora species recorded within the ESAs were recorded using Trimble differential GPS units with sub-metre accuracy. In some cases, threatened flora within the wider Study Area were recorded using a Garmin GPS unit.

Legend

- Project Application Area
- RPS Study Area
- 26.5 Degree Angle of Draw
- Environmental Study Area
- Flora Quadrat
- Rapid Data Point
- University of Queensland Flora Monitoring Location
- Survey Coverage as captured by GPS (note: not all coverage during the course of field work was captured)

N



WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

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kilometres

SCALE: 1:48,000 AT SIZE A3

TITLE: FIGURE 3: FLORA SURVEY METHOD LOCATIONS

LOCATION: ANGUS PLACE

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 20/01/2014
PURPOSE: REPORT

LAYOUT REF: J:\JOBS\Centennial\All Jobs\110328 Angus Place - Major Extension\10. Drafting\Mapinfo
VERSION (PLAN BY): JS (E A3)

CLIENT: CENTENNIAL
JOB REF: 110328

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2.4 Habitat Survey

An assessment of the relative value of the habitat present within the Study Area was conducted during all survey events. Significant fauna habitat including hollow-bearing trees, hollow logs, termite mounds, *Allocasuarina* stands and wombat burrows were identified. This was undertaken to assist with the development of actions to minimise impacts of the proposal on resident fauna, particularly within the ESAs.

Given the flexibility in the final location of ESAs within the Study Area, hollow-bearing tree quadrats were conducted across the Springvale and Angus Place lease areas to determine an overall estimation of hollow-bearing tree densities within the ESAs. A total of 10 hollow-bearing tree quadrats were conducted, with each quadrat totalling 1 hectare and occurring within the forested ridgeline habitats to represent the likely final location for ESAs within the Study Area.

Habitat assessment for threatened species, which are known or have potential to occur, was based on the specific habitat requirements of each threatened fauna species in regards to home range, feeding, roosting, breeding, movement patterns and corridor requirements. Consideration was given to contributing factors including topography, soil, light and hydrology for threatened flora and assemblages.

2.5 Fauna Survey

The fauna survey methodology consisted of the production of an Observed and Expected Fauna Species List for the area (**Appendix 3**) and an assessment of the potential use of the Study Area by threatened fauna species (as listed under the TSC Act and/or EPBC Act) identified from the vicinity of the Study Area. This was achieved by literature and database reviews followed by confirmation through field surveys, and any additional species observed were noted on the list.

The presence of fauna within the Study Area was determined through a variety of survey techniques including Elliot traps, hair tubes, cage traps, spotlighting, call playback, harp trapping, Anabat recordings, avifauna surveys, herpetofauna surveys and opportunistic sightings. These methodologies are described in further detail below.

Much of the habitats within the Study Area are difficult to access, with tracks predominately occurring along the ridge lines. The location and effort of each survey methodology (as shown in **Figure 4 and Figure 5**) was determined based on achieving a suitable spread across the Study Area and included fauna surveys within or close to the ESA. Given that targeted fauna species are highly mobile and contiguous habitat exists across the Newnes Plateau, the likelihood of occurrence of targeted species within potential habitat is considered to be consistent across the entire Study Area, including areas within and surrounding the ESA.

Additional fauna surveys have been undertaken by MKES (2004-2008) and BMS (2009-2012) as part of annual monitoring surveys for the Angus Place lease area. The level of survey effort that has been undertaken has been considered in this report in relation to survey requirements within relevant survey guidelines and the target species (see **Section 2.6**).

2.5.1 Terrestrial Elliot Trapping

Terrestrial trapping was undertaken using Elliott A, Elliott B and cage traps. Elliott traps were baited with a mixture of rolled oats, peanut butter and honey, while cage traps were baited with chicken necks. Traps were checked early each morning, with any captures identified, photographed and released at point of capture. Traps were re-baited where necessary. The location of each trap line is shown in **Figure 5**.

A total of eleven trapping transects were undertaken containing 25 Elliott A, 25 Elliott B and six cage traps per line. This resulted in 1100 Elliott A trap nights, 1100 Elliott B trap nights and 264 cage trap nights.

2.5.2 Arboreal Elliott Trapping

Arboreal trapping was undertaken using tree mounted Elliott B size traps. Traps were mounted on brackets set at approximately 2 m in height on trees with a diameter at breast height of greater than 30 cm. Traps were baited with a rolled oats, peanut butter and honey mixture and the tree trunks were sprayed liberally with a brown sugar and water mix each day in the late afternoon. Traps were checked early each morning.

A total of 11 trapping transects, containing six Elliott B size arboreal traps were installed, resulting in 264 arboreal trap nights. The location of each trap line is shown in **Figure 5**.

2.5.3 Hair Tubes

Surveys were undertaken using Faunatech Hair Tubes across the Study Area. These were baited with rolled oats, peanut butter and honey. Trees in which arboreal Hair Tubes were erected were sprayed each day with a brown sugar and water mix. At each site 10 arboreal and 10 terrestrial Hair Tubes were set. The location of each trap line is shown in **Figure 5**.

Hair Tubes targeted small-medium mammals such as dasyurids (e.g. Antechinus and Dunnarts), rodents (e.g. rats and mice), gliders and bandicoots. A total of twelve trapping transects were undertaken, resulting in 480 arboreal trap nights and 480 terrestrial trap nights.

Any hair samples retrieved during the survey were sent to Barbara Triggs at ‘Dead Finish’ for analysis.

2.5.4 Avifauna Survey

The presence of avifauna within the Study Area was undertaken via systematic diurnal censuses, nocturnal surveys, and by opportunistic observations during field surveys. Diurnal censuses entailed the identification of all birds occurring at one location during a 20 minute period. Birds were identified by direct observation or by recognition of calls or through recognition of distinctive features such as nests, feathers, and owl regurgitation pellets etc. In total, 37 systematic bird censuses were undertaken.

The potential for threatened avifauna to use the Study Area was also assessed by identification of habitat attributes and their capacity to support threatened species that are known to occur in the wider locality.

Nocturnal surveys (see **Section 2.5.8** and **Section 2.5.9**) were undertaken to detect nocturnal bird species within the Study Area. The location of all call playback sites are shown in **Figure 4**.

2.5.5 Herpetofauna Survey

Opportunistic and targeted herpetofauna searches were conducted during fauna surveys encompassing a diversity of habitats across the Study Area. Known occurrences of threatened herpetofauna species from the region were taken into account during assessment of onsite habitat, to determine the potential for the Study Area to support such species. Eight locations, where specific habitat was observed were searched and their location recorded. Amphibian surveys were conducted during Spring and Summer when climatic conditions are the most favourable for activity.

2.5.6 Bat Echolocation Call Recording

Microbat echolocation calls were recorded using Anabat II Detector and CF ZCAIM units set to remotely record for the entire night (6pm to 6am). Anabats were placed at 12 separate sites within the Study Area with each survey location sampled for four consecutive nights. The location of each Anabat site was selected based on the likelihood that it would provide potential foraging sites and flyways for microbats. The location of each Anabat survey site is shown in **Figure 4**.

Bat call analysis was undertaken by Anna McConville who is experienced in the analysis of bat echolocation calls. Each call sequence ('pass') was assigned to one of three categories, according to the confidence with which an identification could be made, being:

- Definite - Pass identified to species level and could not be confused with another species;
- Probable - Pass identified to species level and there is a low chance of confusion with another species; or
- Possible - Pass identified to species level, but short duration or poor quality of the pass increases the chance of confusion with another species.

2.5.7 Bat Trapping – Harp Traps

Harp Traps were utilised at ten of the 13 trap line locations across the Study Area. Harp Traps are designed to catch microbats, allowing for visual identification of species occurring within the Study Area as well as to allow for the identification of species that are not detectable utilising ultrasonic recording devises. Any microbats caught were identified and released on the same night of capture. **Figure 5** shows Harp Trap locations.

2.5.8 Spotlighting

Spotlighting was undertaken across the Study Area via the use of 75-Watt hand-held spotlights and head torches. A combination of vehicular and on foot spotlighting transects were undertaken across the Study Area, targeting tracks and other areas easily accessible during night time periods. A total of 60 person hours of spotlighting was undertaken over 15 nights within the Study Area (**Figure 5**).

2.5.9 Nocturnal Call Playback

Pre-recorded calls of Koala, Owl, and Glider species with the potential to occur within the Study Area were broadcast during the surveys in an effort to elicit vocal responses or to attract the species to the playback site. The calls were broadcast through an amplification system (loud hailer) designed to project the sound for at least 1 km under still night conditions. Owl species targeted included the Barking Owl (*Ninox connivens*), Powerful Owl (*Ninox strenua*), Masked Owl (*Tyto novaehollandiae*) and Koala (*Phascolarctos cinereus*).

As detailed by Kavanagh and Peake (1993) and Debus (1995), the call of each species was broadcast for at least five minutes, followed by five minutes of listening and stationary spotlighting. Following the final broadcast the immediate area was spotlighted on foot. A total of 10 call playback sessions were undertaken within the Study Area. The location of the call playback sites are shown in **Figure 4**.

2.5.10 Secondary Indications and Incidental Observations

Opportunistic sightings of secondary indications (scratches, scats, diggings, tracks etc.) of resident fauna were noted. Such indicators included:

- distinctive scats and scents left by mammals;
- collection of predator scats for analysis;
- nests made by various guilds of birds;
- whitewash, regurgitation pellets and prey remains from Owls;
- skeletal material of vertebrate fauna;
- the calls of fauna;
- tracks and scratches left by fauna; and
- chewed *Allocasuarina* cones, indicative of feeding by *Calyptorhynchus lathami* (Glossy Black-cockatoo).

2.6 Adequacy of Survey Effort and Limitations

2.6.1 Survey Effort

In addition to the surveys presented within this report, annual fauna monitoring that has been occurring since 2004. Fauna monitoring has been undertaken over the Angus Place lease areas by MKES (2004 - 2009) and BMS (2010 -2012).

Monitoring has occurred at four locations, with three additional monitoring sites being included in 2011. All sites are located within wetland habitat (shrub swamps), but the surrounding woodland habitat is also surveyed. Seven fauna monitoring sites occur within the Study Area. One additional site that is monitored as part of the Springvale Mine lease area also falls within the Study Area. Fauna monitoring locations are presented in **Figure 4**.

Seasonal monitoring of swamp vegetation has been undertaken since 2003 by the University of Queensland. A total of 23 monitoring plots have been established within the Study Area. These swamp monitoring sites are permanently marked with 20 m x 20 m quadrats within which vegetation abundance and condition is measured. The locations of all flora monitoring plots are provided in **Figure 3**. A series of methods have been used to record target species. **Table 3** provides a cumulative tally of selected survey techniques and effort undertaken.

Table 3 Survey Effort of the Study Area

Target Species	Method	Value	RPS Surveys 2010 - 2013	MKES (2004 - 2008) and BMS (20109-2012)	University of Queensland (2003-2012)	Total
Small mammals	Terrestrial A	Trap Nights	1800	9,960	-	11,760
Medium sized mammals	Terrestrial B		1492	336	-	1,828
Large mammals	Cage		264	Undertaken, however effort not specified	-	>320
Arboreal mammals	Arboreal B		432	1,972	-	2,404
Various sized mammals	Hair Tube Station Terrestrial		480	1,822	-	2,782
	Hair Tube Station Arboreal		480		-	
Bats	Harp trap		76	-	-	76
	Ultrasonic detection	Hours	342	Undertaken, however effort not specified	-	>342
Various nocturnal mammals and birds	Spotlighting		84	87	-	171
	Call Playback (mammals)		10	Undertaken, however effort not specified	-	>10
	Call Playback (birds) Using the minimum for Masked Owl		16	Undertaken, however effort not specified	-	>10
	Bird Census		12	Undertaken, however effort not specified	-	>12
Reptiles	Habitat Search (based on 0,5 hours per site)		4	Undertaken, however effort not specified	-	>4
	Spotlighting (based on km recorded at approx 1km per hour)		84	87	-	171

Target Species	Method	Value	RPS Surveys 2010 - 2013	MKES (2004 - 2008) and BMS (20109-2012)	University of Queensland (2003-2012)	Total
Amphibians	Habitat Search		14	Undertaken, however effort not specified	-	>14
Plants	Quadrat & Random Meander (30min per quadrat)	Sites	39	-	23	62
	Rapid Data Point		193	-	-	193

If the vegetation survey results (see **Section 3.2.1**) of the Study Area were assessed as stratification units, the combined survey efforts outlined in **Table 3** would not meet the DEC (2004) guidelines minimum survey recommendations. These guidelines, however, recognise that the level of survey effort set out in DEC (2004) may not be necessary in all circumstances. In this instance the main potential impacts are direct vegetation removal and potential subsidence related impacts. This is discussed further below.

The ESA methodology (see **Section 1.2**) has been used to determine the likely clearing impacts of the Project. These impacts are further discussed in **Section 6**. The maximum proposed infrastructure footprint is approximately 23.24 ha. As shown in **Figure 4** and **Figure 5**, most RPS fauna surveys were undertaken within or immediately adjacent to the ESAs. The woodland habitats, over which the infrastructure is proposed, is generally homogeneous and therefore can be considered as one stratification unit.

Seven Elliott trap lines were installed less than 200 m from the proposed infrastructure footprint and spread along its extent. At each trap site, hair tube transects, cage traps, anabats and bat harp traps were also installed. Survey methods for the more mobile avifauna were spread across the Study Area. With consideration of proposed direct habitat losses, the survey effort undertaken is considered to meet the minimum survey requirements as suggested in DEC (2004).

As detailed in **Section 6.2**, those habitats at greatest risk of potential subsidence related impacts are those that are groundwater dependent. The monitoring undertaken by MKES (2004 - 2009), BMS (2010-2012) and University of Queensland (2003-2012) are specifically focused on sampling the shrub swamp habitats. Additionally, all shrub swamps and most hanging swamps within the subsidence extents were sampled by RPS using either RDPs or Quadrats. The nine years of annual fauna surveys undertaken within and around shrub swamps also satisfies amphibian survey requirements (DECC, 2009). The survey methods are also in accordance with Commonwealth survey requirements (SEWPAC 2010a, 2010b, 2010c, 2011a, 2011b and 2011c).

The high level of effort of targeted surveys over the proposed surface infrastructure has enabled those easily detectable threatened species to be assessed for their likelihood of occurrence and subsequent potential impact. For those species that are less easily detected, the combined results from surveys and desktop

analysis, including nine years of fauna monitoring have been used to assess the likelihood of a certain species occurring. Where any uncertainty has arisen due to any of the limitation as discussed below, the precautionary principle has been adopted, thus assuming it has potential for presence where potentially suitable habitat exists.

Much of the habitats within the Study Area are difficult to access, with tracks predominately occurring along the ridge lines. The location and effort of each survey methodology (as shown in **Figure 4 and Figure 5**) was determined based on achieving a suitable spread across the Study Area and included fauna surveys within or close to the ESA. Given that targeted fauna species are highly mobile and contiguous habitat exists across the Newnes Plateau, the likelihood of occurrence of targeted species within potential habitat is considered to be consistent across the entire Study Area, including areas within and surrounding the ESA.

2.6.2 Limitations

Limitations associated with this Flora and Fauna Assessment are presented herewith. The limitations have been taken into account specifically in relation to threatened species assessments, results and conclusions.

2.6.2.1 Seasonality

Threatened flora species should be surveyed within their respective flowering periods to ensure accurate identification. Consideration of previous surveys has provided a reasonable spread of seasonal surveys such that opportunities have existed to detect cryptic threatened species within their respective flowering periods within and in the vicinity of the Survey Area.

The flowering and fruiting plant species that attract some nomadic or migratory threatened species often fruit or flower in cycles spanning a number of years. Furthermore, these resources might only be accessed in some areas during years when resources more accessible to threatened species fail. As a consequence, threatened species may be absent from some areas where potential habitat exists for extended periods and this might be the case for the above-mentioned opportunistic nomadic or migratory species. This limitation has been reduced to some extent by the large amount of survey work that has been undertaken throughout the local area, as well as local knowledge of species occurrence.

2.6.2.2 Data Availability & Accuracy

The collated threatened flora and fauna species records provided by OEH Atlas of NSW Wildlife are known to vary in accuracy and reliability. This is usually due to the reliability of information provided to the NPWS for collation and/or the need to protect specific threatened species locations. During the review of threatened species records sourced from OEH Atlas of NSW Wildlife, consideration has been given to the date and accuracy of each threatened species record, in addition to an assessment of habitat suitability within the Study Area.

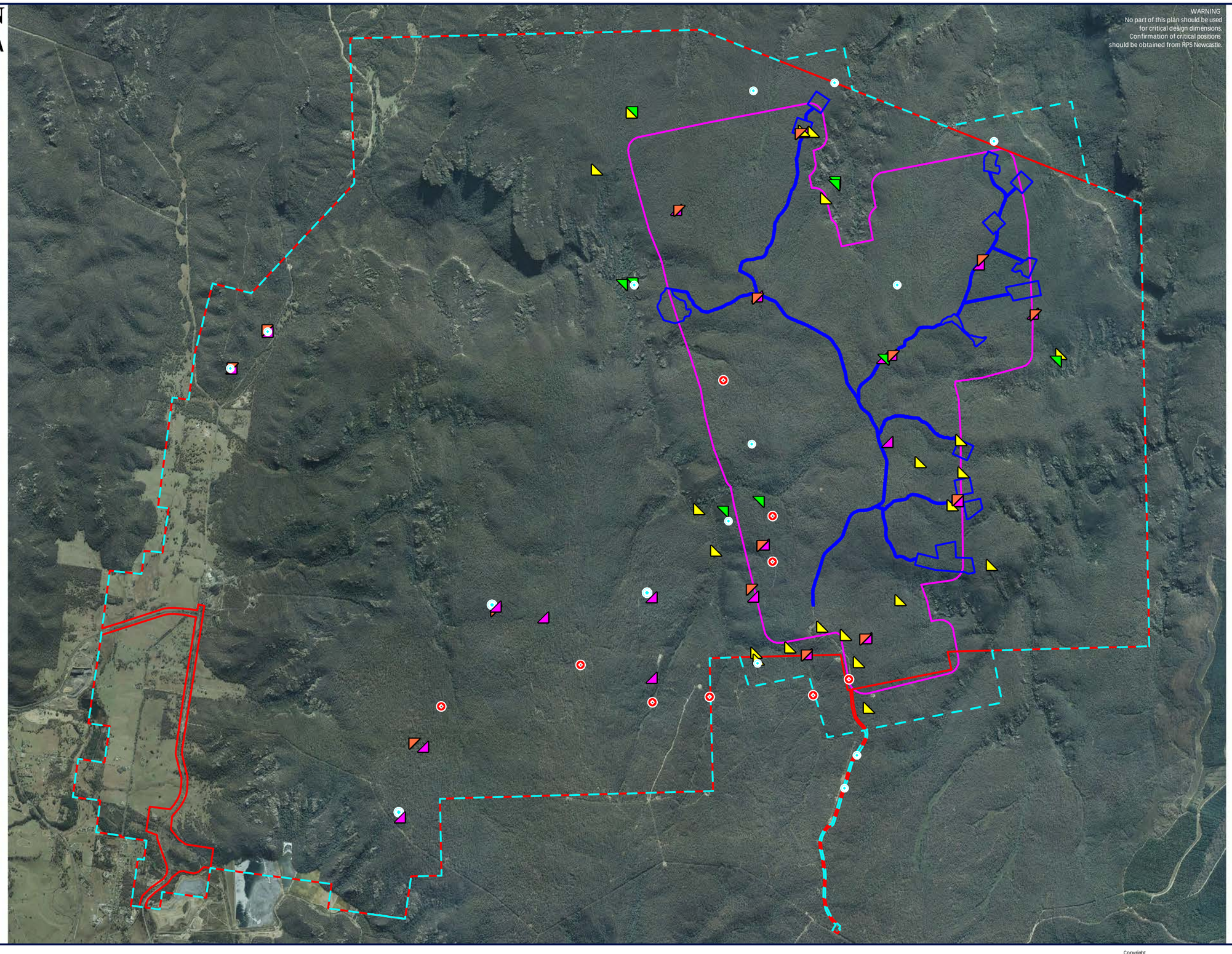
Similarly, EPBC Protected Matters Searches provide a list of threatened species and communities that have been recorded within 10 km of the Study Area, or which have suitable habitat within the wider area, and are subject to the same inherent inaccuracy issues as State derived databases.

In order to address these limitations in respect to data accuracy, threatened species records have been used to only provide a guide to the types of species that occur within the locality of the Study Area. Consequently, habitat assessment and the results of surveys conducted within the Study Area have been used to assess the likelihood of occurrence of threatened species, populations and ecological communities to occur.

Legend

- Project Application Area
- RPS Study Area
- 26.5 Degree Angle of Draw
- Environmental Study Area
- Herpetofauna Search
- Bird Census
- Anabat
- Harp Trap
- Owl Call Playback
- Fauna Monitoring Locations (MKES2004-2008 and BMS 2009-2012)

N



WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

0 1 2
kilometres

SCALE: 1:48,000 AT SIZE A3

TITLE: FIGURE 4: FAUNA SURVEY LOCATIONS

LOCATION: ANGUS PLACE EXTENSION AREA

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 20/01/2014
PURPOSE: REPORT

LAYOUT REF: J:\JOBS\Centennial\All Jobs\110328 Angus Place - Major Extension\10. Drafting\Mapinfo
VERSION (PLAN BY): JS (E A3)

CLIENT: CENTENNIAL
JOB REF: 110328

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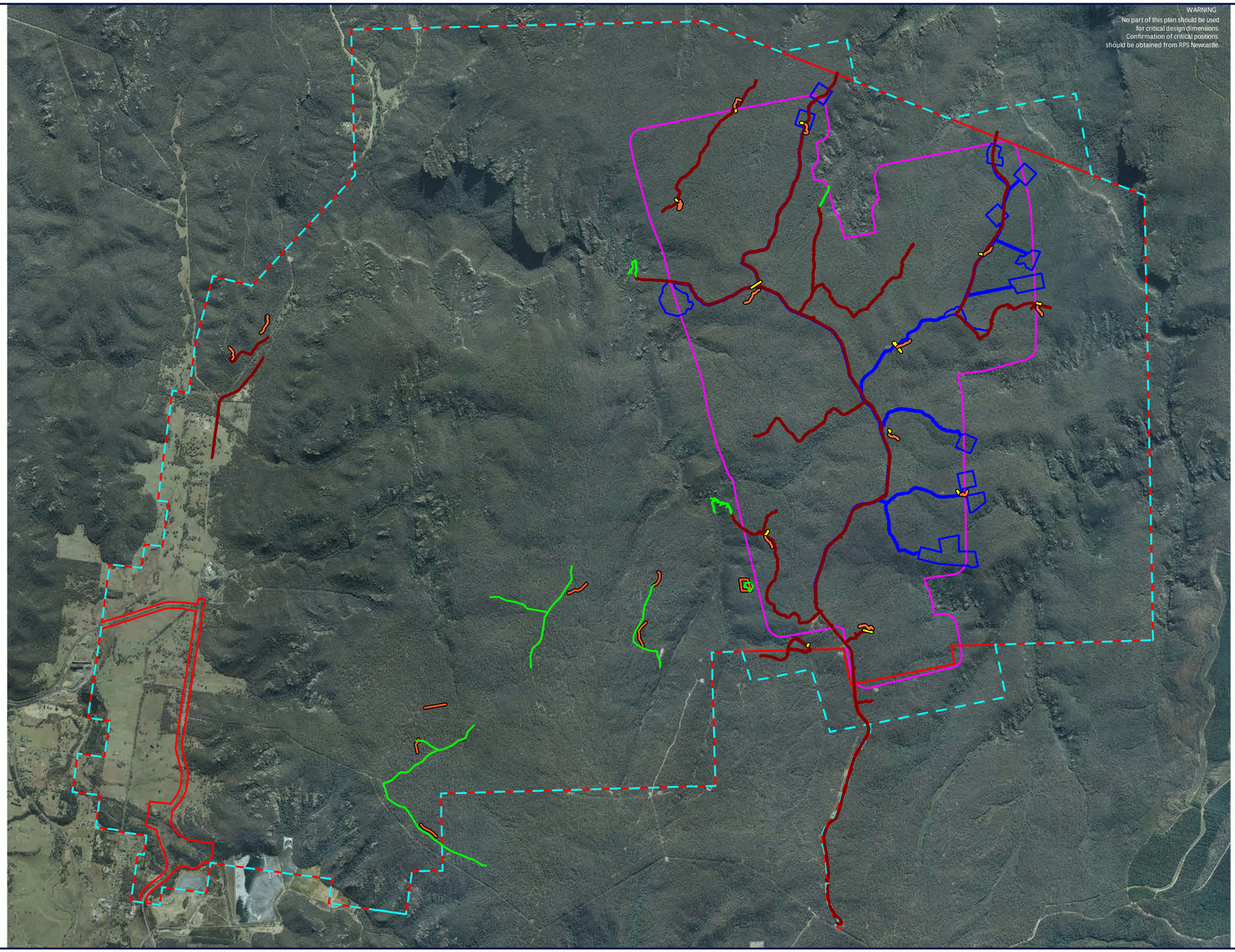
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

Legend

- Project Application Area
- RPS Study Area
- Environmental Study Area
- 26.5 Degree Angle of Draw
- Elliot Trap Line
- Hair Tube Line
- Spotlighting (Vehicle)
- Spotlighting (Foot)

N



WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

0 1 2
kilometres

SCALE: 1:48,000 AT SIZE A3

TITLE: FIGURE 5: FAUNA TRAPPING AND SPOTLIGHTING LOCATIONS

LOCATION: ANGUS PLACE EXTENSION AREA

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 20/01/2014
PURPOSE: REPORT

LAYOUT REF: J:\JOBS\Centennial\All Jobs\110328 Angus Place - Major Extension\10. Drafting\Mapinfo
VERSION (PLAN BY): JS (E A3)

CLIENT: CENTENNIAL
JOB REF: 110328

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3.0 Results

3.1 Desktop Assessment

3.1.1 Literature Review

A review of fauna monitoring reports conducted within the Study Area has been undertaken. Monitoring reports undertaken for the neighbouring Springvale and Clarence mines have also been reviewed. **Table 4** provides a list of any threatened species recorded, including the location and monitoring report from which it has been derived.

Table 4 Threatened Species Recorded by Previous Ecological Surveys.

Species	TSC Act	EPBC Act	Location and Source		
			Angus Place	Springvale	Clarence
Amphibians					
Heleioporus australiacus Giant Burrowing Frog	V	V	BMS (2011b)	-	-
Mixophyes balbus Stuttering Frog	E	V	-	MKES (2004b)	-
Reptiles					
Eulamprus leuraensis Blue Mountains Water Skink	E	E	-	BMS (2011d)	BMS (2009d)
Birds					
Callocephalon fimbriatum Gang-gang Cockatoo	V	-	MKES (2004a, 2006a, 2007, 2008c) and BMS (2009c, 2010c, 2011b, 2012b, 2012c, 2012d, 2012e)	MKES (2004b, 2006b, 2006c, 2008a) and BMS (2009a, 2010a, 2011a, 2011c, 2011d, 2012a, 2012f, 2012g, 2012h)	MKES (2008b) and BMS (2009b, 2009d, 2010b)
Calyptorhynchus lathami Glossy Black-Cockatoo	V	-	MKES (2006a, 2007) and BMS (2009c)	MKES (2008a)	BMS (2009d)
Climacteris picumnus victoriae Brown Treecreeper (eastern subsp.)	V	-	MKES (2004a, 2006a, 2008c and BMS (2009c, 2010c, 2011b)	MKES (2004b, 2006c, 2008a) and BMS (2009a, 2010a, 2011a, 2012f, 2012g, 2012h)	MKES (2008b) and BMS (2009b, 2009d)
Daphoenositta chrysoptera Varied Sittella	V	-	MKES (2008c) and BMS (2009c, 2012d)	BMS (2009a, 2011a, 2011c, 2011d, 2012a, 2012g)	BMS (2009d)
Hieraaetus morphnoides Little Eagle	V	-	MKES (2006a, 2007) and BMS (2011b)	-	-
Melanodryas cucullata cucullata Hooded Robin (south-eastern form)	V	-	MKES (2004a, 2006a)	MKES (2006c, 2008a)	BMS (2010b)

Species	TSC Act	EPBC Act	Location and Source		
			Angus Place	Springvale	Clarence
Melithreptus gularis gularis Black-chinned Honeyeater (eastern subsp.)	V	-	MKES (2004a)	MKES (2004b)	-
Ninox strenua Powerful Owl	V	-	MKES (2006a, 2007, 2008c) and BMS (2009c, 2010c, 2011b, 2012c)	MKES (2004b, 2006b, 2006c) and BMS (2011a, 2012a)	MKES (2008b) and BMS (2009d, 2010d)
Ninox connivens Barking Owl	V	-	MKES (2006a)	-	-
Petroica boodang Scarlet Robin	V	-	MKES (2006a, 2007, 2008c) and BMS (2009c, 2010c, 2011b, 2012b, 2012c, 2012d, 2012e) MKES (2004a, 2006a, 2007, 2008c0 and BMS (2010c, 2011b, 2012c, 2012d)	MKES (2004b, 2006c, 2008a) and BMS (2009a, 2010a, 2011a, 2011c, 2011d, 2012a, 2012f, 2012g, 2012h)	MKES (2008b0 and BMS (2009b, 2010b, 2010d)
Petroica phoenicea Flame Robin	V	-	-	MKES (2006b, 2006c, 2008a) and BMS (2010a, 2011a, 2011c, 2011d, 2012a, 2012f, 2012g, 2012h)	MKES (2008b) and BMS (2010d)
Pomatostomus temporalis Grey-crowned Babbler	V	-	-	MKES (2006c)	-
Pyrrholaemus sagittatus Speckled Warbler	V	-	MKES (2006a) and BMS (2009c)	-	-
Tyto novaeholladiae Masked Owl	V	-	-	-	BMS (2009d)
Tyto tenebricosa Sooty Owl	V	-	BMS (2010c)	BMS (2011a)	-
Mammals					
Cercartetus nanus Eastern Pygmy Possum	V	-	-	MKES (2004b, 2006c) and BMS (2010a, 2011c, 2011d, 2012g, 2012h)	-
Chalinolobus dwyeri Large-eared Pied Bat	V	V	MKES (2007) and BMS (2010c, 2011b, 2012d)	BMS (2010a, 2011a)	MKES (2008b)
Chalinolobus picatus Little Pied Bat	V	-	-	-	BMS (2009d)
Falsistrellus tasmaniensis Eastern False Pipistrelle	V	-	-	MKES (2006b, 2006c, 2008a) and BMS (2009a, 2010a, 2011a, 2012a,	MKES (2008b) and BMS (2009b, 2010d)

Species	TSC Act	EPBC Act	Location and Source		
			Angus Place	Springvale	Clarence
				2012h)	
Miniopterus schreiberii oceanensis Eastern Bentwing-bat	V	-	MKES (2004a, 2007) and BMS (2009c, 2010c, 2011b, 2012d)	MKES (2004b, 2006c, 2008a) and BMS (2009a, 2010a, 2011a, 2012a, 2012h)	MKES (2008b) and BMS (2009b, 2009d, 2010b)
Mormopterus norfolkensis Eastern Freetail-bat	V	-	MKES (2007, 2008c)	-	-
Petaurus norfolcensis Squirrel Glider	V	-	MKES (2006a)	MKES (2004b, 2006c 2008a)	BMS (2010b)
Phascolarctos cinereus Koala	V	V	MKES (2008c)	BMS (2011c)	-
Scoteanax rueppellii Greater Broad-nosed Bat	V	-	BMS (2009c, 2010c)	BMS (2011a)	-

Key:
V Vulnerable Species E Endangered Species

3.1.2 Database Searches

The results of database searches using OEH Atlas of NSW Wildlife (accessed January 2014) and EPBC Protected Matters Search (accessed January 2014) indicated that 30 threatened flora species and 56 threatened fauna species have been previously recorded within 10 km of the Study Area. These species are listed in **Table 5** below.

Table 5 Occurring and potentially occurring Threatened Flora, Fauna and Ecological Communities within a 10 km radius of the Study Area.

Scientific Name	Common Name	TSC Act	EPBC Act	No. of Records
Flora				
Caesia parviflora var. minor	Small Pale Grass-lily	E	-	1
Lastreopsis hispida	Bristly Shield Fern	E	-	1
Pultenaea glabra	Smooth Bush-pea	V	V	-
Pultenaea sp. Genowlan Point (NSW 417813) NSW Herbarium	Genowlan Point Pultenaea	CE	CE	-
Acacia flocktoniae	Flockton Wattle	V	V	-
Prostanthera cryptandroides subsp. cryptandroides	Wollemi Mint-bush	V	V	1
Eucalyptus aggregata	Black Gum	V	-	14
Eucalyptus cannonii	Capertee Stringybark	V	-	65
Eucalyptus pulverulenta	Silver-leaved Gum	V	V	1
Eucalyptus robertsonii subsp. hemisphaerica	Robertson's Peppermint	V	V	-
Melaleuca biconvexa	Biconvex Paperbark	V	V	1
Cryptostylis hunteriana	Leafless Tongue-orchid	E	V	-
Genoplesium superbum	Superb Midge Orchid	E	-	2

Scientific Name	Common Name	TSC Act	EPBC Act	No. of Records
Prasophyllum sp. Wybong (C.Phelps ORG 5269)	a leek-orchid	-	CE	-
Grevillea evansiana	-	V	V	2
Grevillea obtusiflora	Grey Grevillea	E	E	-
Persoonia acerosa	Needle Geebung	V	V	2
Persoonia hindii	-	E	-	71
Persoonia marginata	Clandulla Geebung	V	V	91
Asterolasia elegans	-	E	E	-
Boronia deanei	Deane's Boronia	V	V	40
Pomaderris brunnea	Rufous Pomaderris	V	V	-
Thesium australe	Austral Toadflax	V	V	1
Veronica blakelyi	-	V	-	114
Euphrasia arguta	-	CE	CE	-
Haloragis exalata subsp. exalata	Square Raspwort	V	V	-
Haloragodendron lucasii	-	E	E	-
Pelargonium sp. Striatellum (G.W.Carr 10345)	Omeo Stork's-bill	E	E	-
Philotheca ericifolia	-	-	V	-
Wollemia nobilis	Wollemi Pine	E	E	-
Insects				
Paralucia spinifera	Bathurst Copper Butterfly	E	V	63
Petalura gigantea	Giant Dragonfly	E	-	27
Amphibians				
Heleioporus australiacus	Giant Burrowing Frog	V	V	-
Mixophyes balbus	Stuttering Frog	E	V	1
Pseudophryne australis	Red-crowned Toadlet	V	-	4
Litoria booroolongensis	Booroolong Frog	E	E	-
Litoria littlejohni	Littlejohn's Tree Frog	V	V	1
Reptiles				
Aprasia parapulchella	Pink-tailed Worm-lizard	V	V	-
Eulamprus leuraensis	Blue Mountains Water skink	E	E	25
Varanus rosenbergi	Rosenberg's Goanna	V	-	3
Hoplocephalus bungaroides	Broad-headed Snake	E	V	4
Avifauna				
Botaurus poiciloptilus	Australasian Bittern	E	E	-
Hieraaetus morphnoides	Little Eagle	V	-	6
Lophoictinia isura	Square-tailed Kite	V	-	1
Rostratula australis	Australian Painted Snipe	E	V	-
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	180
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	16
Glossopsitta pusilla	Little Lorikeet	V	-	6
Lathamus discolor	Swift Parrot	E	E	-
Neophema pulchella	Turquoise Parrot	V	-	2
Ninox connivens	Barking Owl	V	-	6
Ninox strenua	Powerful Owl	V	-	44
Tyto novaehollandiae	Masked Owl	V	-	1

Scientific Name	Common Name	TSC Act	EPBC Act	No. of Records
Tyto tenebricosa	Sooty Owl	V	-	7
Climacteris picumnus victoriae	Brown Treecreeper (eastern subsp.)	V	-	87
Chthonicola sagittata	Speckled Warbler	V	-	11
Anthochaera phrygia	Regent Honeyeater	CE	E,M	2
Grantiella picta	Painted Honeyeater	V		1
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subsp.)	V	-	3
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subsp.)	V	-	2
Daphoenositta chrysoptera	Varied Sittella	V	-	32
Melanodryas cucullata cucullata	Hooded Robin (south-eastern subsp.)	V	-	9
Petroica boodang	Scarlet Robin	V	-	210
Petroica phoenicea	Flame Robin	V		197
Stagonopleura guttata	Diamond Firetail	V	-	6
Mammals				
Dasyurus maculatus maculatus	Spotted-tailed Quoll (SE mainland subsp.)	V	E	6
Isoodon obesulus obesulus	Southern Brown Bandicoot	E	E	-
Phascolarctos cinereus	Koala (Qld, NSW, Vic and ACT Populations)	V	V	16
Cercartetus nanus	Eastern Pygmy-possum	V	-	13
Petaurus australis	Yellow-bellied Glider	V	-	5
Petaurus norfolcensis	Squirrel Glider	V	-	11
Potorous tridactylus tridactylus	Long-nosed Potoroo (mainland subsp.)	V	V	-
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	1
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	-
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	-	-
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	2
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	28
Chalinolobus picatus	Little Pied Bat	V	-	-
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	38
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	21
Nyctophilus corbeni	South-eastern Long-eared Bat	V	V	-
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	6
Vespadelus troughtoni	Eastern Cave Bat	V	-	2
Pseudomys fumeus	Smoky Mouse		E	-
Pseudomys novaehollandiae	New Holland Mouse	-	V	1
Fish				
Maccullochella peelii	Murray Cod	-	V	-
Macquaria australasica	Macquarie Perch	-	E	-
Prototroctes maraena	Australian Grayling	-	V	-

Key:

V Vulnerable Species
E Endangered Species
CE Critically Endangered
M Migratory

Migratory species listed under the EPBC Act have also been considered under this assessment. A Protected Matters Search was undertaken (Accessed January 2014) on the DoE website that lists potential migratory species. **Table 6** lists the potentially occurring migratory species within a 10 km radius of the Study Area.

Table 6 Potentially Occurring Migratory Species within a 10 km radius of the Study Area.

Scientific Name	Common name	EPBC Act Status
Anthochaera phrygia	Regent Honeyeater	E,M
Apus pacificus	Fork-tailed Swift	M
Ardea alba	Great Egret	M
Ardea ibis	Cattle Egret	M
Haliaeetus leucogaster	White-bellied Sea-Eagle	M
Hirundapus caudacutus	White-throated Needletail	M
Gallinago hardwickii	Latham's Snipe	M
Merops ornatus	Rainbow Bee-eater	M
Monarcha melanopsis	Black-faced Monarch	M
Myiagra cyanoleuca	Satin Flycatcher	M
Rhipidura rufifrons	Rufous Fantail	M
Rostratula benghalensis	Painted Snipe	M

Key:
E Endangered Species
M Migratory

3.1.3 Potential Threatened Aquatic Species

A search of the Department of Primary Industries (DPI) web based threatened species search tool (http://pas.dpi.nsw.gov.au/Species/Species_byRegionResult.aspx?Region=Central+West) resulted in the return of five species as shown below:

- *Maccullochella macquariensis* Trout Cod Endangered
- *Notopala sublineata* River Snail Endangered
- *Bidyanus bidyanus* Silver Perch Vulnerable
- *Mogurnda adspersa* Purple Spotted Gudgeon Endangered
- *Ambassis agassizii* Olive Perchlet Endangered Population

The Protected Matters Search Tool indicated that three threatened fish species listed under the EPBC Act may occur or suitable habitat for them may occur within the Lithgow LGA. The species includes:

- *Maccullochella peelii* Murray Cod Vulnerable to Extinction
- *Prototroctes maraena* Australian Grayling Vulnerable to Extinction
- *Macquaria australasica* Macquarie Perch Endangered

None of the above eight fish species are likely to occur within the Study Area. This is due to some records being historical with the species no longer occurring in the region, other species records are from coastal rivers that are not part of a species' natural range and represent stocked fish (NSW DPI 2006). Additionally, no preferred habitat occurs on site, and cascades between the Newnes Plateau and Wolgan Valley would pose a formidable barrier to upstream passage of these species if they were present in the lower Hawkesbury-Nepean Catchment (Cardno 2014). Therefore, the presence of these above species is considered unlikely.

3.2 Flora Survey

3.2.1 Vegetation Community Mapping

Flora surveys, including groundtruthing of vegetation communities were undertaken within the Study Area. Those areas within the Study Area that were not sampled have been mapped using the *Vegetation of the Western Blue Mountains – including the Capertee, Coxs, Jenolan and Gurnang Areas* (DEC 2006). **Table 7** below lists the vegetation communities within Study Area. The locations of each vegetation community are provided in **Figure 6**.

Table 7 Vegetation Communities within the Study Area.

Map Unit (DEC 2006)	Project Application Area (ha)	Study Area (ha)
03 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest	91.17	91.17
04 Sheltered Gully Brown Barrel Ferny Forest	11.18	11.18
07 Newnes Plateau Narrow-leaved Peppermint - Mountain Gum - Brown Stringybark Layered Forest	1048.46	1053.35
08 Newnes Sheltered Peppermint - Brown Barrel Shrubby Forest	586.04	626.20
11 Tableland Gully Snow Gum - Ribbon Gum Montane Grassy Forest	59.91	60.88
14 Tableland Mountain Gum - Snow Gum - Daviesia Montane Open Forest	132.26	138.86
15 Tableland Hollows Black Gum - Black Sally Open Forest	57.58	58.45
19 Capertee Box - Narrow-leaf Ironbark - Callitris Grassy Woodland	1.90	1.90
20 Capertee Rough-barked Apple - Redgum - Yellow Box Grassy Woodlands	5.45	5.45
21 Capertee - Wolgan Slopes Red Box - Grey Gum - Stringybark Grassy Open Forest	317.20	317.20
26 Newnes Plateau Narrow-leaved Peppermint - Silvertop Ash Layered Open Forest	1950.58	1993.84
26a Newnes Plateau Gum Hollows varient: Brittle Gum - Mountain Gum, Scribbly Gum - Snow Gum Shrubby Open Forest	303.60	349.39
28 Sandstone Plateau and Ridge Scribbly Gum - Silvertop Ash Shrubby Woodland	1323.77	1387.62
29 Sandstone Slopes Sydney Peppermint Shrubby Forest	664.65	681.08
30 Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	1663.62	1709.77
32 Tableland Hills Scribbly Gum - Narrow-leaved Stringybark Shrubby Open Forest	64.30	64.30
33 Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Open Forest	7.87	7.87
35 Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest	93.98	94.19
37 Coxs Permian Red Stringybark - Brittle Gum Woodland	348.34	351.56
43 Pagoda Rock Sparse Shrubland	510.94	516.53
44 Sandstone Plateau Tea Tree - Dwark Sheoak - Banksia Rocky Heath	394.46	399.97
45 Newnes Plateau Tea Tree - Banksia - Mallee Heath	18.08	18.08
46 Newnes Plateau Dwarf Sheoak - Banksia Heath	10.68	10.68
49 Rock Outcrop	2.92	2.92
50 Newnes Plateau Shrub Swamp	61.70	63.71
51 Newnes Plateau Hanging Swamp	39.59	49.75
53 Mountain Hollow Grassy Fen	20.45	20.45
54 Capertee - Wolgan Riparian Rough-barked Apple - River Oak Open Forest	7.01	7.01
59 Non Native Vegetation Plantation	13.34	13.34
60 Non-native Vegetation - Other exotics (willow etc)	0.24	0.24
61 Unclassified (<1ha patch of remnant vegetation adjacent / within cleared lands)	13.46	14.65
62 Cleared and Severely Disturbed Lands	638.77	701.00
Total	**10463.21**	**10822.58**

3.2.2 Vegetation Community Profiles

The following section provides a brief outline of the dominant floral characteristics of each vegetation community identified within the Study Area. A number of vegetation communities that have been mapped by DEC (2006) were not sampled due to difficult terrain or the vegetation occurring well outside of any proposed activities associated with the Project. On occasion, vegetation communities that were sampled were identified as different communities to that mapped by DEC (2006). Those vegetation communities that were not sampled include:

- 03 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest;
- 04 Sheltered Gully Brown Barrel Ferny Forest;
- 11 Tableland Gully Snow Gum - Ribbon Gum Montane Grassy Forest;
- 15 Tableland Hollows Black Gum - Black Sally Open Forest;
- 19 Capertee Box - Narrow-leaf Ironbark - Callitris Grassy Woodland;
- 20 Capertee Rough-barked Apple - Redgum - Yellow Box Grassy Woodlands;
- 21 Capertee - Wolgan Slopes Red Box - Grey Gum - Stringybark Grassy Open Forest;
- 32 Tableland Hills Scribbly Gum - Narrow-leaved Stringybark Shrubby Open Forest;
- 33 Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Open Forest;
- 35 Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest;
- 37 Cox's Permian Red Stringybark - Brittle Gum Woodland;
- 49 Rock Outcrop;
- 53 Mountain Hollow Grassy Fen;
- 54 Capertee - Wolgan Riparian Rough-barked Apple - River Oak Open Forest;
- MU 60 Non-native Vegetation - Other exotics; and
- MU 61 Unclassified (<1 ha patch of remnant vegetation adjacent / within cleared lands).

A full list of flora species recorded during surveys is provided in **Appendix 4**.

1. MU 7 – Newnes Plateau Narrow-leaved Peppermint – Mountain Gum – Brown Stringybark Layered Forest

Plate 1 Newnes Plateau Narrow-leaved Peppermint – Mountain Gum – Brown Stringybark Layered Forest.

Description: This tall forest community is found on high-altitude parts of the Newnes Plateau with relatively fertile soils. It was scattered across the central and southern parts of the Study Area.

Canopy Layer: 22 – 36 m tall with 30 - 60% Percentage Foliage Cover (PFC). Dominant species included: *Eucalyptus radiata* (Narrow-leaved Peppermint), *Eucalyptus blaxlandii* (Blaxland's Stringybark) and *Eucalyptus sieberi* (Silvertop Ash).

Shrub Layer: 1 – 2 m tall with approximately 60% PFC. Dominant shrub species included: *Leucopogon lanceolata* (Lance-leaf Beard-heath), *Monotoca scoparia*, *Hakea dactyloides* (Broad-leaved Hakea), *Banksia spinulosa* var. *spinulosa* (Hairpin Banksia), *Leucopogon fletcheri* subsp. *brevisepalus*, and *Lomatia silaifolia* (Crinkle Bush).

Ground Layer: 0 - 1 m tall with 15 - 45% PFC. Dominant species included: *Rytidosperma pallidum* (Silvertop Wallaby Grass), *Dianella revoluta* var. *revoluta* (Blue Flax-lily), *Lomandra longifolia* (Spiny-headed Mat-rush) *Patersonia longifolia* (Dwarf Purple Flag) and *Pteridium esculentum* (Bracken).

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

2. MU 8 – Newnes Sheltered Peppermint - Brown Barrel Shrubby Forest

Plate 2 Newnes Sheltered Peppermint - Brown Barrel Shrubby Forest.

Description: This community consists of tall forest occurring on protected slopes and along drainage lines within gullies around the north-eastern edges of the Study Area.

Canopy Layer: 20 – 40 m tall with 20 – 50% PFC. The dominant tree species was *Eucalyptus fastigata* (Brown Barrel), other common species included *Eucalyptus dalrympleana* (Mountain Gum) and *Eucalyptus piperita* (Sydney Peppermint).

Shrub Layer: 1 – 5 m tall with 75% PFC. The shrub layer consisted of various shrub species, the three most abundant within the Study Area being *Olearia phlogopappa* (Dusty Daisy Bush), *Banksia spinulosa* var. *spinulosa* (Hairpin Banksia) and *Leptospermum polygalifolium* subsp. *polygalifolium* (Tantoon).

Ground Layer: 0 – 1 m tall with 10 – 40% PFC. *Pteridium esculentum* (Bracken) was the most common groundlayer plant and other dominant species included *Blechnum cartilagineum* (Gristle Fern), *Viola hederacea* (Native Violet), *Todea barbara* (King Fern), and *Lomandra longifolia* (Mat-rush).

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

3. MU 14 – Tableland Mountain Gum – Snow Gum – Daviesia Montane Open Forest

Plate 3 Tableland Mountain Gum – Snow Gum – Davesia Montane Open Forest.

Description: This low forest community was found on exposed slopes and ridges in depressions and low-gradient slopes at high-altitude. Localised small pockets were scattered across the area and it was mapped in the southern part of the Study Area.

Canopy layer: 10 – 24 m tall with 30 – 55% PFC. *Eucalyptus pauciflora* (Snow Gum) and *Eucalyptus mannifera* (Brittle Gum) were the most common tree species within this community at sites within the Study Area.

Shrub Layer: 0.5 – 4.0 m tall with 10 – 60% PFC. Dominant species included: *Banksia spinulosa* var. *spinulosa* (Hairpin Banksia), *Boronia pinnata* (Pinnate Boronia), *Leptospermum macrocarpum, Monotoca scoparia* and *Leptospermum myrtifolium* (a Tea-tree).

Ground layer: 0.1 – 0.5 m tall with 20 – 80% PFC. *Grevillea laurifolia* (Laurel-leaf Grevillea) was usually the most common ground layer species recorded in this community within the Study Area, but other dominant species included *Lomandra glauca* (Pale Mat-rush), *Austrostipa pubescens* (Speargrass), *Poa sieberiana* (Tussock Grass) and *Dampiera stricta* (Blue Dampiera).

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

4. MU 26 – Newnes Plateau Narrow-leaved Peppermint – Silvertop Ash Layered Open Forest

Plate 4 Newnes Plateau Narrow-leaved Peppermint – Silvertop Ash Layered Open Forest.

Description: This community was found in localised pockets scattered across the south of the Study Area. It occurred in depressions and low-gradient slopes at high-altitude sites.

Canopy Layer: 15 – 30 m with 10 – 60% PFC. Dominant species included: *Eucalyptus dives* (Broad-leaved Peppermint), *Eucalyptus blaxlandii* (Blaxland's Stringybark), *Eucalyptus sieberi* (Silver-top Ash), *Eucalyptus rubida* (Candlebark), *Eucalyptus oreades* (Mountain Ash) and *Eucalyptus piperita* (Sydney Peppermint).

Shrub Layer: 1.5 – 4.0 m tall with 3 – 70% PFC. Dominant shrub species included: *Daviesia latifolia* (Hop Bitter-pea), *Hakea dactyloides* (Broad-leaved Hakea), *Acacia obtusifolia* (Blunt-leaved Wattle), *Phebalium squamulosum* subsp. *squamulosum* (Forest Phebalium) and *Monotoca scoparia*.

Ground Layer: 0 – 1 m tall with 10 – 70% PFC. Dominant species included: *Pteridium esculentum* (Bracken), *Dianella revoluta* var. *revoluta* (Blueberry Lily), *Lomandra glauca* (Pale Mat-rush), *Lomandra longifolia* (Spiky-headed Mat-rush), *Poa sieberiana* (Snowgrass) and *Patersonia sericea* (Silky Purple-flag).

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

5. MU 26a – (Variant of MU26) Newnes Plateau Narrow-leaved Peppermint - Silvertop Ash Layered Open Forest in Gentle Depressions

Plate 5 Newnes Plateau Narrow-leaved Peppermint - Silvertop Ash Layered Open Forest.

Description:	This community occurs in slight depression and hollows. It is a variation of MU26 (described above) that differs in being shorter and characterised by an abundance of *Eucalyptus mannifera*. This community occurred in gentle depressions while MU26 was found on the plateau-top.
Canopy Layer:	10 – 18 m with 10 – 60% PFC. Dominant species included: *Eucalyptus mannifera* (Brittle Gum), *Eucalyptus dives* (Broad-leaved Peppermint), *Eucalyptus radiata* (Narrow-leaved Peppermint), and *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum).
Shrub Layer:	1.5 – 4.0 m tall with 3 – 70% PFC. Dominant shrub species were similar to those in MU26 and included: *Hakea dactyloides* (Broad-leaved Hakea), *Phyllota squarrosa* (Dense Phyllota), *Leptospermum polygalifolium* subsp. *polygalifolium* (Tantoon), *Hakea laevipes* and *Banksia spinulosa* var. *spinulosa* (Hairpin Banksia).
Ground Layer:	0 – 1 m tall with 10 – 70% PFC. The most common species was *Poa sieberiana* (Snowgrass), with *Lepyrodia scariosa* (Scale Rush), *Rytidosperma pallidum* (Silvertop Wallaby Grass), *Rytidosperma tenuius* (Wallaby Grass), and *Lomandra glauca* (Pale Mat-rush).
Classification:	This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

6. MU 28 – Sandstone Plateau and Ridge Scribbly Gum – Silvertop Ash Shrubby Woodland

Plate 6 Sandstone Plateau and Ridge Scribbly Gum – Silvertop Ash Shrubby Woodland.

Description: This community of shrubby woodland was widely distributed across the area and mapped in various parts of the Study Area. It was typically an open woodland, characterised by a diverse and quite dense shrub layer. This community occurred on shallow sandy soils, usually at altitudes greater than 1000 m.

Canopy Layer: 7 – 20 m with 25 – 30% PFC. *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum) was the most abundant species within this community. Other species included *Eucalyptus sieberi* (Silver-top Ash), *Eucalyptus dives* (Broad-leaved Peppermint) and *Eucalyptus sparsifolia* (Narrow-leaved Stringybark).

Shrub Layer: 0.5 – 5.0 m with around 70% PFC. This layer included diverse species such as: *Leptospermum polyanthum, Hakea dactyloides* (Broad-leaved Hakea), *Acacia terminalis* (Sunshine Wattle), *Leptospermum trinervium* (Slender Tea-tree), *Acacia dorothea* (Dorothy's Wattle), *Lomatia silaifolia* (Crinkle Bush) and *Isopogon anemonifolius* (Flat-leaved Drumsticks).

Ground Layer: To 1 m tall with 30 – 65% PFC. *Lomandra glauca* (Pale Mat-rush), *Dianella revoluta* var. *revoluta* (Blueberry Lily), *Austrostipa pubescens* (Tall Speargrass), *Caustis flexuosa* (Curly Wig), *Patersonia sericea* (Wild Iris), *Boronia microphylla*, *Lepidosperma laterale* (Variable Sword-sedge), *Platysace linearifolia* (Narrow-leaved Platysace) and *Hibbertia serpyllifolia*.

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

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7. MU 29 – Sandstone Slopes Sydney Peppermint Shrubby Forest

Plate 7 Sandstone Slopes Sydney Peppermint Shrubby Forest.

Description: This forest community was quite common throughout the area and was mapped as occurring in some smaller patches across the western side of the Study Area. It usually occurred near ridge crests and on gentle slopes in semi-sheltered situations.

Canopy Layer: 15 – 35 m tall with 35 – 70% PFC. Dominant species included: *Eucalyptus. piperita* (Sydney Peppermint), *Eucalyptus sparsifolia* (Narrow-leaved Stringybark) and occasional *Eucalyptus sieberi* (Silvertop Ash).

Shrub Layer: 2 – 10 m with 5 – 25% PFC. Dominant shrub species included: *Banksia spinulosa* var. *spinulosa* (Hairpin Banksia), *Daviesia latifolia*, *Lomatia silaifolia* (Crinkle Bush), *Acacia terminalis* (Sunshine Wattle), and *Monotoca scoparia* .

Ground Layer: 0 – 1.0 m – 5 to 40% PFC. Species included: *Rytidosperma pallidum* (Silvertop Wallaby Grass), *Lomandra glauca* (Pale Mat-rush and *Dianella revoluta* var*. revoluta* (Spreading Flax-lily).

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

8. MU 30 – Exposed Blue Mountains Sydney Peppermint – Silver-top Ash Shrubby Woodland

Plate 8 Exposed Blue Mountains Sydney Peppermint – Silver-top Ash Shrubby Woodland.

Description: This woodland community occurred in large patches on the broad sandstone ridges across the Study Area.

Canopy Layer: 11 – 28 m tall with 2 – 50% PFC. Dominant species included: *Eucalyptus sieberi* (Silvertop Ash), *Eucalyptus piperita* (Sydney Peppermint) and *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum).

Shrub Layer: 0.5 – 4 m tall with 50% PFC. Dominant shrub species included: *Acacia terminalis* (Sunshine Wattle), *Hakea dactyloides* (Broad-leaved Geebung), *Leptospermum trinervium* (Flaky-barked Tea-tree), *Monotoca scoparia* and *Platysace linearifolia*.

Ground Layer: Approximately 0.5 m tall with 5 – 25% PFC. *Lomandra glauca* (Pale Mat-rush), *Caustis flexuosa* (Curly Wig), *Amperea xiphoclada, Dampiera stricta* (Blue Dampiera) and *Patersonia glabrata* (Leafy Purple-flag).

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

9. MU 43 – Pagoda Rock Sparse Shrubland

Plate 9 Pagoda Rock Sparse Shrubland.

Description: This heathy shrub community was found on shallow or skeletal sandy soils on sandstone amongst 'pagodas' in numerous small patches across the Study Area. The structure of this community was variable, with a canopy layer that was generally sparse.

Canopy Layer: 6 – 20 m tall with 8 – 65% PFC. Occasional *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum) with large areas having no canopy trees.

Shrub Layer: 3 – 5 m tall with 10% PFC. Dominant shrub species included: *Leucopogon muticus* (Blunt Beard-heath)*, Isopogon anemonifolius* (Flat-leaved Drumsticks), *Leptospermum arachnoides, Dillwynia phylicoides*, *Hibbertia empetrifolia*, *Leptospermum trinervium* (Slender Tea-tree) and *Hakea dactyloides* (Broad-leaf Geebung).

Ground Layer: 0 – 0.5 m – 10 to 15% PFC. *Dianella revoluta* var. *revoluta* (Spreading Flax-lily), *Amperea xiphoclada*, *Lomandra glauca* (Pale Mat-rush), *Rytidosperma tenuius* (Wallaby Grass), *Lomandra confertifolia* subsp. *pallida*, *Lepidosperma filiforme* and *Lepidosperma laterale* (Variable Sword-sedge).

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

10. MU 44 – Sandstone Plateaux Tea Tree - Dwarf Sheoak - Banksia Rocky Heath

Plate 10 Sandstone Plateaux Tea Tree - Dwarf Sheoak - Banksia Rocky Heath.

Description: Pockets of this heath community were found in the western portion of the Study Area. The plants of this community were rooted within a very thin layer of soil that occurred in small patches on relatively flat areas amongst exposed sandstone, usually near cliffs.

Canopy Layer: Average of 7 m (but occasionally to 20 m) tall with 15 – 50% PFC. *Banksia ericifolia* subsp. *ericifolia* (Heath-leaved Banksia) and *Eucalyptus piperita* (Sydney Peppermint).

Shrub Layer: 2 – 4 m tall with about 10% PFC. Dominant species included: *Allocasuarina nana* (Dwarf She-oak), *Leptospermum arachnoides*, *Hakea dactyloides* (Broad-leaved Geebung), *Leptospermum trinervium* (Slender Tea-tree) and *Isopogon anemonifolius* (Flat-leaved Drumsticks).

Ground Layer: 0.1 – 1.0 m with 5 – 45% PFC. *Epacris microphylla* (Coral Heath), *Gonocarpus teucroides* (Raspwort), *Lomandra glauca* (Pale Mat-rush), *Lepidosperma laterale* (Variable Sword-sedge) and *Stylidium lineare* (Narrow-leaved Trigger Plant).

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

11. MU 45 Newnes Plateau Tea Tree- Banksia- Mallee Heath

Plate 11 Newnes Plateau Tea Tree- Banksia- Mallee Heath.

Description: Within the Newnes Plateau, this vegetation community occurs on shallow soils on exposed crests. It occurs as a tall mallee-heath-woodland community. The heathy layer is dominated by Leptospermum and Proteaceae (Banksias, Isopogon and Hakeas).

Canopy Layer: Height to 5 m and an average PFC of 1%. Dominated by Eucalypt species including: *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum), *Eucalyptus mannifera* (Brittle Gum) and *Eucalyptus pauciflora* (Snow Gum); with patches of mallees such as *Eucalyptus stricta* (Blue Mountains Mallee) and *Eucalyptus multicaulis* (Whipstick Ash).

Shrub layer: 0.5 – 1.0 m tall with 40% PFC. Dominant species include: *Banksia spinulosa* var. *spinulosa* (Hairpin Banksia), *Boronia microphylla* (Small-leaved Boronia), *Leptospermum trinervium* (Flaky-barked Tea-tree) and *Isopogon anemonifolius* (Flat-leaved Drumsticks).

Ground covers: To 0.5 m tall with 30 – 50% PFC. Species include: *Dampiera stricta* (Blue Dampiera), *Platysace linearifolia*, *Epacris microphylla* (Coral Heath) and *Lepyrodia scariosa* (Scale Rush).

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

11. MU 46 – Newnes Plateau Dwarf Sheoak - Banksia Heath

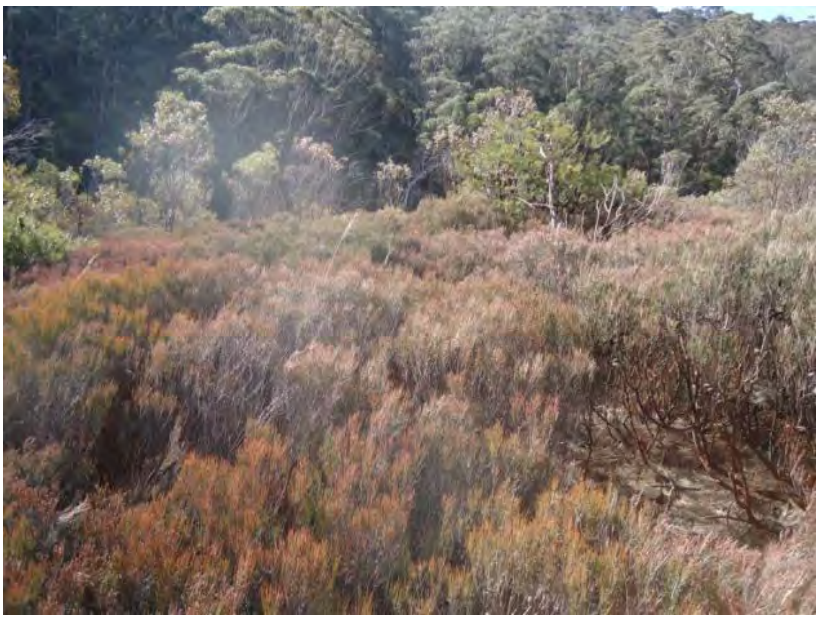

Plate 12 Newnes Plateau Dwarf Sheoak - Banksia Heath.

Description: A small patch occurs in the central western half of the Study Area. This community consists of a dense, low heath located on often skeletal Narrabeen sediments and soils on rock shelves.

Canopy Layer: Low and stunted to 5 m tall with 0 to 2% PFC. *Eucalyptus mannifera* (Brittle Gum), *Banksia ericifolia* (Heath-leaved Banksia) and *Leptospermum trinervium* (Slender Tea-tree).

Shrub layer: 1 – 1.5 m high with 80 to 95% PFC. The shrub layer is highly diverse, but dominant species include: *Allocasuarina nana* (Dwarf She-oak), *Hakea dactyloides* (Broad-leaved Geebung), *Darwinia fascicularis* subsp. *fascicularis*, *Leptospermum trinervium* (Slender Tea-tree), *Leptospermum arachnoides* and *Acacia gunnii* (Ploughshare Wattle).

Ground covers: 0.2 – 1.0 m tall with 10% PFC. Common species were: *Lepidosperma viscidum*, *Hibbertia serpyllifolia* (Hairy Guinea Flower), *Dampiera stricta* (Blue Dampiera), *Entolasia stricta* (Wiry Panic) and several *Schoenus* species.

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

12. MU 50 – Newnes Plateau Shrub Swamp

Plate 13 Newnes Plateau Shrub Swamp.

Description: This vegetation community occurs along long gentle open drainage lines within the Study Area. It forms a dense wet heath with an unevenly textured tussock / hummock grassy sedge understorey. The substrate is typically a deep layer of damp to very wet organic matter and peat moss upon a layer of alluvial sand. Trees are typically absent, although sparsely scattered Eucalypts can occur in the margins.

Canopy Layer: 5 – 8 m tall with 0 to 10% PFC. Generally absent in the core of the community, only sparsely present within the margins. Typical species are dependent upon adjoining vegetation communities.

Shrub Layer: 0.5 – 2.5 m tall with 45 to 70% PFC. Dominant shrub species included: *Leptospermum continentale* (Prickly Tea-tree). *Leptospermum grandifolium* (Woolly Tea-tree), *Grevillea acanthifolia* subsp. *acanthifolia* (Bog Grevillea), *Banksia marginata* (Silver Banksia), *Pultenaea divaricata* and *Baeckea linifolia* (Weeping Baeckea).

Ground Layer: To 0.8 m tall with 10 – 60% PFC. Dominant species included: *Gleichenia dicarpa* (Pouched Coral Fern), *Empodisma minus*, *Gahnia sieberiana* (Red-fruited Saw Sedge), *Blechnum cartilagineum* (Gristle Fern), *Epacris paludosa* (Swamp Epacris), *Baloskion australe* and *Carex inversa* (Knob Sedge).

Classification: This community corresponds to *Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion* as listed in the TSC Act. This vegetation community is also a component of the federally listed (EPBC Act) EEC known as *Temperate Highland Peat Swamps on Sandstone*.

13. MU 51 – Newnes Plateau Hanging Swamp

Plate 14 Newnes Plateau Hanging Swamp.

Description: This vegetation community occurs in gully heads and ridge-top sites where groundwater seepage travelling through permeable rock layers is directed laterally by impermeable layers forming springs or semi permanent wet areas on the surface of higher slopes. These form wet peaty soils in which a range of swamp heath flora species grow.

Canopy Layer: 1 – 3 m tall with 10 – 15% PFC. Generally absent in the core of the community, only sparsely present within the margins. Variable species are sometimes present with species depending on the adjacent vegetation community.

Shrub Layer: 1.0 – 1.5 m tall with approximately 5% PFC. Dominant shrub species included: *Leptospermum continentale* (Prickly Tea-tree), *Leptospermum lanigerum* (Woolly Tea-tree), *Grevillea acanthifolia* subsp. *acanthifolia* (Bog Grevillea), *Epacris breviflora, Banksia marginata* (Silver Banksia) and *Baeckea linifolia* (Weeping Baeckea).

Ground Layer: 0.2 – 1 m tall with variable 40 to 70% PFC. Dominant species include: *Gleichenia dicarpa* (Pouched Coral Fern), *Lepidosperma limicola*, *Empodisma minus, Drosera spathulata* (Common Sundew) and *Gahnia sieberiana* (Red-fruited Saw-sedge).

Classification: This community is a component of and corresponds to the federally listed (EPBC Act) EEC known as *Temperate Highland Peat Swamps on Sandstone.*

14. MU 59 – Non Native Vegetation Plantation

Description: Includes large areas of *Pinus radiata* (Radiata Pine) plantations in State Forest. This forest type consists of a non-native canopy (*P. radiata*) with a sparse understorey.

15. MU 62 - Cleared and Severely Disturbed Lands

Description: This vegetation community occurs along power-line easements, tracks and occasional areas cleared for boreholes. The canopy layer has been removed along with all or most of the shrub layer. These areas contain mostly remnant native vegetation, however, they are sometimes more affected by weed invasion due to previous or repeated disturbance.

Canopy Layer: Generally absent, but occasionally regrowth 3 – 5 m tall with 0 to 10% PFC. Typical species include whichever species are naturally occurring adjacent to the cleared area.

Shrub Layer: Highly variable 0.5 – 2 m in height with 5 to 60% PFC. Species include those species growing in native vegetation in proximity. In addition some exotic species such as Lantana may also be present.

Ground Layer: Highly variable 0 –1.5 m tall with 10 to 90% PFC. Dominant species include species similar to those found in adjacent native vegetation communities. There is also a high likelihood of increased exotic species due to the previous disturbance.

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

3.2.3 Significant Vegetation Communities

Five EECs were mapped within the Study Area. These EECs were:

- Temperate Highland Peat Swamps on Sandstone;
- Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion (Newnes Plateau Shrub Swamp);
- Montane Peatlands and Swamps of the Sydney Basin Bioregion (Montane Peatlands and Swamps);
- Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions (Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland); and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Temperate Highland Peat Swamps on Sandstone is listed as an EEC under the EPBC Act. Vegetation communities recorded within the Study Area that correspond to this EEC are MU 50 - Newnes Plateau Shrub Swamp; MU 51 - Newnes Plateau Hanging Swamp; and MU 52 - Newnes Plateau Rush – Sedge Snow Gum Hollow Wooded Heath as described and mapped within DEC (2006).

Newnes Plateau Shrub Swamp is listed as an EEC under the TSC Act. One vegetation community recorded within the Study Area correspond to this EEC, namely MU 50 - Newnes Plateau Shrub Swamp.

Montane Peatlands and Swamps is listed as an EEC under the TSC Act. MU 53 Mountain Hollow Grassy Fen is regarded by DEC (2006) as forming part of this EEC.

Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland is an EEC listed under the TSC Act. Vegetation communities recorded within the Study Area that correspond to this EEC are MU 11 - Tableland Gully Snow Gum - Ribbon Gum Montane Grassy Forest and MU 15 - Tableland Hollows Black Gum - Black Sally Open Forest.

MU19 Capertee Box - Narrow-leaf Ironbark - Callitris Grassy Woodland and MU 20 Capertee Rough-barked Apple - Redgum - Yellow Box Grassy Woodlands may potentially be commensurate with White box yellow box Blakely's red gum woodland (TSC Act) and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act).

The locations of these EECs are provided in **Figure 7**.

WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.
Note that this Vegetation Community Map depicts clearly defined boundaries between vegetation communities that are the product of individual interpretation and are not distinguished by clearly defined boundaries on the ground. Therefore, this map should only be treated as an indication of approximate peripheries between delineated vegetation communities. Caution should therefore be exercised when using this data for purposes requiring high levels of accuracy. Furthermore, no account for intergrading areas between delineated vegetation communities has been made.

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Legend

- Project Application Area
- Environmental Study Area
- RPS Study Area
- 26.5 Degree Angle of Draw

Vegetation Communities

- 3 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest
- 4 Sheltered Gully Brown Barrel Ferny Forest
- 7 Newnes Plateau Narrow - Leaved Peppermint - Mountain Gum - Brown Stringybark Layered Forest
- 8 Newnes Sheltered Peppermint - Brown Barrel Shrubby Forest
- 11 Tableland Gully Snow Gum - Ribbon Gum Montane Grassy Forest
- 14 Tableland Mountain Gum - Snow Gum - Daviesia Montane Open Forest
- 15 Tableland Hollows Black Gum - Black Sally Open Forest
- 19 Capertee Box - Narrow-leaf Ironbark - Callitris Grassy Woodland
- 20 Capertee Rough-barked Apple - Redgum - Yellow Box Grassy Woodlands
- 21 Capertee - Wolgan Slopes Red Box - Grey Gum - Stringybark Grassy Open Forest
- 26 Newnes Plateau Narrow-leaved Peppermint - Silver-top Ash Layered Open Forest
- 26a Newnes Plateau Gum Hollows varient: Brittle Gum - Mountain Gum, Scribbly Gum - Snow Gum Shrubby Open Forest
- 28 Sandstone Plateau and Ridge Scribbly Gum - Silvertop Ash Shrubby Woodland
- 29 Sandstone Slopes Sydney Peppermint Shrubby Forest
- 30 Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland
- 32 Tableland Hills Scribbly Gum - Narrow-leaved Stringybark Shrubby Open Forest
- 33 Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Open Forest
- 35 Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest
- 37 Coxs Permian Red Stringybark - Brittle Gum Woodland
- 43 Pagoda Rock Sparse Shrubland
- 44 Sandstone Plateaux Tea Tree - Dwarf Sheoak - Banksia Rocky Heath
- 45 Newnes Plateau Tea Tree - Banksia - Mallee Heath
- 46 Newnes Plateau Dwarf Sheoak - Banksia Heath
- 49 Rock Outcrop
- 50 Newnes Plateau Shrub Swamp
- 51 Newnes Plateau Hanging Swamp
- 53 Mountain Hollow Grassy Fen
- 54 Capertee - Wolgan Riparian Rough-barked Apple - River Oak Open Forest
- 59 Non-native Vegetation - Pine plantation / woodlot / shelter
- 60 Non-native Vegetation - Other exotics
- 61 Unclassified (<1ha patch of remnant vegetation adjacent / within cleared lands)
- 62 Cleared and Severely Disturbed Areas

0 1.5 3
kilometres

SCALE: 1:50,000 AT SIZE A3

TITLE: FIGURE 6: VEGETATION COMMUNITIES
LOCATION: ANGUS PLACE EXTENSION AREA
DATUM: GDA 94
PROJECTION: MGA ZONE 56
DATE: 20/01/2014
PURPOSE: REPORT
LAYOUT REF: J:\JOBS\Centennial\All Jobs\110328 Angus Place - Major Extension\10. Drafting\Mapinfo
VERSION (PLAN BY): JS-PH (F A3)

CLIENT: CENTENNIAL
JOB REF: 110328

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3.2.4 Potential Groundwater Dependent Ecosystems

In order to define Groundwater Dependent Ecosystems (GDEs), the following paragraphs have been extracted from Eamus (2009): *Identifying groundwater dependent ecosystems, A guide for land and water managers:*

> *"There are many types of GDEs, but they can all be classed into one of two types. The first class of GDE relies on the surface expression of groundwater. Swamps, wetlands and rivers are ecosystems that rely on the discharge of groundwater to the surface, either into a river or into a swamp or wetland. Rivers and streams that flow all year (perennially flowing) are generally groundwater dependent because a significant proportion of their daily flow is derived from groundwater discharging into the river course. When groundwater availability declines, river flow is reduced and swamps and wetlands may become dry, temporarily or permanently.*
>
> *The second class of GDEs rely on the availability of groundwater below the surface but within the rooting depth of the vegetation. These terrestrial ecosystems include riparian forests all across Australia, banksia woodlands of Western Australia, eucalypts on the floodplains of the Murray River and plantation forests in South Australia, Victoria and New South Wales. They all require a supply of groundwater within the root zone."*

To this end, the vegetation within the Study Area that is dependent on sub-surface flows (i.e. have rooting zones which overlap the sub-surface water interface such as floodplain vegetation) or are located such that surface flows originate from sub-surface flows (i.e. areas of impeded drainage such as swamps and wet heaths) are all classified as GDEs.

The vegetation types within the Study Area that clearly fall into this category are:

- MU 50 – Newnes Plateau Shrub Swamp;
- MU 51 – Newnes Plateau Hanging Swamp; and
- MU 53 – Mountain Hollow Grassy Fen.

All or parts of these vegetation communities are potentially GDEs and are shown in **Figure 7**. The potential impacts of the proposed Project on these GDEs have been assessed in **Section 6** of this report.

3.2.5 Significant Flora

Four threatened flora species were observed within the Study Area during flora surveys. These species were:

- *Persoonia hindii* (listed as Endangered under the TSC Act);
- *Veronica blakelyi* (listed as Vulnerable under the TSC Act).
- *Eucalyptus aggregata* (listed as Vulnerable under the TSC Act) and
- *Eucalyptus cannonii* (listed as Vulnerable under the TSC Act).

The locations of these threatened flora species are shown in **Figure 7**.

Persoonia hindii

Persoonia hindii is a yellow flowered, multi-stemmed suckering shrub 0.3 - 1.0 m high, with shoots rising from extensive rhizomes (underground stems). Due to the rhizomatous habit of *P. hindii*, there is inherit difficulty in recording individuals. Therefore, this Flora and Fauna Assessment does not attempt to estimate individuals, instead, the number of stems are recorded.

This species is concentrated within the south-east of the Study Area. RPS has undertaken numerous ecological surveys that have targeted and recorded this species. RPS has discovered a strong association between *P. hindii* and the vegetation communities of MU7 Newnes Plateau Narrow-leaved Peppermint - Mountain Gum - Brown Stringybark Layered Forest, MU26 Newnes Plateau Narrow-leaved Peppermint - Silver-top Ash Layered Open Forest and MU26a Newnes Plateau Gum Hollows variant: Brittle Gum - Mountain Gum, Scribbly Gum - Snow Gum Shrubby Open Forest. It has also been recorded less frequently within MU14 Tableland Mountain Gum - Snow Gum - Daviesia Montane Open Forest. These vegetation communities occur over the ridge lines and upper slopes of much of the Newnes Plateau State Forest.

RPS has recorded or has been provided with records of 14,866 stems of *P. hindii* throughout the Newnes Plateau. This number is not inclusive of the recorded stems which may be lost as a result of other projects as discussed in **Section 6.5** (Cumulative Impacts).

Veronica blakelyi

Veronica blakelyi is a small glabrous and glaucous shrub or woody herb to 50 cm high, with one to several erect softly woody stems from a narrow rootstock. This species is frequently found in moist sites and is restricted to the western Blue Mountains.

Throughout the Newnes Plateau, RPS has recorded or has been provided with records of 446 plants. This number is not inclusive of the recorded stems that may be lost as a result of other projects as discussed in **Section 6.5** (Cumulative Impacts).

Eucalyptus aggregata

Eucalyptus aggregata (Black Gum) is a small to medium-sized woodland tree growing to 18 m tall. The bark on the trunk and main branches is dark greyish-black, deeply fibrous or flaky. Only the uppermost branches and twigs have smooth whitish, cream or greyish bark that sheds yearly. This species grows in the lowest parts of the landscape, on alluvial soils, on cold, poorly drained flats and hollows adjacent to creeks and small rivers. It often grows with other cold-adapted eucalypts, such as Snow Gum (*Eucalyptus pauciflora*), Ribbon Gum (*E. viminalis*), Candlebark (*E. rubida*), Black Sallee (*E. stellulata*) and Swamp Gum (*E. ovata*). *E. aggregata* usually occurs in an open woodland formation with a grassy groundlayer dominated either by River Tussock (*Poa labillardierei*) or Kangaroo Grass (*Themeda australis*), but with few shrubs. It also occurs as isolated paddock trees in modified native or exotic pastures.

A total of 333 individuals were recorded in the west of the Study Area during RPS surveys. These specimens were recorded on the lower parts of the landscape, predominately along drainage lines and hollows, west and north of the Angus Place pit top (**Figure 7**). The trees recorded are considered to be a sample of the extant population in that area. Points recorded represent several individual trees that were identified in close proximity to each other.

Eucalyptus cannonii

Eucalyptus cannonii (Capertee Stringybark) usually occurs as a tree 10 – 15 m high with persistent, stringy bark. Leaves are lance-shaped, 9 – 15 cm long and 1. 5 – 2.5 cm wide. Buds and bud stems are angular, and fruits are generally greater than 10 mm diameter, often with a distinct rim around the middle. It can be distinguished from *E. macrorhyncha*, a closely related species that may grow in similar habitat, by the angular buds and usually larger fruit with a medial rim and shorter pedicels. Hybrids between the two species are common in some places where they co-exist. Hybrids may be distinguished in the field on the basis of fruit diameter, lack of prominence of the medial rim and reduced angularity of buds.

The distribution of *E. cannonii* is restricted to an area of about 100 by 60 km in the central tablelands of NSW. The western border is approximately marked by a line between Bathurst and Mudgee, while the eastern locations occur approximately on a line between Lithgow and the town of Bylong. Within this area, the species is often locally frequent.

Nineteen individual *E. cannonii* trees have been recorded in the talus slopes located north and east of the Angus Place pit top in the western part of the Study Area, (**Figure 7**). These records are considered to represent a very small proportion of the overall local population. This species is known to be prevalent within Ben Bullen State Forest, which occurs to the west of the Study Area. No recording of this species have been made on the Newnes plateau itself.

Legend

- Project Application Area
- RPS Study Area
- 26.5 Degree Angle of Draw
- Environmental Study Area

Threatened Flora Species

RPS Records

- *Eucalyptus aggregata*
- *Eucalyptus cannonii*
- *Persoonia hindii*
- *Veronica blakelyi*

University of Queensland Records

- *Veronica blakelyi*

Endangered Ecological Communities

Temperate Highland Peat Swamps on Sandstone (EPBC Act)

- 50 Newnes Plateau Shrub Swamp
- 51 Newnes Plateau Hanging Swamp

Montane Peatlands and Swamps (TSC Act)

- 53 Mountain Hollow Grassy Fen

Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland (TSC Act)

- 11 Tableland Gully Snow Gum - Ribbon Gum Montane Gr
- 15 Tableland Hollows Black Gum - Black Sally Open Fore

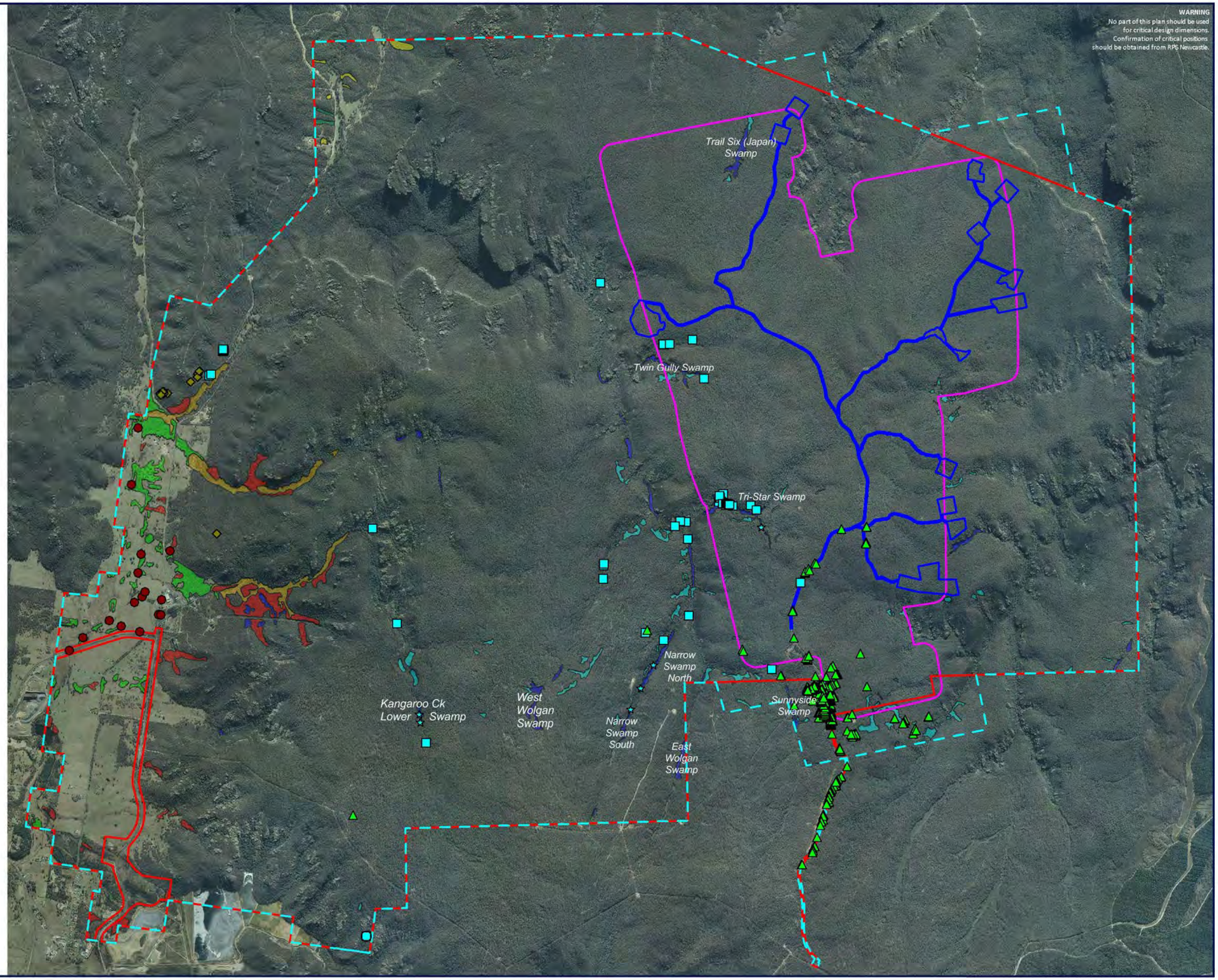
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (EPBC Act and TSC Act)

- 19 Capertee Box - Narrow-leaf Ironbark - Callitris Grassy
- 20 Capertee Rough-barked Apple - Redgum - Yellow Box

N

0 1.5 kilometres

SCALE: 1:48,000 AT SIZE A3



TITLE: FIGURE 7: LOCATION OF THREATENED FLORA SPECIES AND ENDANGERED ECOLOGICAL COMMUNITIES

LOCATION: ANGUS PLACE

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 20/01/2014
PURPOSE: REPORT

LAYOUT REF: J:\JOBS\Centennial\All Jobs\110328 Angus Place - Major Extension\10. Drafting\Mapinfo
VERSION (PLAN BY): JS (G A3)

CLIENT: CENTENNIAL
JOB REF: 110328

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3.3 Fauna Survey

The following sections provide the results of the RPS fauna surveys undertaken for the Project. Field surveys including threatened species searches and opportunistic searches were undertaken within suitable habitat across the Study Area. In total, 111 species were identified across the Study Area, including nine threatened fauna species listed under the TSC Act and/or EPBC Act. Those species observed within the Study Area are discussed further below. Threatened fauna species locations are shown in **Figure 8**. A full list of fauna species recorded within the Study Area is provided in **Appendix 3**.

3.3.1 Terrestrial Mammals

Open forest communities containing grassy understorey components provide suitable habitat for a number of terrestrial mammals. Three species of macropod were observed within the ESA and the wider locality, namely the Red-necked Wallaby (*Macropus rufogriseus*), Eastern Grey Kangaroo (*Macropus giganteus*) and Swamp Wallaby (*Wallabia bicolor*), these were encountered frequently during the survey period. The Common Wombat (*Vombatus ursinus*) was also recorded on regular occasions throughout the survey period.

3.3.2 Arboreal Mammals

Canopy tree species and understorey proteaceous shrubs provide abundant foraging resources such as foliage, seeds, pollen, nectar and invertebrates for possums, gliders and bats. Five arboreal mammal species, including the TSC Act listed Eastern Pygmy Possum (*Cercatetus nanus*) were recorded within the Study Area. The Greater Glider (*Petauroides volans*), Common Ringtail Possum (*Pseudocheirus peregrinus*), Sugar Glider (*Petaurus breviceps*) and Common Brushtail Possum (*Trichosurus vulpecular*) were recorded during spotlighting surveys. The threatened Eastern Pygmy Possum was detected through the use of arboreal Elliot B traps. Although not observed during surveys, there is suitable habitat within the Study Area for the threatened Squirrel Glider (*Petaurus norfolcensis*).

Records for *Petaurus australis* (Yellow-bellied Glider) are sparse on the Newnes Plateau and this highly vocal species was not observed or heard during spotlighting surveys.

3.3.3 Bats

Ten species of microchiropteran bat were positively identified from Anabat echolocation call recording within Study Area:

- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Gould's Wattled Bat (*Chalinolobus gouldii*);
- Chocolate Wattled Bat (*Chalinolobus morio*);
- Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*);
- Eastern Horseshoe Bat (*Rhinolophus megaphyllus*);
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*);
- White-striped Freetail Bat (*Tadarida australis*);
- Large Forest Bat (*Vespadelus darlingtoni*);
- Southern Forest Bat (*Vespadelus regulus*); and
- Little Forest Bat (*Vespadelus vulturnus*).

Additional bat species that are known to exist within the Study Area, but could not be confidently identified to species level (those classified as possible or as a species group), include:

- Eastern Falsistrelle (*Falsistrellus tasmaniensis*);
- Eastern Freetail bat (*Mormopterus species* 2);
- Large-footed Myotis (*Myotis macropus*);
- Lesser Long-eared Bat (*Nyctophilus geoffroyi*);
- Gould's Long-eared Bat (*Nyctophilus gouldi*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*); and
- Eastern Broad-nosed Bat (*Scotorepens orion*).

Overall, three threatened microchiropteran bat species listed under the TSC Act and/or EPBC Act were recorded during RPS surveys. These being the Large-eared Pied Bat, Eastern Bentwing Bat and Yellow-bellied Sheathtail Bat, as shown in **Figure 8**.

A full list of bat species recorded is provided in **Appendix 3** with the results of the bat call analysis provided in **Appendix 6**.

3.3.4 Avifauna Survey

A moderate diversity of common open forest birds including those characterising elevated habitats were observed across the Study Area. Avian species groups encountered, included, but were not limited to, Honeyeaters, Fairy-wrens, Thornbills, Magpie / Currawongs, Parrots / Cockatoos, Whistlers, and Frogmouths. Five TSC Act threatened bird species including the Varied Sittella (*Daphoenositta chrysoptera*), Flame Robin (*Petroica phoenicea*), Scarlet Robin (*Petroica boodang*), Powerful Owl (*Ninox strenua*) and Gang-gang Cockatoo (*Callocephalon fimbriatum*) were recorded during RPS surveys undertaken for the Project. These five species are listed as Vulnerable under the TSC Act, though are not listed under the EPBC Act.

A number of other State-listed threatened bird species have been recorded within the Newnes Plateau and within the Study Area in previous studies, including the Brown Treecreeper – South-eastern subspecies (*Climacteris picumnus* ssp. *victoriae*), Speckled Warbler (*Chthonicola sagittata*), Black-chinned Honeyeater (*Melithreptus gularis* ssp. *gularis*), Hooded Robin – South-eastern subspecies (*Melanodryas cucullata* subsp. *cucullata*) and Glossy Black-Cockatoo (*Calyptorhynchus lathami*).

Two native species of Sheoak trees (*Allocasuarina littoralis* and *A. nana*) were found within the Study Area in patchy distributions. These species of *Allocasuarina* represent potential feed trees for Glossy Black-Cockatoos. The Study Area contains scattered hollows of varying sizes in a multitude of Eucalypt species providing breeding opportunities for this species within the Study Area.

One forest owl, the Powerful Owl, was recorded within the Study Area. However, it is likely that the Study Area represents a portion of the local foraging range of Barking Owl, Masked Owl and Sooty Owl. The Study Area contains a variety of terrestrial and arboreal mammals, which make up the diet of the respective owl species.

3.3.5 Herpetofauna

Targeted and opportunistic herpetofauna searches for the Blue Mountains Water Skink (*Eulamprus leuraensis*) failed to detect this species within the Study Area. A total of 12 reptile species were recorded within the Study Area including Cunningham's Skink (*Egernia cunninghami*), Yellow-bellied Water-skink (*Eulamprus heatwolei*) and Lesueur's Velvet Gecko (*Oedura lesueurii*). No threatened herpetofauna were detected within the Study Area during surveys undertaken for this report.

Targeted and opportunistic amphibian searches were undertaken within the Study Area in accordance with DECC Guidelines (2009). Nine amphibian species were recorded within the Study Area including the Blue Mountains Tree Frog (*Litoria citropa*), Tyler's Tree Frog (*Litoria tyleri*) and Spotted Grass Frog (*Limnodynastes tasmaniensis*).

3.4 Secondary and Incidental Observations

During fauna surveys macropod and wombat scats were recorded. In addition, some scratches on tree trunks were observed. The tree trunk scratches were most likely attributable to Greater Gliders and Ringtail Possums. Diggings were observed in the soil on numerous occasions which were attributed to Superb Lyrebirds observed during field surveys, but diggings could potentially be a result of ground dwelling mammals also.

3.5 Habitat Survey

Habitats within the Study Area were assessed for their potential to support native fauna species, including threatened fauna for which records occur within the wider locality. Broad habitat types recorded within the Study Area included; open forest areas, riparian/damp areas characterised by swampy vegetation and exposed rocky areas.

3.5.1 Terrestrial Habitats

The terrestrial habitats of the open forests consist of a varied density and condition of understorey shrubs and ground cover vegetation with additional habitat features such as woody debris, rocks, and leaf litter. The density of shrubs and ground vegetation is greatest in gullies, wetter areas, and amongst patches of *Banksia* species. In these areas, higher numbers of small mammals, such as Bush Rats (*Rattus fuscipes*), take advantage of the improved cover from aerial predators. Secretive reptiles find cover beneath woody debris and rocks while abundant and conspicuous small skinks forage and shelter amongst dense leaf litter. Small carnivorous marsupials forage for insects at night and nest within hollows and fissures of fallen logs by day. Wombats and macropods graze on low shrubs and grasses. Woodland birds use a variety of techniques as they forage for ground dwelling insects. Secretive Superb Lyrebirds utilise dense vegetation and scratch for insects in the leaf litter. Small passerines, such as thornbills and White-browed Scrubwrens, hunt insects from low vegetation and woody debris.

Moist areas are favoured by *V. blakelyi*, while *P. hindii* can be found in drier areas with more open understorey. Recently logged areas often have a diminished understorey structure but an increased amount of woody debris while areas which have had recent bushfires experience a temporary loss of both understorey vegetation and woody debris. In both cases, the terrestrial habitats recover with time and are still utilised by many species for foraging, provided the patches affected by fire or logging exist as part of a larger mosaic of woodland with greater average age and older fire history.

Shrub swamps occur in wetter areas and along small watercourses. Frogs and reptiles favour these wet habitats. Low shrubs, ferns, and grasses form a very dense ground cover in which small terrestrial mammals, forage and nest. Some more secretive birds, such as the Eastern Whipbird, can only be found in this dense vegetation.

Sandstone outcrop/dry heath associations provide ideal habitat for many reptile species. The highest diversity of reptiles within the Study Area occurs in these areas where geckos, skinks, and small snakes can take shelter beneath slabs and bask on exposed rock. The dense heath, which grows on the skeletal soils, provides foraging habitat for small birds. Macropods often shelter beneath ledges in the larger rock formations.

3.5.2 Arboreal Habitats

Forest habitats throughout the Study Area provide important foraging resources such as foliage, seeds, pollen, nectar and invertebrates for a range of arboreal fauna species. Arboreal mammals are nocturnal, emerging at night to feed on the leaves and flowers of trees and shrubs whilst some may opportunistically take insects. Microchiropteran bats take insects during flight and utilise decorticating bark and small hollows and/or logs for roosting purposes.

Diverse guilds of woodland bird species detected over the Study Area feed on seeds, pollen, and nectar of canopy and understorey vegetation and glean insects from the bark and foliage. Ongoing forestry activities have resulted in a low average age of canopy trees, particularly in recently logged areas. As a result, hollow abundance is limited, minimising nesting and denning habitat for arboreal mammals and birds or roosts for Microchiropteran bats. However, enough hollows are present, particularly Scribbly Gum and Peppermint Eucalypt forests, to support a substantial population of arboreal mammal species, particularly Greater Gliders (*Petauroides volans*). Greater Gliders are a major dietary component of Powerful Owls (*Ninox Strenua*) resulting in a sufficient abundance of foraging resources to sustain this threatened species within the Study Area. Smaller arboreal mammals, such as Ringtail Possums (*Pseudocheirus peregrinus*) and Sugar Gliders (*Petaurus breviceps*), also occur frequently, providing food resources for other predatory Owl species. Hollow-bearing tree quadrats indicated that average density of hollow-bearing trees within the forested ridgeline habitats located across the Study Area is approximately 18 hollow-bearing trees per hectare.

Shrub swamps and dense heath/sandstone outcrops do not provide arboreal habitat in the form of canopy trees, however, the airspace above these habitats is utilised by foraging microbats and scattered trees provide vantage points for foraging birds. Birds also forage and often nest in the dense shrub thickets. Sandstone outcrops, particularly larger formations around the edges of the plateau and within deeper gullies, can contain deep fissures and overhangs which provide roosting habitat for cave dwelling bat species.

The cleared areas (mostly tracks, fire-trails and powerline easements) occurring within the Study Area are considered to be insignificant in terms of providing habitat for native fauna species aside from providing foraging habitat along the ecotone between cleared and forested areas (such as for hunting by owls and Microchiropteran bat species).

3.5.3 Corridors and Habitat Linkages

The Study Area is located mainly within the Newnes State Forest. The Study Area and surrounds, for a distance of greater than 2 km in any direction, contain native vegetation that is unbroken apart from occasional fire trails and access roads. Being a State Forest, the native vegetation is periodically selectively logged but there are no areas of clear-felling. This creates small and temporary disconnectedness between vegetation communities within the Newnes State Forest, however, overall connectedness remains intact.

The Study Area is connected to the Ben Bullen State Forest to the North and west, Wollemi National Park to the East and Blue Mountains National Park to the south.

As a result of the almost complete vegetative cover within and external to the Study Area, the habitat linkages throughout the Study Area and surrounding area are sufficient for fauna movement and are of high quality. The high connectivity to large tracts of commensurate habitats indicates that local populations of many of the common and threatened species present would extend well outside of the Study Area.

3.6 State Environmental Planning Policy No. 44 (Koala Habitat Protection)

SEPP 44 does not apply to State Forest lands. Therefore, SEPP 44 is not applicable to the majority of the Study Area. However, the west of the Study Area occurs outside the State Forest. Assessment of potential Koala habitat under SEPP 44 requires the following steps be undertaken:

First Consideration – Is the land 'Potential Koala Habitat'?

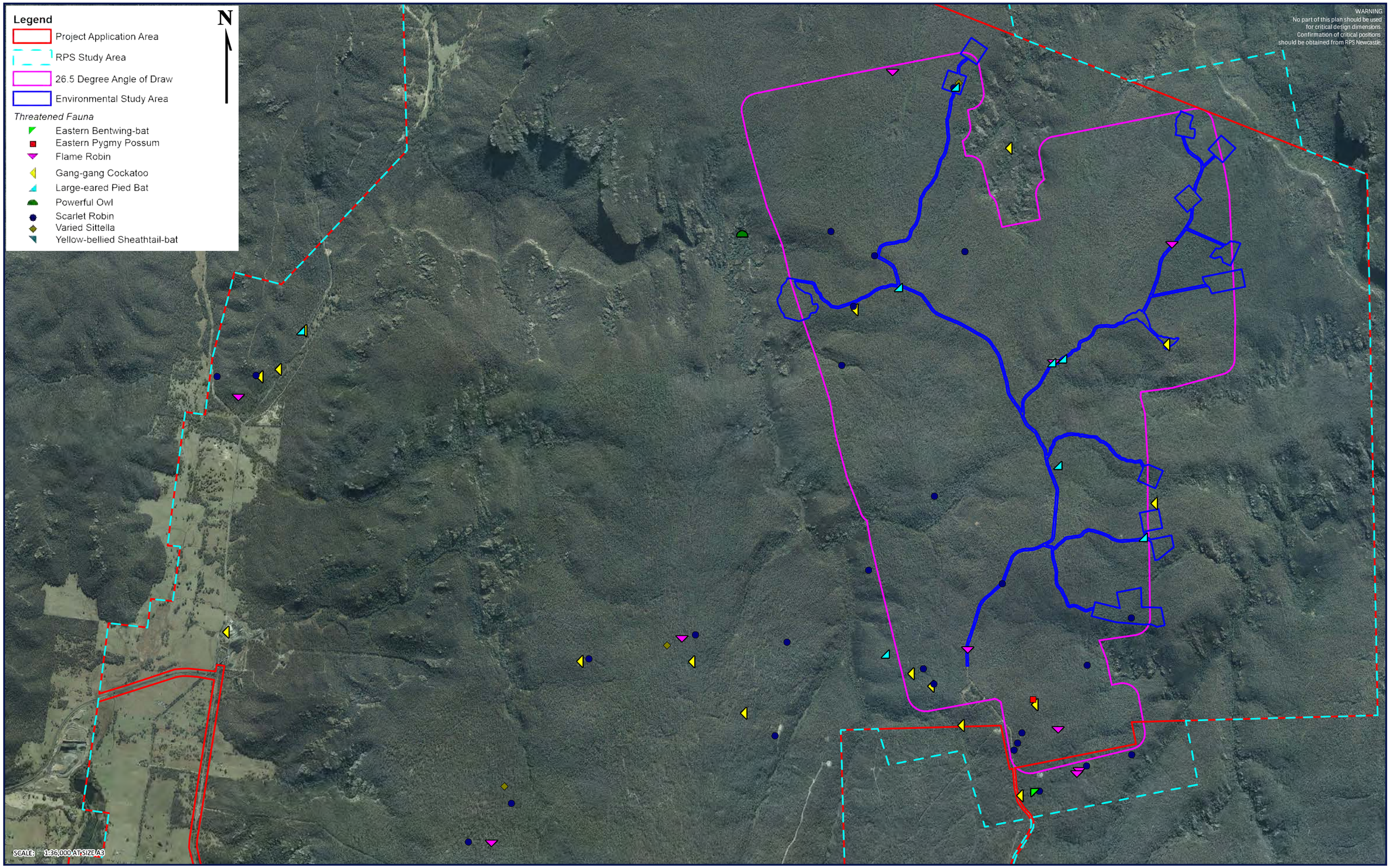
If the total tree cover contains 15% or more of the Koala food tree species listed in Schedule 2 of SEPP 44 then it is deemed to be "potential" Koala habitat. Identification of 'Potential Koala Habitat requires the determination of the presence of 'Core Koala Habitat'.

Lithgow LGA is listed in Schedule 1 of SEPP 44 and, therefore, the Project is subject to SEPP 44 assessment. Of those species recorded within the Study Area, only *Eucalyptus viminalis* (Ribbon Gum) is listed under Schedule 2 of SEPP 44 as a primary feed tree and was recorded opportunistically within the Study Area. *Eucalyptus viminalis* is a dominant canopy species (occurs >15%) within MU 11 Tableland Gully Snow Gum - Ribbon Gum Montane Grassy Forest. This community occurs within the west of the Study Area, outside of State Forest lands. There are areas of the Study Area that therefore constitute 'Potential Koala Habitat'.

Second Consideration – Is the land 'Core Koala Habitat'?

"Core Koala habitat" is defined as an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (females with young), recent sightings and historical records of a Koala population. One Koala record is known from within the Study Area (MKES 2008c). This record was made within the State Forest, however, it indicates the presence of a local Koala population. Therefore, the areas outside of the State Forest are regarded as "Core Koala Habitat".

Under SEPP 44, identification of "Core Koala Habitat" requires that a plan of management accompany the Development Application (DA). However, no activities that may disturb areas containing primary Koala feed trees are proposed. Therefore, a plan of management is not considered warranted in this instance. Potential impacts to Koalas as a result of the Project have been further assessed under the TSC Act and EPBC Act in **Appendix 1** and **Appendix 2**.



TITLE: FIGURE 8: LOCATION OF THREATENED FAUNA SPECIES

LOCATION: ANGUS PLACE EXTENSION AREA

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 20/01/2014
PURPOSE: REPORT

LAYOUT REF: J:\JOBS\Centennial\All Jobs\110328 Angus Place - Major Extension\10. Drafting\Mapinfo
VERSION (PLAN BY): JS (D A3)

CLIENT: CENTENNIAL
JOB REF: 110328

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4.0 Threatened Species and Communities Assessment

4.1 Identification of Subject Species and Communities

Threatened flora and fauna species (listed under the TSC Act and/or the EPBC Act) that have been recorded within a 10 km radius (the locality) of the Study Area and/or in the EPBC Protected Matters Search have been considered within this assessment. In addition, species that were not identified within database searches, but are considered to have potential habitat within the locality of the Study Area, have also been included. Endangered Ecological Communities (EECs) known to occur in the locality have also been addressed. This assessment deals with each species/community separately and identifies the ecological parameters of significance associated with the Project. Unless otherwise specified, habitat information is sourced from the NSW OEH Threatened Species Profiles (http://www.environment.nsw.gov.au/threatenedSpeciesApp/) and/or the EPBC Species Profile and Threats Database (http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl).

'Species / Community' – Lists each threatened species / EEC known from the vicinity. The status of each threatened species under the TSC Act and the EPBC Act is also provided.

'Habitat Description' – Provides a brief account of the species / community and the preferred habitat attributes required for the existence / survival of each species / community.

'Likelihood of Occurrence – Assesses the likelihood of each species / community to occur along or within the Study Area in terms of the aforementioned habitat description and takes into account local habitat preferences, results of current field investigations, data gained from various sources (such as OEH Atlas of NSW Wildlife, herbariums) and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Potential Impact' – Assesses the potential for any impacts to each species / community that would result from the proposed development, taking into account direct and indirect short and long-term impacts. In addressing the potential for impacts, the following causes of potential direct and indirect impacts have been considered:

- direct habitat removal within ESAs to accommodate surface facilities;
- subsidence related impacts (for the area of predicted subsidence, which is referred to in **Table 8**, see MSEC (2014)); and
- increases in mine water discharge, affecting the quantity and chemistry of surface water.

Those species/communities that have been identified as having potential to be impacted upon have been subject to further assessment and comment in **Section 6**, **Appendix 1** and **Appendix 2** where relevant.

Table 8 Chance of Occurrence and Likely Level of Impact

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
Flora			
Caesia parviflora var. minor (E)	This species is found in damp places in heath, woodland and open forest on sandstone (Harden 1993). This variety may be more common than currently known, as Pale Grass-lilies are often not identified to variety level. Two other larger varieties of *C. parviflora* have been described and are more common and widespread. A small or stunted *C. parviflora* of another variety may potentially be mistaken for *C. parviflora var. minor.* One OEH Atlas of NSW Wildlife record exists within 10 km of the Study Area. The location description for this record identifies the plant as occurring at the northern end of Sunnyside Ridge. This record therefore lies within the Study Area.	Whilst there is potential for misidentification of this species, there is also potential for it to be more widespread than currently known. Potentially suitable habitat occurs within the Study Area. Therefore, the precautionary approach has been applied to this species and it could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Lastreopsis hispida Bristly Shield Fern (E)	This species ranges from Victoria to NSW within moist humus-rich soils in wet forest and rainforest gullies of the Blue Mountains (Harden 1990), where it grows on rotting logs. The only Atlas of NSW Wildlife records that exist for this species are from Mt Wilson in the Blue Mountains (NSW Wildlife Atlas data 2014).	Records in the locality are restricted to the Mt Wilson area, however, this species can be difficult to differentiate between similar *Lastreopsis* species and its distribution may therefore extend further. Potentially suitable wet forest habitats occur within sheltered gullies of the Study Area. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Pultenaea glabra Smooth Bush-pea (V, V*)	This species typically occurs in discrete populations within swamp margins, hillslopes, gullies and creek banks and occurs within dry sclerophyll forest and seasonally swampy heath on sandstone (Fraser *et al.*, 2004). In NSW, it is confined to the higher Blue Mountains (Katoomba-Hazelbrook and Mount Victoria).	This species has a restricted distribution within the higher Blue Mountains. The distribution of this species does not incorporate the Study Area. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Pultenaea sp. Genowlan Point (NSW 417813) NSW Herbarium Genowlan Point Pultenaea (CE, CE*)	This species is endemic to the Greater Blue Mountains area of NSW, where it has been recorded as a single population on the north-west facing tip of Genowlan Point in the Capertee Valley (Delaney and Brown 2008).	This species is only known from Mount Genowlan. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Acacia bynoeana Bynoe's Wattle (V, V*)	Endemic to the Central Coast and Central Tablelands of NSW (Bell and Driscoll 2002). This species occurs in a range of habitat types on sandstone ridge tops including Scribbly Gum open forest, stringy bark communities and disturbed sites (James *et al.*, 1999).	This species was not recorded by desktop assessments, however, records are known from the Blue Mountains. Suitable sandy habitats occur within the Study Area. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an Assessment of Significance (AoS) (EPBC Act) in **Appendix 2**.
Acacia flocktoniae Flockton Wattle (V, V*)	Occurs in the Central Tablelands of NSW (Harden 1991) and is found only in the southern Blue Mountains (at Mt Victoria, Megalong Valley and Yerranderie). Grows in sclerophyll forest on low nutrient soils derived from sandstone and has been conserved in the Blue Mountains NP (Harden 1991). Occurs at an altitude of 500-1000 m above sea level in areas of high rainfall.	The Study Area is outside the known distribution of *Acacia flocktoniae*. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Prostanthera cryptandroides subsp. cryptandroides Wollemi Mintbush (V, V*)	Known from Glen Davis to Capertee and extending to the Goulburn River Valley in NSW. Occurs within the Hawkesbury-Nepean, Central West, Hunter-Central Rivers and Lachlan Natural Resource Management Regions. Found in dry sclerophyll forested slopes and gullies in rocky areas (Harden 1991), particularly at the base of scree slopes and sandstone boulders, and in shallow sandy loam.	A single record for this species exists within a 10 km radius of the Study Area (NSW Atlas Data 2013), with most records occurring further to the north near Glen Davis. Scree slopes and forested gullies may provide potential habitat for this species within the Study Area. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an AoS (EPBC Act) in **Appendix 2.**
Eucalyptus aggregata Black Gum (V)	Occurs on the central and southern tablelands of NSW. Grows in grassy woodlands on alluvial soils in moist sites along creeks, flats and hollows. Associated plants include *Eucalyptus rubida* (Candlebark) and *E. viminalis* (Ribbon Gum) – with which it readily hybridises (Field 2008), along with *E. pauciflora* (Snow Gum) and *Poa labillardieri* (River Tussock) as an understorey grass.	This species has been **recorded** in the west of the Study Area.	No areas of occupied or potential habitat of this species occur within the areas of predicted subsidence or ESAs. This species is likely to occur downstream of proposed discharge points, which has potential indirect impacts. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
Eucalyptus cannonii Capertee Stringybark (V)	This species is endemic to the Ilford – Rylstone – Capertee region within the Central Tablelands of NSW (Brooker and Kleinig 1999). The altitude range of *Eucalyptus cannonii* is from about 460 – 1040 m. Within the range, the species appears to tolerate most situations except the valley floors.	This species was **recorded** in the west of the Study Area.	No areas of occupied or potential habitat of this species occur within the areas of predicted subsidence, ESAs or mine water discharge. This species is **unlikely** to be impacted upon.
Eucalyptus pulverulenta Silver-leaved Gum (V, V*)	This species has a very restricted distribution in disjunct locations within the upper Cox River area south-west of the Blue Mountains, east of Bredbo in the Southern Highlands and further south to Gurubang and Merriangah (Brooker and Kleinig 1999). This species occurs on the crests or upper slopes of moderately steep hillsides or mountains. Locally, it can be found in shallow soils as an understorey plant in open forest, typically dominated by Brittle Gum (*Eucalyptus mannifera*), Red Stringybark (*E. macrorhyncha*), Broad-leafed Peppermint (*E. dives*), Silvertop Ash (*E. sieberi*) and Apple Box (*E. bridgesiana*). The nearest population is near Bowenfels, approximately 13 km south of the Study Area.	As this species can occur on steep terrain, there is potential that individuals could occur within the Study Area, however, could not be accessed to be recorded. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1** as well an AoS (EPBC Act) in **Appendix 2**.
Eucalyptus robertsonii subsp. *hemispherica* (V, V*)	Tree to 30 m high. Known only from the Central Tablelands of NSW, from north of Orange to Burraga. It is locally common in grassy or dry sclerophyll woodland or forest. It occurs in close association with other Eucalypts including *Eucalyptus piperita*, *Eucalyptus goniocalyx*, *E. dalrympleana, E. dives*, *E. mannifera* and *E. rossi*. Habitats include ridges and upper slopes.	The Study Area is outside the known distribution of this species and it is therefore **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Melaleuca biconvexa Biconvex Paperbark (V, V*)	Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. This species is found on the east coast of NSW from the Jervis Bay to Port Macquarie.	A single record for this species exists within a 10 km radius of the Study Area (NSW Atlas Data 2013), however, the details of this record indicate that it was recorded near Blackheath, approximately 32 km south. This isolated record is not recognised in the distribution descriptions of OEH (1998). This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Cryptostylis hunteriana Leafless Tongue-orchid (E, V*)	Occupies swamp heath, but also sclerophyll forest and woodland, often on sandy soils. Typically found in communities containing *Eucalyptus haemastoma*, *E. capitellata* and *Corymbia gummifera*. Its distribution in NSW is primarily coastal.	The Study Area is outside its known distribution of *Cryptostylis hunteriana*. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Genoplesium superbum (E)	*Genoplesium superbum* is restricted to the southern tablelands of NSW where it has been recorded from 2 locations near Nerriga, c. 20 km apart, and north of Wallerawang. *Genoplesium superbum* occurs predominantly in wet heathland on shallow soils above a sandstone cap but has also been found in open woodland interspersed with heath. This species can only be seen when in flower (December - March). Further details were sought from OEH with regard to the local habitat preferences of this species. OEH confirmed that the record was made in a woodland environment on a slope.	This species has been recorded within the locality of the Study Area, within a woodland environment on a slope. The local population does not conform to the typically noted habitat preference of the southern populations and just one location is currently known. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Prasophyllum fuscum Tawny Leek Orchid (CE, V*)	*Prasophyllum fuscum* is restricted to the Blue Mountains, Hawkesbury sandstone and the Burrawang district in NSW. Occurs on the margins of swamps and heaths and often along seepage lines at about 500-700 m above sea level. This species may not flower every year, often skipping years at a time.	This species was not recorded within database searches, however, it is known from the Blue Mountains area. Although this species is rare, there is **potential** for this species to occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an AoS (EPBC Act) in **Appendix 2**.
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid (CE*)	Endemic to NSW and known only from seven populations in eastern NSW near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell and Tenterfield (NSW Scientific Committee 2009a). Found in shrubby and grassy habitats in dry to wet soil.	The Study Area is outside of the known distribution of this species. It is considered **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
Grevillea evansiana (V, V*)	Grows in dry sclerophyll forest or woodland, occasionally in swampy heath, in sandy soils, usually over Hawkesbury sandstone. Restricted to a small area east of Rylstone on the Central Tablelands.	This species was not detected during targeted field surveys and its restricted distribution does not incorporate the Study Area. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Grevillea obtusiflora (E, E*)	Two subspecies of *Grevillea obtusiflora* exist, with subspecies *obtusiflora* occurring within Clandulla State Forest near Rylstone and subspecies *fecunda* occurring in the Capertee Valley and Gardens of Stone National Park, north-west of Lithgow. Subspecies *fecunda* occurs in clusters within low, open scrub beneath open, dry sclerophyll forest, on orange, sandy loam soils with sandstone boulders, at an altitude of 570 m. It grows in association with *Eucalyptus tenella, E. fibrosa, E. macrorhyncha, E. punctata, Callitris endlicheri, Acacia buxifolia, Leptospermum continentale, Monotoca elliptica, Persoonia linearis, Indigofera* sp. and *Pomax umbellata*.	Potential habitat for this species occurs within the Study Area, within MU19 Capertee Box - Narrow-leaf Ironbark - Callitris Grassy Woodland and the species could therefore **potentially** occur.	No areas of potential habitat of this species occur within the areas of predicted subsidence, ESAs or mine water discharge. This species is **unlikely** to be impacted upon.
Persoonia acerosa Needle Geebung (V, V*)	Known from the Blue Mountains in the Newnes Plateau south through Kings Tableland to Hilltop and east to the lower Mountains. Occurs in dry sclerophyll forest, scrubby low-woodland and heath, generally on clayey sandstone and laterites of the Narrabeen Group (NPWS 2000). This species is strongly associated with disturbance margins, such as road and trail verges.	This species is known to occur in the Newnes Plateau and suitable dry sclerophyll habitat occurs within the Study Area. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an AoS (EPBC Act) in **Appendix 2**.
Persoonia hindii (E)	Distribution is limited to the Newnes Plateau in the Upper Blue Mountains, where it occurs in dry forest habitats.	This species was **recorded** within the Study Area.	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Persoonia marginata Clandulla Geebung (V, V*)	Distributed in the Capertee district in the Rylstone LGA (Harden 1991). Known from 11 different locations with the majority occurring in the Clandulla State Forest, west of Kandos. Also known from Ben Bullen State Forest. Found in dry woodland communities associated with Shoalhaven Group sediments.	A review of the atlas Atlas of NSW Wildlife data for this species shows that most records do occur in association with the Shoalhaven Group Sediments. Atlas records also occur over areas mapped as Illawarra Coal Measures. The Study Area lies almost entirely over the Narrabeen Group sediments, with some of the Illawarra Coal Measures within the deep valleys of the Wolgan River and Carne Creek in the far north-east and north-west of the Study Area respectively. Suitable habitat exists for *Persoonia marginata.* This species could **potentially** occur.	Vegetation communities within the Study Area that are geologically derived from Shoalhaven or Illawarra formations are limited to the far west of the site. No areas of occupied or potential habitat of this species occur within the areas of predicted subsidence, ESAs or mine water discharge. This species is **unlikely** to be impacted upon.
Asterolasia elegans (E, E*)	This species is endemic to the Maroota district of northern Sydney, with a current known distribution of less than 37 km and an extent of occurrence of approximately 22 km^2. Occurs on Hawkesbury sandstone in wet sclerophyll forests close to creeks or on sheltered slopes that are amongst rocky outcrops and boulders (James *et al* 1999).	The Study Area is outside its known distribution of *Asterolasia elegans*. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Boronia deanei Deane's Boronia (V, V*)	Occurs in wet heath, appearing to prefer the margins of open forest where it adjoins swamps and streams. It is known to occur in the Blue Mountains in the upper Kangaroo River near Carrington falls, the Endrick River near Nerriga and on the Nalbaugh Plateau.	This species has been recorded within numerous shrub swamps on the Newnes Plateau, however, none of these confirmed occupied swamps occur within the Study Area. A potentially suitable habitat occurs in the form of swamps and damp riparian habitats, some of which are difficult to access. This species could **potentially** occur.	As this species has the potential to occur within the Study Area it has the **potential** to be impacted. Therefore, a 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an AoS (EPBC Act) in **Appendix 2**.
Pomaderris brunnea Rufous Pomaderris (V, V*)	Found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden. It grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines (James *et al*., 1999).	The Study Area is outside of the known distribution of *Pomaderris brunnea*. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Thesium australe Austral Toadflax (V, V*)	This species occurs in grassland or grassy woodland and is often found in damp sites in association with kangaroo grass (*Themeda australis*). This species is a root parasite that takes water and some nutrient from other plants, especially kangaroo grass. A population of this species is known from Blackmans Flat, which occurs to the west of the Study Area.	There is limited potential for this species to occur within low lying areas in the west of the Study Area. This species could **potentially** occur.	No areas of occupied or potential habitat of this species occur within the areas of predicted subsidence or ESAs. There is potential for areas of occupied habitat to occur downstream of local mine water discharge points. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an AoS (EPBC Act) in **Appendix 2**.
Veronica blakelyi (V)	This species occurs in moist areas of Eucalypt forest. It is known to occur in the Western Blue Mountains near Clarence, Mt Horrible, Nullo Mountain and in the Coricudgy Range.	This species has been **recorded** in the Study Area.	Known habitat for this species occurs within the areas of predicted subsidence. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
Euphrasia arguta (CE, CE*)	This species is known from Nundle State Forest and adjacent private land in NSW in an area estimated to be 26 km^2 (NSW DPI 2008). Previously known from Bathurst to Sydney and north to Walcha. Occurs in eucalypt forest with a mixed grass understorey within Nundle State Forest. Historic records describe the habitat as grassy areas near rivers at elevations up to 700 m above sea level.	This species is extremely rare and potentially locally extinct, historic records indicate a habitat that is not represented within the Study Area. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Haloragis exalata subsp. exalata (V, V*) Square Raspwort	This species occurs in 4 widely scattered localities in eastern NSW within the Central Coast, South Coast and North Western Slopes botanical divisions of NSW. The species appears to require shady and damp areas in riparian habitats.	The Study Area is outside of the known distribution of *Haloragis exalata subsp. exalata*. The species is therefore **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Haloragodendron lucasii (E, E*)	Known locations of this species are confined to a small area on the north shore of Sydney. It is associated with dry sclerophyll forests in moist, sandy loam soils on sheltered aspects, and on gentle slopes below cliff-lines near creeks.	The Study Area is outside of the known distribution of *Haloragodendron lucasii*. The species is therefore **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Pelargonium sp. Striatellum (G.W.Carr 10345) Omeo Stork's-bill (E, E*)	Known to occur in habitat usually located just above the high water-level of irregularly inundated or ephemeral lakes. Occurs within the South Eastern Highlands and South East Corner IBRA Bioregions and the Hawkesbury-Nepean, Murrumbidgee, Southern Rivers and North East Natural Resource Management Bioregions.	No areas of suitable aquatic habitats occur within the Study Area. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Philotheca ericifolia (V*)	This species inhabits the north-western slopes and central western slopes of NSW from the Upper Hunter to the Pilliga and to the Peak Hill district. It occurs in drainage areas in dry sclerophyll open forest or woodland on sandstone, and within heath on damp sandy flats and gullies.	The Study Area is to the south-west of the known distribution of *Philotheca ericifolia*. The species is therefore **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Wollemia nobilis Wollemi Pine (E, E*)	This species is confined to the remote canyons of the Wollemi National Park west of Sydney NSW. Known habitats include deep gorges on Narrabeen Group Triassic sandstone often within warm temperate rainforest. Exact record locations have been withheld from public knowledge to protect the remaining populations of this species.	This species is restricted to gorges of the Wollemi National Park. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Invertebrates			
Paralucia spinifera Bathurst Copper Butterfly (E, V*)	Restricted to an area within the Central Tablelands of NSW between Oberon, Hartley and Bathurst. Found in open woodland or open forest with a sparse understorey that is dominated by *Bursaria spinosa* subsp. *lasiophylla* (Blackthorn) which is used as the larval food plant. Found above 850 m, where direct sunlight reaches the habitat, with a south-west to north-west aspect. These areas come with extreme cold cycles, such as frost or winter snowfalls. In 2011, this species was found at 29 sites throughout the Blue Mountains (CSIRO 2002 in DoE 2014).	There is potential for this species to occur within low-lying areas in the west of the Study Area where *B. spinosa* subsp. *lasiophylla* may occur. This species could **potentially** occur.	No areas of occupied or potential habitat of this species occur within the areas of predicted subsidence or ESAs. This species is **unlikely** to be impacted upon.
Petalura gigantea Giant Dragonfly (E)	*Petalura gigantea* can be found along the east coast of NSW, from the Victorian border to northern NSW. There are only a handful of known locations in NSW. They occur in permanent swamps and bogs with some water and open vegetation.	This species is known to occur in Sunnyside Swamp (Benson & Baird 2012). Sunnyside Swamp crosses into the south-west corner of the Study Area and therefore this species **potentially** occurs. Additional areas of suitable swamp habitat also within other parts of the Study Area.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Amphibians			
Heleioporus australiacus Giant Burrowing Frog (V, V*)	Confined to the eastern slopes of the Great Divide in south-east coastal NSW and into Victoria (Tyler and Knight 2011). The species can tolerate a variety of geological habitats from sandstone to granite or basalt (Anstis 2013). It has been recorded in hanging swamps, sandstone ridges supporting heath vegetation and dry sclerophyll forests that support wet habitats.	This species has been **recorded** by call recognition in previous surveys within the Study Area (BMS 2011b). The location description provided was the 'Kangaroo Creek road crossing' area.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1** as well an AoS (EPBC Act) in **Appendix 2**.
Mixophyes balbus Stuttering Frog (E, V*)	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range, at elevations of 20 – 1100 m (Tyler and Knight 2011). Recent DNA evidence suggests there are two distinct species that are separated north and south of Barrington Tops in NSW (Anstis 2013). The species is associated with flowing streams, breeding from spring to autumn after heavy rain (Anstis 2013). Outside the breeding, season adults live in deep leaf litter and thick understorey vegetation on the forest floor.	This species has been recorded within the Springvale lease area by call recognition (MKES 2004b). Suitable habitat occurs within the Study Area. This species is **likely** to occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an AoS (EPBC Act) in **Appendix 2**.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
Pseudophryne australis Red-crowned Toadlet (V)	This species is confined to areas of Hawkesbury sandstone within a 160 km radius of Sydney (Tyler and Knight 2011). It inhabits seepages at the base of large sandstone rocks and around soaks and bushland drainage lines where water is collected (Anstis 2013; Tyler and Knight 2011).	No records for this species exist on the Newnes Plateau, however, scattered records are present within the connected forested areas, including Wollemi National Park. Potential suitable habitats exist within the Study Area. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Litoria booroolongensis Booroolong Frog (E, E*)	This species has a historical distribution spanning the eastern ranges of NSW, but has declined drastically, particularly within the northern part of its range, and is now restricted to two or three isolated areas (Anstis 2013; Tyler and Knight 2011). Areas of occupancy are closely related to permanent rocky streams and cobble bank habitats with fringing vegetation such as ferns, sedges and grasses (Tyler and Knight 2011).	Although streamside habitat occurs within the Study Area, a lack of perennial rocky stream habitat limits the potential for the species to inhabit the Study Area. This species is therefore **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Litoria littlejohni Heath Frog (V, V*)	The distribution of this species extends from near Wyong south along the NSW coast to eastern Victoria occurring in patchy fragments (Anstis 2013). Habitats include forest, coastal woodland and heath, with rocky streams, and semi-permanent dams being required for breeding periods (Anstis 2013; Tyler and Knight 2011). The nearest records to the Study Area are within the Mount Wilson Area.	Whilst the surveys and ongoing monitoring have not detected this species, it is regarded as being one of the least known and least frequently encountered frogs in New South Wales. As potential habitat exists within the Study Area, this species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an AoS (EPBC Act) in **Appendix 2**.
Reptiles			
Aprasia parapulchella Pink-tailed Worm-lizard (V, V*)	This species has a patchy distribution along the foothills of the western slopes of the Great Divide. Habitats are described as primary and secondary grassland, grassy woodland and woodland communities including mallee, and box-ironbark forest. They shelter under small rocks on well-drained soil and in ants' nests (Swan *et al.*, 2009).	This species has a more western distribution than the Study Area. Additionally, the grassy habitats typically associated with this species are not present. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Eulamprus leuraensis Blue Mountains Water Skink (E, E*)	This species is restricted to the Blue Mountains and Newnes Plateau in NSW (Wilson and Swan 2010). Occurs in high elevated habitats generally in shrub or hanging swamps but can also occur in open forest, open scrub or heath. Larger, wetter swamps in close proximity to other inhabited swamps are more likely to be occupied by this species.	Potential habitat, in the form of shrub swamps, occur within the Study Area. This species could **potentially** occur.	Known habitat for this species occurs within the areas of predicted subsidence. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an AoS (EPBC Act) in **Appendix 2**.
Varanus rosenbergi Rosenberg's Goanna (V)	In NSW, this species occurs on Sydney Sandstone in Wollemi NP to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. Habitats include heath, open forest and woodlands that contain termite mounds for which this species requires to lay eggs inside. the Atlas of NSW Wildlife (2014) records exist for the species within the site's locality in Gardens of Stone and Wollemi NPs.	The sandstone habitats required for this species occur within the Study Area. Coupled with the close proximity of Atlas records, it is considered that the species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Hoplocephalus bungaroides Broad-headed Snake (E, V*)	Largely confined to Triassic sandstones, including the Hawkesbury, Narellan and Shoalhaven formations, within the coast and ranges. Occurs in the Sydney basin within a 200 km radius of Sydney on rocky outcrops and adjacent sclerophyll forest and woodland (Cogger et al,. 1993). The most suitable habitats occur on sandstone ridgetops. Nocturnal, sheltering by day in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Broad-headed Snakes select refuge based on seasonal temperature differences, preferring cooler tree hollows on top of plateaus and below cliffs during summer and warmer sun-exposed sandstone slabs and exfoliations during winter.	Targeted searches did not detect this species within the Study Area. However, suitable habitat in the form of sandstone outcrops with adjacent forest vegetation does occur within the Study Area. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an AoS (EPBC Act) in **Appendix 2**.
Birds			
Botaurus poiciloptilus Australasian Bittern (E, E*)	The Australasian Bittern occurs from south-east Queensland to south-east South Australia, Tasmania and in the southwest of Western Australia (Marchant & Higgins 1990). In NSW, it occurs along the coast and is frequently recorded in the Murray-Darling Basin, notably in floodplain wetlands of the Murrumbidgee, Lachlan, Macquarie and Gwydir Rivers (Marchant & Higgins 1990). Occurs mainly in densely vegetated freshwater wetlands and, rarely, in estuaries or tidal wetlands (Marchant & Higgins 1990).	This species was not detected during targeted field surveys, and has not been recorded within a 10 km radius of the Study Area. A lack of available wetland habitat on the Newnes Plateau has determined it **unlikely** for the species to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Heiraaetus morphnoides Little Eagle (V)	Widespread over mainland Australia including NSW but not near the coast (Marchant and Higgins 2007). Habitats include wooded and forested lands and open country, particularly timbered areas such as wooded farmland, gallery forest and wooded floodplains along watercourses (Marchant and Higgins 2007). Requires mature living trees in open woodland for nesting purposes.	The various habitats of the Study Area are not consistent with the noted habitat preferences of wooded farmland, gallery forest and wooded floodplains along watercourses of the Little Eagle. However, this species has been **recorded** within the Angus Place mining lease area (MKES 2006a, 2007 and BMS 2011b) south of the Study Area, most likely traversing the site en route to more favourable habitats.	Whilst this species has been recorded, areas of predicted subsidence and ESAs provide little, if any, area of preferred habitat for this species. It is **unlikely** that this species would be impacted upon.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
Lophoictinia isura Square-tailed Kite (V)	Endemic to Australia and widespread throughout coastal and subcoastal regions, but sparsely distributed in NSW (NSW Scientific Committee 2009). This species favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes and Coolibah/River Red Gum on the inland plains (Marchant and Higgins 1993). Has also been known to forage in urban areas, at forest edges and over coastal heathlands (NSW Scientific Committee 2009).	The various habitats of the Study Area are not consistent with the noted habitat preferences of productive coastal forests, box-ironbark-gum woodlands and inland Coolibah/River Red Gum forests of the Square-tailed Kite. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Rostratula australis Australian Painted Snipe (E, V*)	Occurs over a wide area of Australia, with the exception of Cape York and the more extensive arid lands (Garnett *et al.,* 2000). In NSW it inhabits both inland and coastal localities, occupying shallow freshwater wetlands with muddy grounds (Smith 1991). Commonly recorded in freshly flooded areas and shallow freshwater swamps that have rushes, as well as wet pastures. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds.	This species was not detected during targeted field surveys, and has not been recorded within a 10 km radius of the Study Area. A lack of available wetland habitat on the Newnes Plateau has determined it **unlikely** for the species to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Callocephalon fimbriatum Gang-Gang Cockatoo (V)	Gang-gang Cockatoos are restricted to the south-eastern coast and highlands, from the lower Hunter and northern Blue Mountains to the Southwestern Slopes (NSW Scientific Committee 2008a). Found in the summer months in tall mountain forests and woodlands, and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open Eucalypt forests and woodlands, and often found in urban areas in some districts.	This species has been **recorded** within the Study Area.	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Calyptorhynchus lathami Glossy Black-Cockatoo (V)	Glossy-black Cockatoos are distributed in eastern NSW from the coast to the tablelands with populations in the western slopes and plains (NSW Scientific Committee 2008b). Occurs in forests and woodlands where it forages predominantly on Allocasuarina cones, particularly those of *A. littoralis*, *A. torulosa* and at time *A. distyla* (NSW Scientific Committee 2008b). Requires large Eucalypt tree hollows for nesting.	This species has been **recorded** within the Study Area in previous surveys (MKES 2006a, 2007 and BMS 2009c).	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-part test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Glossopsitta pusilla Little Lorikeet (V)	The distribution of the Little Lorikeet ranges from Cairns in QLD to Adelaide along the east coast of Australia, it can commonly be found in dry, open eucalypt forests and woodlands and in roadside vegetation and woodland remnants (NSW Scientific Committee 2011). In the western parts of its range Yellow Box (*Eucalyptus meliodora*) and White Box (*E. albens*) form important food sources for Little Lorikeets (Courtney & Debus 2006).	This species was not detected during targeted field surveys, however, several records for this species exist within a 10 km radius of the Study Area (Atlas of NSW Wildlife 2013). A wide ranging species in wooded areas across eastern Australia due to its nectivorous habits, this species may use surrounding forests and woodlands for foraging purposes on at least a seasonal basis. This species could **potentially** occur.	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Lathamus discolour Swift Parrot (E, E*)	Swift Parrots Breed only in Tasmania during Summer and migrate north to mainland Australia during Winter (Saunders and Tzaros 2011). In NSW, occupied habitat includes dry forests and woodlands of the box-ironbark type on the inland slopes of the Great Dividing Range. Coastal regions tend to be more favourable during drought periods in the west (Saunders and Tzaros 2011).	This species predominantly prefers coastal woodlands and forests of New South Wales, preferring eucalypt species typically not found on the Newnes Plateau. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Neophema pulchella Turquoise Parrot (V)	In NSW, Turquoise Parrots typically occur west of the Great Dividing Range on the tablelands and western slopes extending to the coastal districts through the dry forest corridor of the Hunter Valley (Crome and Shields 1992). This species inhabits steep, rocky ridges and gullies, rolling hills, valleys and river flats and the nearby plains of the Great Dividing Range (Higgins 1999). Also historically occurs in a variety of habitats including savannah, riparian woodlands and farmland, preferring forest edges (Morris 1980).	The high altitude of the Study Area along with the lack of plains and rocky ridges in which this species prefers make the area unsuitable habitat for this species. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Ninox connivens Barking Owl (V)	Throughout NSW, this species is widespread on the coastal plain and foothills and the inland slopes and plains (NPWS 2003). Habitats include forests and woodlands of tropical, temperate and semi-arid zones, typically dominated by eucalypts, often red gum species and *Melaleuca* species (NPWS 2003). Roosts in dense foliage in large trees including rainforest species of streamside gallery forests.	This species has been **recorded** within the Study Area in previous surveys (MKES 2006a).	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Ninox strenua Powerful Owl (V)	Occurs in coastal and adjacent ranges of eastern Australia in sclerophyll forests and woodlands, gallery rainforest and inland riverine woodland (NSW Scientific Committee 2008c). Often roosts and nests in dense gully eucalypt forest. Occurs throughout the Blue Mountains and Gardens of Stone National Park (Atlas of NSW Wildlife Data 2013).	This species has been **recorded** within the Study Area.	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
Tyto novaehollandiae Masked Owl (V)	In NSW, Masked Owls are distributed throughout the length of the Great Dividing Range and extends from the coast to the western slopes (Kavanagh 2002). Occupies a range of environments from tall, wet Eucalypt forest to dry woodland, and often at the ecotone with cleared land.	This species has been recorded within the Clarence lease area in previous surveys (BMS 2009d). This species is **likely** to occur within the Study Area.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Tyto tenebricosa Sooty owl (V)	Occupies the easternmost areas of NSW, occurring patchily on the coast, coastal escarpment and eastern tablelands. There is no seasonal variation in its distribution, often occurring in tall old-growth montane forests, including temperate and subtropical rainforest (Higgins 1999), but may also persist in younger forest if suitable nesting trees are located nearby (Garnett *et al.*, 2000).	This species has been **recorded** within the Study Area in previous surveys (BMS 2010c).	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Climacteris picumnus victoriae Brown Treecreeper (eastern subsp.) (V)	Brown Treecreepers are endemic to eastern Australia. They frequent drier eucalypt forests and woodlands, particularly open woodland lacking a dense understorey, in the inland plains and slopes of the Great Dividing Range. The eastern subspecies lives in eastern NSW in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands such as the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond and Clarence Valleys. Can be found in grasslands in proximity to wooded areas where there are sufficient logs, stumps and dead trees nearby.	This species has been **recorded** within the Study Area in previous surveys (MKES 2004a, 2006a, 2008c and BMS 2009c, 2010c, 2011b).	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Chthonicola sagittata Speckled Warbler (V)	This species has a patchy distribution from south-east Queensland to the eastern half of NSW and into Victoria. Occupies Eucalypt and Cypress woodlands in drier areas and on the western/eastern slopes of the Great Dividing Range. More commonly found on the western slopes, living in a wide range of Eucalypt dominated vegetation that has a grassy and shrubby understorey often on rocky ridges or gullies (Garnett et al. 2000).	This species has been **recorded** within the Study Area in previous surveys (MKES 2006a and BMS 2009c).	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Anthochaera phrygia Regent Honeyeater (CE, E*)	Regent Honeyeaters are endemic to South-east Australia, extending from south-east Queensland to central Victoria. This distribution is however extremely segmented. Preferred habitat includes Box-Ironbark eucalypt woodland and dry sclerophyll forest, particularly the more fertile, moist sites within these associations (Garnett *et al.*, 2000). Seasonal movements appear to be dictated by the flowering of various *Eucalyptus* species that are characteristic of the dry forests and woodlands of South-Eastern Australia.	Known to occur in the Capertee area, individuals are recorded in more easterly habitat, particularly in areas characterised by winter flowering *Eucalyptus* sp. when westerly habitats are experiencing extended dry periods. As such, this species may occur in Newnes Plateau forests on an intermittent basis. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an AoS (EPBC Act) in **Appendix 2**.
Grantiella picta Painted Honeyeater (V)	This species occurs in scattered locations through eastern and mid NSW north to QLD and south to central Victoria (Higgins et. al 2001). In NSW, this species is widespread on and west of the Great Dividing Range from Tenterfield, Glen Alice, Canberra and Kosciusko NP (Higgins et al. 2001). Generally occurs on dry open woodlands and forest that are strongly associated with mistletoes (Higgins et al. 2001). Woodlands including species such as Red Ironbark, Mugga, Yellow Box, Broad-leaved Peppermint with drooping *Amyema pendulum* and *A. miquelii* mistletoes preferred (Higgins et al. 2001).	This species was not detected within the Study Area with only one record existing within a 10km radius of the Study Area (Atlas of NSW Wildlife Data 2013). There is an abundance of mistletoe within the Study Area amongst suitable habitat for this species. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Melithreptus gularis gularis Black-chinned Honeyeater (eastern subsp.) (V)	This species extends from central Queensland, south through NSW and into Victoria to south eastern South Australia. Widespread in NSW, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Occurs in dry open forests or woodlands dominated by box and ironbark eucalypts where it spends its time in the upper canopies (Garnett *et al.*, 2000). Habitat species include Mugga Ironbark (*E. sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*).	This species has been **recorded** within the Study Area in previous surveys (MKES 2004a).	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Pomatostomus temporalis temporalis Grey-crowned Babbler (eastern subsp.) (V)	In NSW this species is widespread west of the Great Divide. East of the Great Divide they are similarly widespread but scattered, experiencing a significant decline in numbers in the southern part of its range (Garnett *et al* 2000; Higgins and Peter 2002). Occupies open forests and woodlands especially on inland plains, and also live in acacia shrublands and adjoining farmland (Garnett *et al.*, 2000; Higgins and Peter 2002).	This species has been recorded within the Springvale lease in previous surveys (MKES 2006c). Available habitat for the species exists within the Study Area. Therefore, this species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
Daphoenositta chrysoptera Varied Sittella (V)	This species occurs across most of the Australian mainland, with nearly a continuous distribution in NSW from the coast to the far west. This species inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland (Pizzey and Knight 2007).	This species has been **recorded** within the Study Area.	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Melanodryas cucullata cucullata Hooded Robin (south-eastern subsp.) (V)	*Melanodryas cucullata cucullata* occur widely across south-eastern Australia aside from driest deserts and wetter coastal areas. (Garnett *et al*., 2000). Favoured habitats include lightly wooded country, usually open eucalypt woodland, acacia shrub and mallee near clearings and open areas. This species requires structurally diverse habitats that feature mature eucalypts, saplings, small shrubs and diverse tall grasses.	This species has been **recorded** within the Study Area in previous surveys (MKES 2004a, 2006a).	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Petroica boodang Scarlet Robin (V)	Scarlet Robins are located in south-eastern Australia and south-west western Australia (Higgins and Peter 2002). In NSW, it occupies open forests and woodlands from the coast to the inland slopes and it breeds in drier eucalypt forests and temperate woodlands (Higgins and Peter 2002).	This species has been **recorded** within the Study Area.	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Petroica phoenicea Flame Robin (V)	Flame Robins are found in south-eastern Australia from the QLD border to Tasmania (Garnett *et al*., 2000). In NSW, they are sparsely scattered from east of the Great Divide in coastal areas from Northern Rivers to the South Coast, but are more widely spread west of the Great Divide (Higgins and Peter 2002). During Spring-Summer (breeding season) they are found mainly upland, wet to moist eucalypt forests and woodlands, usually on slopes and ridges and with an open understorey or in clearings and pine plantations (Garnett *et al*., 2000; Higgins and Peter 2002). During Autumn-Winter they occur more often in open areas at lower altitudes in drier more open habitats particularly native and introduced grasslands and farmlands and in dry sclerophyll forests and woodlands (Higgins and Peter 2002).	This species has been **recorded** within the Study Area.	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Stagonopleura guttata Diamond Firetail (V)	Endemic to South-eastern Australia extending from central QLD to the Eyre Peninsula in South Australia. Widespread in NSW with most records occurring on the inland slopes of the Great Divide (Garnett *et al*., 2000). Not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. The species can live in a wide range of grassy eucalypt-dominated vegetation communities including woodland, forest and mallee (Garnett *et al*., 2000).	The Study Area occurs within the known distribution of this species and available habitats do exist. This species has **potential** to occur in the west of the Study Area.	No areas of occupied or potential habitat of this species occur within the areas of predicted subsidence or ESAs. This species is **unlikely** to be impacted upon.
Mammals			
Dasyurus maculatus maculatus Spotted-tailed Quoll (SE mainland subsp.) (V, E*)	In NSW, this species is largely confined to within 200 km of the coast and ranges from the QLD border to Kosciuszko NP, including areas such as the Hunter Valley, Taree, Port Macquarie, and coastal national parks. Disjunct populations have been recorded between the Border Ranges and the Blue Mountains area. The species has a preference for mature wet forest habitat particularly in areas with rainfall approximate to 600 mm/year but has been recorded from a wide range of habitats, including temperate and subtropical rainforests, wet sclerophyll forest, lowland forest, open and closed eucalypt woodlands, inland riparian and dry 'rainshadow' woodland, sub-alpine woodlands and coastal heathlands (Strahan, 1995).	This species was not detected during field surveys within the Study Area. However, five records for this species exist within a 10 km radius of the Study Area (NSW Atlas Data 2013). Suitable habitat for this species does occur within the Study Area. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an AoS (EPBC Act) in **Appendix 2**.
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern subsp.) (E, E*)	In NSW, this species is distributed along the coastal fringe of the state from the southern side of the Hawkesbury River in the north, to the Victorian border in the south. Two main populations are from Kuringai Chase NP north of Sydney and in the far south-east corner of the state in Ben Boyd NP, East Boyd NP and multiple state forests and has been recorded in small numbers in the Blue Mountains NP. It occurs in a variety of habitats including heathland, shrubland, dry sclerophyll forest with heathy understorey, sedgeland and woodland, preferring a dense understory and areas recently opened up after fire for foraging purposes (Strahan 1995).	This species was not detected during current or previous surveys, and no records exist within a 10 km radius of the Study Area. However, this species is known to occur within the Blue Mountains National Park. Suitable habitat for this species does occur within the Study Area. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1** as well an AoS (EPBC Act) in **Appendix 2**.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
Phascolarctos cinereus Koala (V, V*)	Occurring along the east coast of Australia and extending into woodland, mulga and River Red Gum forests west of the Great Dividing Range, the Koala occurs across all such suitable areas of NSW. Koalas inhabit a variety of eucalypt woodlands and forests including coastal forests, the woodlands of the tablelands and western slopes, and the riparian communities of the western plains (Strahan 1995). However, the sustained distribution of the species is generally limited to areas containing large densities of preferred feed trees including *Eucalyptus tereticornis*, *E. camaldulensis*, *E. robusta*, *E. punctata* and *E. parramattensis* (Phillips *et al.*, 2000; Strahan 1995).	A female Koala has been **recorded** in a Eucalypt tree along the Beecroft Trail (near the Kangaroo Creek road), within the Angus Place lease area (MKES 2008c).	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1** as well an AoS (EPBC Act) in **Appendix 2**
Cercartetus nanus Eastern Pygmy Possum (V)	Found in south-eastern Australia from southern QLD to eastern SA and into Tasmania (Strahan 1995). In NSW, it extends from the coast inland as far as the Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath. The species prefers habitats with an abundance of Banksias and myrtaceous shrubs and trees including eucalypts and bottlebrushes where it feeds on nectar and pollen, supplementing its diet with fruits and insects when nectar sources are lacking (Strahan 1995).	This species has been **recorded** within the Study Area.	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Petaurus australis Yellow-bellied Glider (V)	Has a patchy distribution across a wide range of eastern and south-eastern Australia and is generally a coastal species in NSW, extending inland to adjacent ranges (NPWS 2003a). The species is patchily distributed in a range of habitat types, but generally is associated with tall, mature eucalypt forest in regions of high rainfall (Strahan 1995).	This species was not recorded within the Study Area during fieldwork. Five records exist for this species within a 10 km radius of the Study Area (NSW Atlas Data 2013). Chance of occurrence is low, but cannot be entirely discounted. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Petaurus norfolcensis Squirrel Glider (V)	The Squirrel Glider is sparsely distributed along the east coast and immediate inland districts from western Victoria to north Queensland (NPWS 1999). Individuals have been recorded in a diverse range of vegetation communities, including Blackbutt Forest, Red Gum and red Bloodwood Forests, Coastal Banksia heathland and Grey Gum / Spotted Gum / Grey Ironbark dry hardwood forests of the Central NSW Coast (Quin 1995). Important habitat includes areas where one or more Eucalypt species occur that flower heavily in winter or the presence of good stands of winter-flowering Banksias (Quin 1995), whilst the availability of tree hollows may be a limiting factor to the species' persistence in an area (Strahan 1995).	This species has been **recorded** within the Study Area in previous surveys (MKES 2006a).	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Potorous tridactylus tridactylus Long-nosed Potoroo (mainland subsp.) (V, V*)	Long-nosed Potoroo has a patchy distribution throughout south-eastern Australia and Tasmania with an isolated population occurring in south-west WA. Known from a variety of habitats, including dry and wet sclerophyll forests with dense groundcover, and dense coastal heathlands (Strahan 1995). Soft (often sandy) substrates are preferred by this species, with the distribution of the species dependent upon access to some form of dense vegetation for shelter and the presence of an abundant supply of fungi for food (Strahan 1995).	This species was not detected during current or previous surveys, and no records within a 10 km radius of the Study Area exist. Potential habitat within the Study Area may exist. However, owing to the lack of records within the Newnes Plateau it is considered **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Petrogale penicillata Brush-tailed Rock-wallaby (E,V*)	Historically this species was spread over much of NSW aside from the arid west. It is now absent west of the Great Divide aside from one population in the Warrumbungle Ranges, and the overall distribution is fragmented into small isolated populations across most of its range (DECC 2008).The species inhabits cliffs and other steep rocky areas that have an association with shelters, overhangs and/or caves, favouring those with a northerly aspect that provides adequate sun in the morning and evenings. The species also relies on adjacent areas of wooded and grassy habitats to provide foraging resources (Strahan 1995).	This species was not recorded during fieldwork and only one record for this species exists within a 10 km radius of the Study Area (Atlas of NSW Wildlife 2013). Steep rocky areas do occur within the Study Area, offering potential habitat for this species. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an AoS (EPBC Act) in **Appendix 2**.
Pteropus poliocephalus Grey-headed Flying-fox (V, V*)	The Grey-headed Flying Fox is endemic to Australia and presently occurs along the east coast from Bundaberg in Queensland to Melbourne, Victoria and is infrequently encountered west of the Great Dividing Range (Strahan 1995). A blossom-eater, frugivore and nectarivore of habitats such as rainforests, open forests, woodlands, Melaleuca swamps and Banksia woodlands, it is also known to feed on commercial fruit crops (Churchill 2009; Strahan 1995).	This species was not detected during current or previous surveys, and no records within a 10 km radius of the Study Area exist. This species is unlikely to inhabit areas of high altitudes such as those within the Study Area. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
Saccolaimus flaviventris Yellow-bellied Sheathtail Bat (V)	Wide-ranging across Australia and covering the whole state of NSW, this species occurs in almost all habitat types – from wet and dry sclerophyll forest, open woodland, acacia shrubland, mallee, grasslands and desert (Churchill 2009). It requires small hollows in trees to roost, but has been identified using abandoned Sugar Glider nests (Strahan 1995; Churchill 2009).	This species has been **recorded** within the Study Area.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Mormopterus norfolkensis Eastern Freetail-bat (V)	This species exists from the east coast of NSW south of Sydney to near Brisbane in QLD, with most records collected from dry eucalypt forest and woodland east of the Great Divide where it forages above the canopy or along forest edges (Churchill 2009). It roosts in tree hollows, under bark and within man-made structures (Churchill 2009; Strahan 1995).	This species has been **recorded** within the Study Area in previous surveys (MKES 2007, 2008c).	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Chalinolobus dwyeri Large-eared Pied Bat (V, V*)	Distributed from south-east QLD to NSW from the coast to the western slopes of the Great Dividing Range (Churchill 2009). In NSW, the known distribution occurs in Coolah Tops, Mt Kaputar and Warrumbungle National Parks, the Sydney Basin and the western slopes and plains including Pilliga Nature Reserve (DERM 2011). This species is dependent on the presence of diurnal roosts for shelter which include disused mine shafts, caves, overhangs and abandoned fairy martin (*Hirundo ariel*) nests (Churchill 2009). Roosts are generally in close proximity to fertile woodland valley habitats in which this species forages including dry and wet sclerophyll forest, grassy woodland, *Callitris* dominated forest, tall open eucalypt forest with rainforest understorey, sub-alpine woodland and sandstone outcrop country (DERM 2011).	This species has been **recorded** within the Study Area.	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1,** as well an AoS (EPBC Act) in **Appendix 2**.
Chalinolobus picatus Little Pied Bat (V)	The Little-Pied Bat is found in inland Queensland and NSW (including Western Plains and Slopes), extending slightly into South Australia and Victoria (Churchill 2009). It occurs in a variety of open forests, woodlands and shrublands; roosting in caves, rocky outcrops, mine shafts and tunnels as well as in tree hollows and buildings (Duncan *et al.*, 1999).	This species was not identified during desktop assessments or recorded onsite during targeted field surveys. However, it has been recorded within Clarence (BMS 2009d). Potential roosting and foraging habitat exists for this species. As a result, there is **potential** for this species to occur within the Study Area.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Falsistrellus tasmaniensis Eastern False Pipistrelle (V)	This species is distributed from south-east QLD south along the NSW coast into Victoria and Tasmania and is found in a variety of forest types such as open forests, woodlands and wetter sclerophyll forests (usually with trees >20m) (Churchill 2009). The species generally roosts colonially in hollow trunks of eucalypt species (Churchill 2009).	This species has been **recorded** within the Springvale Lease Area in previous surveys (MKES 2006b, 2006c, 2008a and BMS 2009a, 2010a, 2011a, 2012a, 2012h).	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Miniopterus schreibersii oceanensis Eastern Bentwing Bat (V)	Occurs along the east and north coasts of Australia. This species utilises a range of habitats for foraging, including rainforest, wet and dry sclerophyll forests, woodlands and open grasslands. Requires caves or similar structures for roosting habitat such as derelict mines, disused buildings and storm-water tunnels (Churchill 2009).	This species has been **recorded** within the Study Area.	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Nyctophilus corbeni South-eastern Long-eared Bat (V, V*)	A recently described species, this species is the south-eastern form of the Greater Long-eared Bat (*Nyctophilus timoriensis*) that is restricted around the Murray-Darling Basin in south-eastern Australia. It is distributed throughout inland NSW, except in the north-west area that is dominated by treeless plains. They can occur in a range of habitat types including but not limited to Box, Ironbark, Bulloak, Brigalow, Belah, Smooth-barked Apple and Cypress Pine woodlands, and they roost in tree hollows and fissures (Churchill 2009).	This species was not detected during current or previous surveys, and no records within a 10 km radius of the Study Area exist. This species is typically a more western species. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Scoteanax rueppellii Greater Broad-nosed Bat (V)	Occurs only along the eastern coastal strip of Queensland and NSW where it is restricted to the coast and adjacent areas of the Great Dividing Range. In NSW, it extends as far south as the Bega Plain. Most commonly found in wet forest, however, it can also occur in lightly wooded areas and open spaces/ ecotones (Churchill 2009). The species roosts in tree hollows, cracks and fissures along with exfoliating bark however it has also been recorded in roofs of buildings (Churchill 2009; Duncan *et al.*, 2000).	This species has been **recorded** within the Study Area in previous surveys (BMS 2009c, 2010c).	Known habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Vespadelus troughtoni Eastern Cave Bat (V)	Distributed along both sides of the Great Dividing Range in Queensland and the northern half of NSW. As the name suggests, it is a cave dwelling species known from wet sclerophyll forest and tropical woodlands from the coast to the drier forests of the semi-arid zone	This species was not recorded during field surveys and only two records for this species exist within a 10 km radius of the Study Area (Atlas of NSW Wildlife 2013). Potential foraging habitat for this species is widespread across the Study Area, as are rock crevices and caves which	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
	(Churchill 2009). It has been found roosting in small groups in relatively well-lit sandstone overhangs, in mine tunnels and occasionally in buildings (Strahan 1995).	offer roosting habitat for this species. This species could **potentially** occur.	
Pseudomys fumeus Smoky Mouse (CE, E*)	Distributed over Victoria, NSW and ACT but with small fragmented populations; in NSW it is confined to the south-eastern corner in areas such as Kosciusko NP, Bondo State Forest, Buccleugh SF and South-East Forests NP (Menkhorst and Broome 2008). Occurs in a variety of habitats within its range, from coastal heath to dry ridgeline forest, sub-alpine heath and occasionally wetter gullies (Menkhorst and Broome 2008). A consistent feature of habitat occupied by the Smoky Mouse is that bush-pea species are present, combined with availability of underground fungi for sustenance during winter and potential shelter such as woody debris and/or rocks (Menkhorst and Broome 2008; Strahan 1995).	The distribution of this species within NSW is limited to the south-east corner of the state. This species is **unlikely** to occur.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Pseudomys novaehollandiae New Holland Mouse (V*)	Distributed across Tasmania, Victoria, NSW and QLD, predominantly in coastal locations (Strahan 1995), however, some records exist up to 100 km inland and a record exists for the species on the western slopes of the Great Dividing Range as recently as 2005 (Murphy 2005). The species prefers areas with a soft substrate for digging burrows within which it seeks refuge, and forages within habitats such as heathlands and vegetated sand dunes (Strahan 1995).	This species was not recorded within the Study Area during fieldwork. OEH Atlas of NSW Wildlife Data (2013) shows a scattering of records of this species within the Wollemi National Park and one record within the Newnes State Forest. Suitable habitat exists for this species within the Study Area. This species could **potentially** occur.	Potential habitat for this species occurs within the areas of predicted subsidence and ESAs. Therefore, it has the **potential** to be impacted. An AoS (EPBC Act) has been applied to this species in **Appendix 2**.
Fish			
Maccullochella peelii Murray Cod (V*)	The largest freshwater fish in Australia found extensively throughout the Murray Darling Basin in the south-east region of NSW. Occurs in a diverse range of habitats including rocky clear streams, turbid rivers and billabongs (McDowall 1996).	Neither this species nor adequate habitat for its survival was discovered during fieldwork. No previous records exist for this species within the Lithgow LGA. Therefore, it is considered **unlikely** that the species occurs within the Study Area.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Macquarie australasica Macquarie Perch (E*)	Macquarie Perch are found in both river and lake habitats within their range, preferring the upper reaches of rivers and their tributaries. They spawn through spring and summer in shallow upland streams or the flowing sections of rivers. There are thought to be at least two forms of the species, one of which occurs within the Murray-Darling basin in the upper reaches of the Murray, Murrumbidgee and Lachlan Rivers and another form within more coastal South-eastern NSW including the Hawkesbury and Shoalhaven Rivers (Lintermans 2007).	Neither this species nor adequate habitat for its survival was discovered during fieldwork. No previous records exist for this species within the Lithgow LGA. Therefore, it is considered **unlikely** that the species occurs within the Study Area.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Prototroctes maraena Australian Grayling (E*)	The species is diadromous, migrating between rivers, their estuaries and coastal seas across the south-east of the continent including southern NSW, Victoria and Tasmania. The adults are known to occur up to 100 km inland, inhabiting freshwater rivers and streams that are characterised by gravelly substrates with alternating pools and riffles, but has also been recorded in turbid waters. Larvae and juveniles inhabit more estuarine areas, and there appears to be an obligatory marine stage during the juvenile phase (Backhouse *et al*., 2008).	Neither this species nor adequate habitat for its survival was discovered during fieldwork. No previous records exist for this species within the Lithgow LGA. Therefore, it is considered **unlikely** that the species occurs within the Study Area.	This species is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.
Threatened Ecological Communities			
Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion (E)	This community occurs in the headwaters of water courses draining the Newnes Plateau. It occurs where low slope gradients and vegetation impede water flow in headwater valleys and is dominated by sedges and shrubs that favour poorly drained sites. The community occurs at higher elevations than Blue Mountains sedge swamps and in the Bell and Clarence area the transition between these communities occurs at approximately 850-950 m. Newnes Plateau Shrub Swamp has a greater dominance of shrubs when compared to Blue Mountains Sedge Swamps.	This community has been **recorded** within the Study Area.	Areas of this community occur within the areas of predicted subsidence. Therefore, it has the **potential** to be impacted. A 7-Part Test of significance (TSC Act) has been applied to this community in **Appendix 1**.
Temperate Highland Peat Swamps on Sandstone (E*)	The Temperate Highland Peat Swamps on Sandstone ecological community comprises temporary or permanent swamps with a substrate of peat over sandstone, and vegetation characterised by the presence of sedges, graminoids (grass-like plants) and forbs (herbaceous non-grass or grass-like plants) with or without shrubs (TSSC 2005). The swamps generally occur at altitudes from around 600 to 1200 m above sea level and are restricted to the South Eastern Highlands and Sydney Basin Interim Biogeographic Regionalisation of Australia (IBRA) (see	This community has been **recorded** within the Study Area.	Areas of this community occur within the areas of predicted subsidence. Therefore, it has the **potential** to be impacted. An AoS (EBPC Act) has been applied to this community in **Appendix 2**.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
	Environment Australia 2000) regions in New South Wales.		
Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions (E, E*)	The Montane Peatlands community is associated with accumulated peaty or organic-mineral sediments on poorly drained flats in the headwaters of streams. It occurs on undulating tablelands and plateaux, above 400-500 m elevation, generally in catchments with basic volcanic or fine-grained sedimentary substrates or, occasionally, granite. Montane Peatlands and Swamps comprises a dense, open or sparse layer of shrubs with soft-leaved sedges, grasses and forbs. It is the only type of wetland that may contain more than trace amounts of *Sphagnum* spp., the hummock peat-forming mosses. Small trees may be present as scattered emergents or absent.	This community was mapped by DEC 2006 within the west of the Study Area. This community is **likely** to occur.	This community was mapped by DEC (2006) far from the areas of predicted subsidence and ESAs. It is therefore **unlikely** to be impacted.
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland (CE*)	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* (White Box), *E. melliodora* (Yellow Box) and *E. blakelyi* (Blakely's Red Gum). 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 groundlayers are rare. Modified sites include the following: 1. areas where the main tree species are present ranging from an open woodland formation to a forest structure, and the groundlayer is predominantly composed of exotic species; and 2. sites where the trees have been removed and only the grassy groundlayer and some herbs remain.	This community was mapped by DEC 2006 within the west of the Study Area. This community is **likely** to occur.	This community was mapped by DEC (2006) far from the areas of predicted subsidence and ESAs. It is therefore **unlikely** to be impacted.
Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions (E)	Occurs as an open-forest, woodland or open woodland. This community may also occur as a secondary grassland where the trees have been removed, but the groundlayer remains. The main tree species are *Eucalyptus pauciflora* (Snow Gum), *E. rubida* (Candlebark), *E. stellulata* (Back Sallee) and *E. viminalis* (Ribbon Gum), either alone or in various combinations. The trees may occur as pure stands, mixtures of the four species or in mixtures with other trees, including wattles. The community commonly occurs on valley floors, margins of frost hollows and on footslopes and undulating hills. It occurs between approximately 600 and 1400 m in altitude on a variety of substrates, including basalt, sediments, granite, colluvium and alluvium.	This community was mapped by DEC 2006 within the west of the Study Area. This community is **likely** to occur.	This community was mapped by DEC (2006) far from the areas of predicted subsidence and ESAs. It is therefore **unlikely** to be impacted.
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion (E*)	Occurs in areas of high rainfall ranging from 950 to 1600 mm/year on igneous rock, in or adjacent to, the Sydney Basin Bioregion. Generally occurs at elevations between 650 and 1050 m above sea level. A tall open forest with a sparse dense layer of shrubs and vines, and a diverse understorey of native grasses, forbs, twiners and ferns (Keith 2004).	No suitable basalt derived habitats exist within the Study Area. This community is **unlikely** to occur.	This community is unlikely to occur within the Study Area and is therefore **unlikely** to be impacted.

Key:

V	Vulnerable Species under the TSC Act	V*	Vulnerable Species under the EPBC Act
E	Endangered Species under the TSC Act	E*	Endangered Species under the EPBC Act
CE	Critically Endangered under the TSC Act	CE*	Critically Endangered under the EPBC Act

5.0 Avoidance Measures

5.1 Surface Disturbance

The project includes the construction of surface facilities within the Study Area comprising infrastructure for mine ventilation, storage and underground delivery of stone dust, concrete and ballast, hydrocarbon storage floxal unit, electrical reticulation, water reticulation, water management, communications and other ancillary services and activities. The Project may also require track upgrades and widening in specific areas. Removal of vegetation is subsequently required to accommodate the proposed surface infrastructure. These facilities will be constructed within the boundaries of the ESAs (see **Section 1.2**).

Initial design of the surface infrastructure aimed to utilise existing tracks as much as possible whilst still enabling the required facilities to operate as required. The use of existing tracks significantly avoids the amount of clearing required. This has resulted in just three additional tracks required to be cleared for access to ESA locations. Positioning of surface infrastructure also considered topography, with proposed access tracks and facilities being located on flatter ridge-tops. Locating infrastructure in these areas avoids the need to clear additional areas to establish cutting in slopes and also reduces risks of soil erosion and sedimentation.

Dedicated targeted surveys were undertaken within the ESAs in order to identify threatened species and EECs, as well as to gain a perspective of particular habitat attributes, including occurrence of hollow-bearing trees and animal burrows. This data was collected to inform avoidance measures and any unavoidable impacts that follow. Following targeted surveys, an avoidance mapping exercise was undertaken to identify significant ecological features within the ESAs. This was provided to the Applicant such that ecological constraints could be analysed and avoided as required. This mapping is provided in **Appendix 5**.

Targeted surveys recorded two threatened flora species within the ESAs, namely *P. hindii and V. blakelyi*. All locations of *P. hindii and V. blakelyi* have been recorded with a GPS unit, which has achieved sub-metre accuracy. Therefore, as part of detailed assessment of construction requirements, including track upgrades, consideration has been afforded to avoiding these species. *P. hindii* was recorded along the edges of the existing tracks, predominately along Sunnyside Ridge Road (53 stems at 14 locations) and an unnamed fire trails (45 stems at seven locations). One individual of *V. blakelyi* was recorded along Sunnyside Ridge Road within the ESAs. Due to avoidance measures implemented along this road, all *P. hindii* and *V. blakelyi* found along this track will be avoided. Where the narrower fire trails require widening, detailed avoidance mapping has ensured that no *P. hindii and V. Blakelyi* will require removal.

It was determined that overhead power lines and potential associated asset protection zones may impact considerably upon native vegetation and State-listed threatened species such as *P. hindii*. By proposing to trench power lines, vegetation clearing and the potential risk of bushfire and further hazards is significantly reduced.

An area of MU 51 - Newnes Plateau Hanging Swamp was recorded within an ESA (see **Map 3**, **Appendix 5**). This vegetation community is commensurate with the EPBC Act listed EEC *Temperate Highland Peat Swamps on Sandstone*. This particular area of EEC was not mapped by DEC (2006) and therefore represents an addition to the known occurrences of this EEC in the locality. Modifications to the ESA boundary was undertaken to completely avoid this EEC.

During targeted surveys over the ESAs, the presence of hollow-bearing trees was assessed. The arboreal habitats along the ridges, where the surface facilities are proposed, were found to be generally consistent in value, with specific vegetation communities occupying large areas relative to the amounts of clearing proposed. With this, the presence and density of tree hollows within and surrounding the proposed surface

facilities footprint was found to be generally consistent. Given the limited choices of placement of surface facilities, the hierarchy of avoidance first considered threatened species and EECs. The complete avoidance of hollow-bearing trees is unlikely to be feasible due to the consistency of this habitat features over the limited areas available to position the facilities. Therefore, losses of tree hollows will be primarily limited by ensuring that the smallest footprint required for surface facilities is maintained, however, some loss of tree hollows is likely.

Common Wombat (*Vombatus ursinus*) burrows were observed and recorded within the proposed surface facilities footprint. These habitat features are also difficult to avoid due to the relative abundance in surrounding habitats. Therefore, if any Wombat burrows require removal, surveys to determine burrow activity and best practice exclusion methods can be employed to ensure harm to individual animals is avoided. An individual Common Wombat can have up to 13 burrows within its home range (Strahan, R. (ed). 1995). Therefore, the impacts to this species would be minimal.

The purpose of the ESAs is to allow for a degree of flexibility in final location and design of surface infrastructure. The targeted surveys and avoidance mapping exercise has, however, highlighted areas within the ESAs that are no longer viable options for clearing. It is acknowledged that the environments being assessed are likely to change over time. This includes the potential for threatened flora to grow within new areas prior to clearing and construction being undertaken. These measures ensure that known and therefore viable habitats for the threatened flora recorded are avoided. As the proposed infrastructure will be required in stages, there may be future opportunities to revisit avoidance considerations, including threatened species and habitats, including hollow-bearing trees, and finalise the micro-siting of project infrastructure within the ESAs.

No other habitat features of note, such as caves or rock outcrops were recorded within the ESAs.

5.2 Subsidence

Where feasible, the design investigations aim to avoid and/or reduce potential adverse impacts to flora and fauna. For example, to avoid potential impacts at Twin Gully Swamp, proposed LW1010 (that will be directly beneath this swamp) has been shortened. In addition proposed LW1013 and LW1014 have been divided into two “A” and “B” longwalls, with “step-arounds” created to avoid environmentally sensitive features.

Due to their positions in the landscape, complete avoidance of swamps in mine plan design is not feasible. However, specific mitigation measures are proposed to ensure the protection from subsidence related impacts and this is further discussed in **Section 7.2**.

5.3 Mine Water Discharge

In April 2009, significant mine water discharges occurred at LDPs which discharge into the Wolgan River catchment upstream from Narrow Swamp and East Wolgan Swamp. Following the cessation of emergency discharges, two isolated areas of peat slumping were located in East Wolgan Swamp. Narrow Swamp also experienced severe scour, head cut, and sedimentation.

The damage to those swamps affected by the emergency mine water discharge has prompted Centennial to find an alternative to emergency discharge of mine water that would avoid the swamps. The Project includes the construction of the SDWTS duplication. This will ensure that mine water is discharged both to the SDWTS, which carries water to the Wallerawang Power Station, and at Licensed Discharge Points (LDP), which discharge into minor water courses that feed directly into the Coxs River. This construction of the SDWTS duplication results in complete avoidance of any future potential impacts to Newnes Plateau swamp habitats as a result of mine water discharge.

6.0 Potential Impacts

The following section provides an overview of the potential direct, indirect, cumulative and facilitative impacts associated with the Project. This overview was used to inform the potential for impacts to occur to threatened species and EECs (**Section 4**). The impacts identified herewith also inform the TSC Act 7 Part Test of Significance and EPBC Act Assessment of Significance in **Appendix 1** and **2** respectively.

6.1 Surface Infrastructure Establishment

The Project involves the construction of surface facilities within the Study Area comprising infrastructure for mine ventilation, storage and underground delivery of stone dust, concrete and ballast, hydrocarbon storage floxal unit, electrical reticulation, water reticulation, water management, communications and other ancillary services and activities. The installation of the surface facilities will require the removal of habitats potentially suitable for threatened flora and fauna species. The specific impacts of the proposed vegetation removal are discussed below.

6.1.1 Vegetation

The proposed surface infrastructure is proposed to encompass a total maximum area of approximately 23.24 ha containing native vegetation. A breakdown of the vegetation communities that occur within the proposed surface infrastructure footprint is provided in **Table 9**.

Table 9 Vegetation within Proposed Surface Infrastructure Footprint.

Vegetation Community	Proposed Clearing Area (ha)	Extent Mapped by DEC (2006)	Proposed Clearing percentage (%)
07 Newnes Plateau Narrow - Leaved Peppermint - Mountain Gum - Brown Stringybark Layered Forest	1.10	2477.21	0.04
14 Tableland Mountain Gum - Snow Gum - Daviesia Montane Open Forest	0.16	1713.	0.01
26 Newnes Plateau Narrow-leaved Peppermint - Silvertop Ash Shrubby Woodland on Ridges	8.20	4996	0.16
26a Newnes Plateau Gum Hollows varient: Brittle Gum - Mountain Gum, Scribbly Gum - Snow Gum Shrubby Open Forest	0.11	1537	0.01
28 Sandstone Plateau and Ridge Scribbly Gum - Silvertop Ash Shrubby Woodland	5.45	3239.34	0.17
29 Sandstone Slopes Sydney Peppermint Shrubby Forest	1.84	2949	0.06
30 Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	6.38	68	9.38
Total	**23.24**	**116979.55**	**0.14**

6.1.2 Flora

Two threatened flora species have been recorded within the ESAs, namely *P. hindii* and *V. blakelyi*. Avoidance measures (**Appendix 5**) will ensure no recorded *P. hindii* or *V. blakelyi* will be lost. Observations of the vegetation communities in which *P. hindii and V. blakelyi* occur have been previously discussed in **Section 3.2.5**. Whilst both species have observable common habitat associations, they may also occur in a range of other habitats within the Study Area. Therefore, a maximum of 23.24 ha of potential habitat for *P. hindii and V. blakelyi* is proposed to be removed.

Targeted surveys across the proposed surface infrastructure footprint did not record any additional threatened flora. With consideration of the outcomes of **Table 8**, eight additional threatened flora have been identified as having the potential to occur within the proposed surface infrastructure footprint. As per **Table 9** above, the habitats within the surface infrastructure footprint are generally characterised by dry shrubby to

grassy woodlands and forests. These are on rocky or sandy substrates. **Table 10** considers the habitats available within the proposed surface infrastructure footprint – with consideration of the habitat preferences, seasonality and detectability of these additional threatened flora species. It is noted that the proposed surface infrastructure footprint was intensively surveyed for the presence of the threatened flora listed in **Table 10** below. Additionally, the proposed footprint is predominately located along existing heavily utilised vehicle tracks. The lack of records or otherwise within this very accessible location has also been acknowledged where appropriate.

Table 10 Likelihood of Occurrence of Threatened Flora Within Proposed Surface Infrastructure Footprint

Species	Habitat and Detectability	Likelihood of Occurrence within Surface Infrastructure Footprint
Boronia deanei Deane's Boronia (V, V*)	Wet heaths, swamps and streams. This species is easily detectable all year.	No suitable habitat is present. This species is unlikely to occur.
Caesia parviflora var. *minor* (E)	Damp places in open forest on sandstone. This is a small inconspicuous species that may be difficult to detect.	Minor depressions within the forest and woodland habitats may provide suitable damp places for this species.
Eucalyptus pulverulenta Silver-leaved Gum (V, V*)	Crests or upper slopes of moderately steep hillsides or mountains. This species is easily detectable all year.	Potentially suitable habitats exist, however, this species is easily detectable and no records exist within close proximity to the proposed footprint. This species is unlikely to occur.
Acacia bynoeana Bynoe's Wattle (V, V*)	Occurs in heath or dry sclerophyll forest on sandy soils.	Potentially suitable habitats exist and therefore have potential to occur. However, the likelihood of occurrence is reduced due to the lack of records over this frequently visited area of the Newnes Plateau.
Genoplesium superbum (E)	Due to the paucity of information on this species' local occurrence, OEH was contacted for more information. It was established that the known local occurrence of this species is well outside the Study Area, within dry shrubby woodland on a slope. This species can only be detected during its flowering period (January - March) but has not been recorded flowering during several of the years since it was first discovered locally in 2004.	Detailed habitat associations for the local occurrence of this species have not been studied. Based on the available information, the possible presence of this species within the proposed footprint cannot be completely discounted. However, the likelihood of occurrence is reduced due to the lack of records over this frequently visited area of the Newnes Plateau.
Lastreopsis hispida Bristly Shield Fern (E)	Moist humus-rich soils in wet forest and rainforest gullies. This species is detectable all year.	No suitable habitat is present. This species is unlikely to occur.

Species	Habitat and Detectability	Likelihood of Occurrence within Surface Infrastructure Footprint
Persoonia acerosa Needle Geebung (V, V*)	Occurs in dry sclerophyll forest, scrubby low-woodland and heath. This species is strongly associated with disturbance margins such as road and trail verges. It is generally 1-2 m tall, with bright green foliage and is easily detectable all year.	Despite the noted trait of this species favouring disturbance margins, no individuals occur along the various tracks within and around the surface footprint. Additionally, this species is easily detectable and was not recorded during targeted surveys. This species is unlikely to occur.
Prostanthera cryptandroides subsp. *cryptandroides* Wollemi Mintbush (V, V*)	Dry sclerophyll forested slopes and gullies in rocky areas, particularly at the base of scree slopes and sandstone boulders. This species is easily detectable all year.	The flat ridge-tops of the proposed footprint are not the commonly associated habitats for this species. This species is unlikely to occur.

Persoonia hindii and *V. blakelyi* have been recorded within the ESA. Due to their inconspicuous nature and specific habitat associations, three additional species are considered to have potential to occur within ESAs, namely *Caesia parviflora* var. *minor*, *A. bynoeana* and *G. superbum*. It is noted, however, that records and information of these species are extremely limited.

If present, *C. parviflora* var. *minor* would mostly be isolated to damp depressions that may occur within the proposed footprint. Other potential areas of habitat for *C. parviflora* var. *minor* within the wider Study Area may include any damp depression of seepages within the numerous forest communities that occur therein. Therefore, if individuals of a local population of *C. parviflora* var. *minor* are to be impacted upon by proposed clearing, it is highly likely that the population would extend throughout the Newnes Plateau. An assessment of significance (7-Part Test) has been undertaken for *C. parviflora* var. *minor* in **Appendix 1**. This assessment has found that, given the wide representation of potential habitats for this species, it is unlikely to be affected by the Project.

An abundance of suitable habitat for *A. bynoeana* occurs throughout the Newnes Plateau. If present it is likely that a local population would extend throughout the heaths and woodlands that occur on sandy soils and into the adjacent national parks. Due to the wide representation of potential habitats for this species, it is unlikely to be significantly affected by the Project through either clearing or subsidence related impacts.

G. superbum has been recorded within one location within 10 km of the Study Area. The OEH Atlas of NSW Wildlife record of this species has been spatially denatured in order to protect this species from the risk of being collected. The habitat of the local occurrence of this species can be generally described as shrubby woodland on a slope. Habitats within the ESAs have potential to support this species. If present, there is a high likelihood that a local population would extend outside the ESAs, given the large areas of commensurate habitat surrounding the ESAs. An assessment of significance (7-Part Test) has been undertaken for *G. superbum* in **Appendix 1**. This assessment has found that, given the wide representation of potential habitats for this species, it is unlikely to be affected by the Project through either clearing or subsidence related impacts.

6.1.3 Fauna

As per **Table 9,** the habitats within the proposed surface infrastructure areas are generally characterised by dry shrubby to grassy woodlands and forests, with up to 23.24 ha potentially being removed. Habitat features

within this area includes grasses, shrubs and ground debris that may be used by small reptiles and mammals, providing shelter for these species and prey for a variety of birds and fauna. The Project may therefore constitute a direct loss of potential habitat for threatened fauna, including Spotted-tailed Quoll, Southern Brown Bandicoot and New Holland Mouse. This would also remove hunting habitats for species of owl and threatened woodland birds, such as Brown Treecreeper, Hooded Robin, Scarlet Robin and Flame Robin.

The proposed footprint does not have areas of particularly rocky habitats, thus limited sheltering use by reptiles with this habitat preference, such as the Broad-headed Snake, is expected. Additionally, the footprint is separated from rocky escarpments by approximately 400 m and would therefore not impact upon potential Brush-tailed Rock-wallaby habitat. No caves or similar structures were recorded that may be used by cave dwelling microbats.

The loss of midstorey and canopy trees would remove nesting and foraging habitat for threatened bird species, as well as foraging habitats for threatened arboreal mammals, microbats and hunting habitat for the Broad-headed Snake and Rosenberg's Goanna. Specific foraging habitat niches within the proposed surface infrastructure footprint include Banksia species utilised by Eastern Pygmy Possum, *Allocasuarina* species utilised by Glossy Black-Cockatoos and nectar producing trees and shrubs utilised by nectivorous birds and mammals. Foraging habitat for the Koala is limited to secondary feed trees within the proposed footprint. Therefore, some Koala habitat will be lost.

Much of the proposed footprint is also occupied by hollow-bearing trees. The location of hollow-bearing tree quadrats was chosen to represent the habitat located within the ESAs, and resulted in an approximate density of 18 hollow-bearing trees per hectare. These numbers were found to be generally consistent across quadrats and similar habitats across the wider Study Area, allowing for the extrapolation of these results to determine the likely impact on hollow-bearing tree numbers within areas to be developed for surface infrastructure. Given that 23.24 ha of forested habitat is located within the proposed surface infrastructure footprint, an extrapolated total of 418 hollow-bearing trees are estimated to occur within the surface footprint.

Loss of hollows will constitute a loss of habitat to hollow dependent arboreal mammals, including Broad-headed Snake (in the summer), Eastern Pygmy Possum, Squirrel Glider and Yellow-bellied Glider. This habitat feature is also likely to be utilised by hollow dependent species of microbats.

Whilst less abundant, hollow sizes were also recorded that would be suitable for supporting forest owls and large species of parrot. The Project will therefore constitute a loss to potential roosting or nesting trees for the Gang-Gang Cockatoo, Glossy Black-Cockatoo and threatened owls. It is noted, however, that the threatened Barking Owl, Powerful Owl and Masked Owl have preferred hollow types, which involve hollows developing from the main stem of the tree. Therefore, there is less likelihood that actual preferred roost trees occur within the surface infrastructure footprint. The Sooty Owl prefers moist tall forests and, therefore, is unlikely to be affected by proposed clearing.

The proposed surface infrastructure footprint does not include areas of swamp habitat. The footprint would not constitute habitats for the Blue Mountains Water Skink or Giant Dragonfly and these species would not be impacted by the proposed clearing. Only marginal potential breeding habitat would be removed for the Giant Burrowing Frog, Stuttering Frog, Red-crowned Toadlet or Littlejohn’s Tree Frog – where proposed tracks cross ephemeral drainage lines. The proposed clearing may cause a loss of potential foraging habitat for these species.

The proposed surface infrastructure footprint occurs within a large area containing contiguous forest, woodland, heath, swamp and rocky habitats. These habitats continue throughout the Newnes State Forest and into the Gardens of Stone National Park, Blue Mountains National Park and Wollemi National Park. For those more mobile species, including the threatened birds, bats, arboreal mammals and terrestrial mammals,

which are likely to be impacted upon by the Project, local populations of these species would extend into these adjacent protected habitats. Those less mobile fauna, such as threatened frogs and the Blue Mountains Water Skink, have specific habitat niches which are not represented within the proposed surface infrastructure footprint and therefore no impacts are expected for these species.

Within the immediate surrounds of the proposed surface infrastructure footprint, commensurate habitat is also available for the threatened species considered to have potential to occur. Approximately 1,395.59 ha of MU 28 Sandstone Plateau and Ridge Scribbly Gum - Silvertop Ash Shrubby Woodland has been mapped across the Study Area. *Eucalyptus sclerophylla* (Scribbly Gum) and *Eucalyptus sieberi* (Silvertop Ash) were noted as having a propensity for hollow development during flora and habitat surveys. Therefore, there are additional habitats containing high hollow densities available to arboreal mammals, as well as large forested areas containing moderate hollow densities in other vegetation communities. Due to the widely available habitats for fauna species within the locality, the proposed clearing is unlikely to significantly impact upon hollow-dependent species.

6.2 Subsidence

6.2.1 Predicted Subsidence

Longwall mining has been undertaken in Angus Place for 34 years. Subsidence monitoring has shown that nearly all measurements are less than those predicted. Based on the monitoring data there is an approximate 95% confidence level that the maximum observed total subsidence will be less than the maximum predicted total subsidence. The maximum observed total subsidence is, on average, around 86% of the maximum predicted total subsidence (MSEC 2014 section 3.7.). There is, therefore, a high level of accuracy between pre-mining modelled subsidence predictions and post-mining measured subsidence.

The maximum predicted total conventional subsidence, after the completion of all the proposed longwalls, is 1700 mm (MSEC 2014 section 4.2.). Longwall mining can result in surface cracking, heaving, buckling, humping and stepping at the surface. The following sections discuss the potential impacts that may be experienced upon the broad habitat types that occur within the Project Application Area. The potential for, and level of, impacts upon threatened species and ecological communities, as a result of the predicted subsidence is discussed within the below sections in relation to those habitats expected to occur within the subsidence extents. The areas of the vegetation communities occurring within the 26.5 degree angle of draw is provided in **Table 11** below.

Table 11 Vegetation Communities within the 26.5 Degree Angle of Draw.

Vegetation Community	Area (ha)
07 Newnes Plateau Narrow - Leaved Peppermint - Mountain Gum - Brown Stringybark Layered Forest	184.48
08 Newnes Sheltered Peppermint - Brown Barrel Shrubby Forest	22.90
14 Tableland Mountain Gum - Snow Gum - Daviesia Montane Open Forest	54.82
26 Newnes Plateau Narrow-leaved Peppermint - Silvertop Ash Layered Open Forest	1119.15
26a Newnes Plateau Gum Hollows varient: Brittle Gum - Mountain Gum, Scribbly Gum - Snow Gum Shrubby Open Forest	123.88
28 Sandstone Plateau and Ridge Scribbly Gum - Silvertop Ash Shrubby Woodland	319.73
29 Sandstone Slopes Sydney Peppermint Shrubby Forest	219.26
30 Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	267.52
43 Pagoda Rock Sparse Shrubland	2.19
44 Sandstone Plateaux Tea Tree - Dwarf Sheoak - Banksia Rocky Heath	8.19
45 Newnes Plateau Tea Tree - Banksia - Mallee Heath	18.03
46 Newnes Plateau Dwarf Sheoak - Banksia Heath	3.82
50 Newnes Plateau Shrub Swamp	10.33

Vegetation Community	Area (ha)
51 Newnes Plateau Hanging Swamp	9.71
59 Non-native Vegetation - Pine plantation / woodlot / shelter	3.81
62 Cleared and Severely Disturbed Areas	0.11
Total	**2637.93**

6.2.2 Potential Impacts to Groundwater Dependent Ecosystems (GDEs)

Two different vegetation types have been identified as potential Groundwater Dependent Ecosystems (GDEs) within the predicted subsidence extent, these being:

- MU 50 - Newnes Plateau Shrub Swamp; and
- MU 51 - Newnes Plateau Hanging Swamp.

This section provides a summary of the potential impacts to GDEs, which includes the Temperate Highland Peat Swamps on Sandstone (listed as an EEC under the EPBC Act) and Newnes Plateau Shrub Swamp (listed as an EEC under the TSC Act). Assessment of impacts to GDEs from subsidence has included consideration of the potential for ecosystem functioning of these systems to be impaired. An 'ecosystem' is defined as:

> *A functional unit consisting of all the living organisms (plants, animals, and microbes) in a given area, and all the non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow* (Serov *et al*., 2012).

'Ecosystem function' is defined as:

> *A fundamental characteristic of ecosystems related to conditions and processes necessary for maintaining ecosystem integrity. Ecosystem function will include such processes as decomposition, nutrient cycling and production. It is generally considered that maintenance of biodiversity is integral to ecosystem function* (Serov *et al*., 2012).

Within peat swamps, water-levels and saturation of soils are important for the maintenance of vegetation and the ecosystem. The waterlogged organic soils of the peat swamps are anoxic, which inhibits breakdown of organic matter and enables peat formation. As soil anoxia also prevents aerobic respiration in the root cells of plants, unless the plant is adapted to these low oxygen conditions, death will occur (Hose *et al*., 2014). The presence of high nutrient, organic-rich peaty soils, as well as sufficient waterlogging, may also affect species selection and diversity throughout a swamp. Changes in swamp hydrology, which may lead to drying of the peat, has the potential to impair the ecological functioning of this system. This may include increased organic matter decomposition, death of those plant species requiring waterlogged soils and alteration of soil conditions, which may open up these habitats to competition from less specialised species. This section considers the predicted change to base flow and depth of standing water in the monitored swamps, in relation to the requirements of these GDEs to maintain ecosystem function.

These GDEs may provide potential habitat for threatened flora, including *B. deanei*, *C. parviflora* var. *minor* and *V. blakelyi*, as well as threatened fauna, including Blue Mountains Water Skink, Giant Dragonfly and threatened frogs. The potential impacts to these species are considered in line with the potential for impact upon their habitats.

Detailed investigations of the relationship between the groundwater and surface water movements, the underlying geology and the proposed mining layout has concluded, through empirical modelling, that the proposed longwall mining would not create interconnected fracturing between the aquifer supporting swamps and the longwalls. This is primarily due to the large vertical distance between extracted coal seam and the swamps, resulting in these swamps being located significantly higher than the predicted fracturing zone. These swamps and their important aquifer zones occur above the semi-plastic Mount York Claystone. The

Mount York Claystone separates the Burra-Moko Head Formation and the Banks Wall Sandstone, which has a thickness typically varying between 4 and 35 m, with an average thickness of around 22 m within the mining area. This unit has been found to act as an aquitard (MSEC 2014 section 4.6.).

Predicted minor ground surface movements above the Mount York Claystone include tilting, subsidence, and, to a lesser degree, valley bulging. Cracks may divert some water temporarily from swamps, but will initially fill with water before eventually filling with silt/peat from within the swamp so that there should be no long-term permanent impact on the groundwater level or flows in the swamp. The elasticity and 'sealing effect' of the Mount York Claystone will prevent interconnectedness between the predicted minor surface cracking and the fracturing zone of longwalls. Whilst fracturing is predicted in the uppermost bedrock within these swamps, enhanced permeability associated with fracturing also tends to be short-lived, as any surface cracking would tend to be naturally filled with sediment during subsequent flow events (RPS 2014a section 7.2).

6.2.2.1 Newnes Plateau Shrub Swamps

MSEC (2014) analysed the predicted gradient changes, as a result of subsidence, for several shrub swamps within the Study Area. For these shrub swamps, the predicted post mining grades are similar to the natural grades within the shrub swamps. There are no predicted significant reductions or reversals of grade. Therefore, it is not expected that there would be any adverse changes in ponding or scouring within the swamps resulting from the predicted mine subsidence movements (MSEC 2014 section 5.12.5.). Nor is it anticipated that there would be any significant changes in the distribution of the stored surface waters within the swamps as a result of the mining induced tilt or vertical subsidence (MSEC 2014 section 5.12.5.).

Diversion of some surface water flows, from upstream of swamps to beneath parts of the shrub swamps may potentially occur. However, the drainage lines upstream of the swamps are generally ephemeral and, therefore, surface water flows occur during and shortly after rainfall events. Any diverted surface water flows are expected to remerge short distances downstream, due to the limited depth of fracturing and dilation and due to the high natural stream gradients.

Projected maximum changes to average baseflows and standing water levels for a range of Newnes Plateau Shrub Swamps is presented in Table 7.2 and 7.3 of the Groundwater Impact Assessment (RPS 2014a) and expanded upon within the CSIRO report (Adhikary and Wilkins 2013). This assessment considers shrub swamps that occur directly over proposed longwalls or within close proximity, and provides a projection of cumulative change as a result of all current and proposed mining operations at Angus Place and Springvale. Due to a lack of empirical data that would otherwise allow accurate estimates of the magnitude and extent of surface cracking as a result of subsidence, the assessment uses three models (scenarios) that differ in assumptions regarding horizontal and vertical rock permeability at different depths above mining operations. An in-depth analysis of each scenario is provided within the CSIRO report (Adhikary and Wilkins 2013) and Groundwater Impact Assessment (RPS 2014a), however can be summarised for our purposes as such:

- 'Base case' scenario – assumes that changes to rock permeability as a result of fracturing after longwall mining occurs throughout all rock strata above the longwalls up to the ground surface;
- 'Truncated-ramp1' scenario – assumes no permeability changes to current values for rock strata higher than 230 m above the longwalls, but is the same as 'Base case' below 230 m; and
- 'Truncated-ramp2' scenario – assumes rock strata higher than 230 m above longwalls are only modified in regards to vertical permeability, not horizontally as in the 'Truncated-ramp1' scenario, but maintains same changes to overall permeability below 230 m as both previous scenarios.

As indicated in the Groundwater Impact Assessment (RPS 2014a) and the Executive Summary of the CSIRO report (Adhikary and Wilkins 2013), the assumptions within the 'Basecase' scenario regarding mining induced changes to permeability of rock strata are considered quite conservative. The assumptions

presented within the 'Truncated ramp1' and 'Truncated ramp2' scenarios are less conservative and, as indicated within the Groundwater Impact Assessment (RPS 2014a), the assumptions provided in the 'Truncated ramp2' scenario are more consistent with the outcomes of the Subsidence Impact Assessment (MSEC 2014) within which the likely degree of fracturing and associated rock permeability changes for the Project have been concluded. The 'Truncated ramp2' results are therefore the most appropriate for the purpose of this impact assessment with respect to the other technical studies involved. Accordingly, and as per the recommendations presented within the Groundwater Impact Assessment (RPS 2014a), we have assumed that the results from the 'Truncated ramp2' simulation are the most appropriate for the purpose of evaluating potential impacts to baseflow and standing groundwater levels to the Newnes Plateau Shrub Swamps, and only these results are considered in our assessment. Projected changes to baseflow and average standing groundwater levels for shrub swamps located within the Study Area are provided below (as sourced from Adhikary and Wilkins 2013) and include:

- Kangaroo Creek Swamp;
- Sunnyside Swamp;
- Tri-Star Swamp; and
- Twin Gully Swamp.

Kangaroo Creek Swamp

Kangaroo Creek Swamp is located within the western portion of the Study Area and is not within the subsidence extents of the proposal. One record for the Giant Dragonfly (*Petalura gigantea*) exists within close proximity of this swamp (NSW Wildlife Atlas Data 2014). Baseflow projections for this swamp are for a maximum decrease of a 'very small volume' (0.002 ML/day) (Adhikary and Wilkins 2013). The associated projected changes to average standing groundwater levels is an approximate drop of 1.2 cm from 10.2 cm above the ground surface at December 2012 to 9.0 cm post mining (Table 40 of Adhikary and Wilkins 2013).

Sunnyside Swamp

Sunnyside Swamp is located in the south of the Study Area between approved Springvale longwall panels LW413 and LW 415, and will not be undermined under current or proposed mining operations. The Giant Dragonfly is known to occur within this swamp (Benson and Baird 2012). Predicted changes to both baseflow and maximum average standing water levels are minimal, with a projected 'small increase' in baseflow representing an increase in average standing groundwater levels from 17.4 cm above the ground surface in December 2012 to 18.0 cm post mining (Table 40 of Adhikary and Wilkins 2013).

Tri-Star Swamp

Tri-Star Swamp is located towards the centre of the Study Area and is located within the subsidence extents for the proposal. No known records exist for threatened fauna or flora species within this swamp. Baseflow projections for this swamp are for a maximum projected decrease of 0.040 ML/day, with an associated decrease in average standing groundwater levels of 4.9 cm from 8.7 cm above the ground surface in December 2012 to 3.8cm post mining (Table 40 of Adhikary and Wilkins 2013).

Twin Gully Swamp

Twin Gully Swamp is located within the central portion of the Study Area, with the eastern half of this swamp located within subsidence extents. No known records exist for threatened fauna or flora species within this swamp. Baseflow projections for this swamp are for a maximum projected decrease of 0.021 ML/day, with an associated decrease in average standing groundwater levels of 1.8 cm from 12.4 cm above the ground surface in December 2012 to 10.6 cm post mining (Table 40 of Adhikary and Wilkins 2013).

Discussion

It should be noted that the modelling projections provided above are the *maximum* changes to baseflow and average groundwater levels as predicted under the 'Truncated ramp2 scenario', the assumptions within which are supported by the Subsidence Impact Assessment (MSEC 2014). The Subsidence Impact Assessment has concluded that there is unlikely to be an impact that would cause ponding or scouring (MSEC 2014), and monitoring of swamp water levels and surface water gauging in previously undermined areas has shown over the life of the current mining operations that no impacts to the swamps or surface water flows have occurred as a result of mining to date at either the Springvale or Angus Place Collieries (RPS 2014a section 7.3.13). Regular seasonal monitoring of the flora and fauna since 2005 have also revealed no observable impacts on the flora and fauna recorded within undermined areas, including GDEs. However, the projections listed above need to be considered within the realm of possibility, and consequentially, a decrease in baseflows and associated standing water levels within several of the swamps listed above.

The most significant reductions to average standing groundwater levels are predicted in Twin Gully Swamp. This swamp has a projected drop in average standing water levels from 12.4 cm to 10.6 cm above the soil surface. The post mining values predicted at Twin Gully Swamp therefore suggest that soil saturation would persist, maintaining water availability for flora and fauna, as well as soil anoxia, allowing for continued peat formation. All other monitored swamps have smaller projected decreases in average standing water levels and monitored swamps are projected to maintain average standing water levels above the surface.

As the CSIRO model measures *average* standing water levels, it is possible that these levels may naturally fall below the surface in certain locations of the swamp. However, highly organic peat soils with low bulk density capillary forces are likely to be saturated for some distance above the water table itself (Hose *et al*., 2014). Modelling of an upland peat swamp on the Buggeroo Plateau, NSW, discussed within Hose *et al*. (2014), suggested that the capillary fringe may extend at least for 10-40 cm above the water table at that swamp. A similar process is likely for the Newnes Plateau Shrub Swamps. The peat swamp studies on the Buggeroo Plateau found that a small number of samples from their study site exceeded 90% soils saturation in the upper fibric layers (0-10 cm depth), despite the water table being at depth (Gough, 2010 in Hose *et al*., 2014). Natural decreases in water levels, in addition to the small predicted decreases from the CSIRO model, are still likely to enable capillary forces to saturate the peat layer. Therefore, a possible reduction in the average standing water levels, by the magnitudes predicted in Adhikary and Wilkins (2013), is unlikely to result in drying of the peat layer.

6.2.2.2 Newnes Plateau Hanging Swamps

Section 7.3.5 of the Groundwater Impact Assessment identifies that the hanging swamps present within the Study Area are associated with the perched aquifer system and not the regional water table. As a result, these systems are heavily reliant on rainfall recharge to the perched aquifer system and are independent of changes to groundwater table levels and associated baseflow modifications.

6.2.3 Potential Impacts to Riparian Habitats

The Study Area contains two minor unnamed drainage lines, which feed the Wolgan River to the west and Carne Creek to the east. These may provided habitat for those threatened frog species that have potential to occur within the Study Area. Potential subsidence related impacts upon riparian habitats may include surface cracking, ponding or erosion due to changes of gradient.

It is expected that fracturing of the bedrock would occur beneath some sections of the drainage lines which are located directly above the proposed longwalls. Where the beds of the drainage lines have exposed bedrock, there may be some diversion of surface water flows into the dilated strata beneath them. However,

it is unlikely that there would be any net loss of water from the catchment, as any diverted surface water is likely to re-emerge into the catchment further downstream (MSEC 2014 section 5.4.3.).

This phenomenon was noted to occur on Kangaroo Creek in late 2009. Surface monitoring recorded a sudden drop in water level. An investigation revealed that this was due to minor cracking and tilting, with the tilting diverting water away from the monitoring devise. The cracking also diverted the water from this point of the creek. The Kangaroo Creek Swamp downstream was recorded as remaining partially full, however, monitoring of the swamp has shown no consequence of the subsidence event.

A similar cracking event had also occurred in 2008 at the site of KC1, a groundwater monitoring weir of Kangaroo Creek. Cracking was found to divert water further downstream. This has shown to have depressed water levels, however ongoing monitoring downstream of the bore shows no impacts to swamp or riparian vegetation.

The cracking incidences, as observed in Kangaroo Creek, indicate that the Project has the potential to cause minor changes to flows within riparian habitats. These changes have not been found to be of a magnitude that any observable or measurable changes to the riparian vegetation can be noted. In most instances, surface cracking would tend to be naturally filled with soil during subsequent flow events – especially during times of heavy rainfall. Subsequently, these minor, localised and, as shown by past mining, isolated impacts are unlikely to impact upon threatened flora or fauna species that may occur therein. It is noted that the void width of longwall 960 (under Kangaroo Creek) was 293.1 m, compared to the reduced void widths proposed for this Project of a maximum of 261 m. Therefore, the potential impacts associated with surface cracking are reduced.

6.2.4 Potential Impacts to Caves and Rocky Habitats

The mining layout has been designed such that the majority of the cliffs and pagoda complexes are located outside the 26.5 degree angle of draw line from the extents of the proposed longwalls (MSEC 2014 section 5.7.). Cliffs and Pagodas provide potential habitat particularly for Broad-headed Snake and Brush-tailed Rock-wallaby. These structures also contain cave structures, which may be utilised by cave-dwelling microbats.

It is unlikely that the cliffs and pagoda complexes would experience any adverse impacts resulting from the extraction of the proposed longwalls (MSEC 2014 section 5.7.3.). Subsequently, no impacts would be expected to potential habitats of the Brush-tailed Rock-wallaby. As cliffs are likely to provide the most suitable cave habitats, no impacts to cave-dwelling bats are also expected. The small numbers of pagodas that occur within the angle of draw are unlikely to experience any adverse impacts resulting from the extraction of the proposed longwalls. There is potential for some rock falls, however, as the Broad-headed Snake uses flat sandstone rocks, steeper more unstable rocks are likely to be less utilised. Consequently, the Broad-headed Snake is unlikely to be impacted by subsidence.

6.2.5 Potential Impacts to Wooded Habitats

No significant impacts to the dry woodland and forest habitats are predicted as a result of subsidence. Localised changes in soil on steeper slopes may result from the downslope movement of the soil, resulting in tension cracks appearing at the tops and along the sides of the steep slopes and compression ridges forming at the bottoms of the steep slopes.

Tension cracks and soil destabilisation may cause local destabilisation of the root zone for some plants where this occurs. It is noted, however, that a number of those threatened flora considered as having potential to occur either respond positively to or readily recover from disturbance, or naturally occur within areas where the soil surface is naturally unstable, such as mountain scree slopes. These species include *P.*

acerosa and *P. cryptandroides* subsp. *cryptandroides*. Notwithstanding, any loss of threatened flora would be highly isolated and would not remove a significant proportion of a soil seed bank such that an area would become unviable to support threatened flora species.

It is highly unlikely that subsidence related ground movements would affect woodland or forest habitats such that they would become in any way unsuitable for any of the threatened fauna that were recorded or could potentially occur. No observable significant impacts to woodland habitats have occurred from subsidence within previously undermined areas of Angus Place.

6.3 Mine Water Discharge

A detailed description of the Mine Water Discharge (MWD) Strategy for the Project is provided in RPS (2014b). The current MWD strategies for Angus Place include discharging at Licensed Discharge Point (LDP) 1. This site flows into the Coxs River. The potential impacts from increased mine water discharge include increases in flow and changes to water quality, particularly increases in salinity. Changes to hydrology and water chemistry have potential to impact upon terrestrial flora and fauna that inhabit the affected riparian environments. **Table 8** identified the following threatened species and ecological communities as having potential to occur within those habitats that may be affected by MWD:

- *Eucalyptus aggregata* (Black Gum);
- *Thesium australe* (Austral Toadflax); and
- Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions.

Extension of operations at Angus Place Mine will result in increased dewatering requirements and increased inflow to underground mine workings that will be required to be managed. The increase in mine water make will be managed through discharge to LDP001, with utilisation of existing capacity of the SDWTS and at a later project stage, the SDWTS will be upgraded from its current capacity of 30ML/d to 50ML/d (RPS 2014b section 1.4.2). This will comprise upgrades of Angus Place's portion of the SDWTS by Angus Place Mine as well as an upgrade of Springvale's portion of the SDWTS by Springvale. The predicted increase in discharge to the Coxs River at LDP001 will help satisfy existing excess demand for water by heavy industry in the Coxs River catchment.

There is no proposed change to surface water management infrastructure at Angus Place Pit Top. As discussed in RPS (2014b section 6.1.1), there is sufficient capacity in current sediment control structures to accommodate existing throughflows at Pit Top, and sediment control infrastructure associated with VSF will be designed in accord with presented requirements. Water balance modelling indicates that there will be an increase in discharge from the current value of 2ML/d to 6.3ML/d in 2022 (the year of maximum contribution from Springvale to the SDWTS). Infrastructure at Angus Place|LDP001 has a discharge limit of 30 ML/d and, therefore, no change is required to accommodate this expected volumetric rate (RPS 2014b section 6.1.1).

Increased dewatering requirements will be managed through transfer to Springvale's SDWTS, which will be upgraded from its current capacity of 30 ML/d to 50 ML/d, to accommodate increased inflows to Springvale's SDWTS from Angus Place Mine. The consequence of increased discharge to the Coxs River, either at Angus Place|LDP001 or through Springvale|LDP009, is not significant as there is excess demand for this water resource in this catchment (RPS 2014b section 6.1.2).

Salt mass balance modelling undertaken by RPS (2014b section 7.2.1) indicates that predicted peak in average salinity in the Coxs River, downstream of the confluence with Kangaroo Creek, is 717µS/cm in 'normal' conditions and is 968µS/cm in 'drought' conditions. The median salinity at LDP001 is 1,010µS/cm and median salinity at LDP002 is 314µS/cm (RPS 2014b section 4.2.2).

Hart et. al. (1991) provide salt tolerance limits of several species of freshwater biota, including *E. aggregata*. *E. aggregata* has a salinity tolerance of up to 12,000 uS/cm. Therefore, this species should tolerate the predicted maximum salinity of the discharged mine water. Hart et. al. (1991) also provide tolerance levels for *E. stellulata* and *E. viminalis*, which have salinity tolerance limits of 12,000 uS/cm and 9,000 uS/cm respectively. These two tree species are common in the Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland EEC. Whilst there is potential for sudden or sustained increases in salinity to cause stress to certain plants, Hart et al. (1990 and 1991) reviewed the biological effects of saline discharges into freshwater systems, and concluded that adverse biological effects would be expected in Australian aquatic ecosystems if salinity was allowed to increase to 1500 µS/cm. The potential maximum salinity of 1200 µS/cm is below this threshold.

No information could be obtained for the salinity tolerance limits of *Themeda australis* (Kangaroo Grass), the common host plant of *T. australe*. Habitats for *T. australe* may be found along the low lying areas adjacent to watercourse that may be affected by mine water discharge. However, as discussed above, expected increase in flows are below flood levels and will remain in bank. Therefore, potential habitats for this species would remain largely unaffected and salinity levels would be particularly low during natural flood events. Predicted salinity changes are therefore unlikely to significantly alter habitats for *E. aggregata*, *T. australe* and Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland.

The current pH levels at the Angus Place discharge points are between 6.5 and 9.0. Therefore, pH is not expected to affect habitats for *E. aggregata*, *T. australe* and Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland.

6.4 Indirect Impacts

Potential indirect impacts associated with the Project may include:

- Fragmentation of landscapes due to surface clearing;
- Edge effects from increased forest edges associated with clearing;
- Introduction of exotic flora and fauna species;
- An increase in runoff from disturbed areas of land; and
- Accidental release of lubricants, oils, hydraulic fluids and fuel into surrounding environments.

The following sections discuss the potential indirect impacts associated with the Project.

6.4.1 Fragmentation

Fragmentation is the process of reducing what was once a continuous area of vegetation or habitat into smaller divided and discrete patches of vegetation in isolation. Fragmentation of landscapes reduces a species' ability to adapt to climatic conditions (NWCPAG 2012). Many fauna species are implicated by the process of fragmentation, including experiencing severe population declines (Robertson and Radford 2009). The overall ecology of fragmented patches may be detrimentally altered which influences flora and fauna assemblages (Lindenmayer et al. 1999).

Indirectly, fragmentation can put stress on native flora and fauna by increasing the amount of competition for resources and space of remaining fragments (Fischer and Lindenmayer 2007). Direct clearing can impact immobile organisms such as plants (and also mobile organisms that do not escape efficiently) leaving mobile animals to traverse to other surrounding environments that could be smaller remnants. This can result in overcrowding of an already overpopulated patch, interbreeding, and increased competition (Fischer and Lindenmayer 2007).

In context of the Angus Place Surface Infrastructure footprint, the surface clearing to be undertaken is not regarded as contributing to the fragmentation of two or more separate vegetation patches. Removal of vegetation is proposed for nine dewatering facility sites with a maximum area of 110 x 90 m and a proposed ventilation facility with a road network connecting the sites with a maximum width of 10 m along its entirety. The surrounding area remains a contiguous patch of vegetation with easy access to the current available habitats. These areas of clearing are not expected to prevent any known or potentially occurring fauna from traversing the areas or from gaining access to the surrounding vegetation.

Seed dispersal for flora is not expected to be hindered by the areas of clearing. Although the area of direct occupancy will be reduced marginally for a select few species that exist within the surface infrastructure footprint, they are not expected to be restricted in their ability to disperse naturally within the immediate surrounding environments.

6.4.2 Edge Effects

As a result of vegetation clearing, edges of landscapes become more abundant, consequently increasing the amount of edge effects associated with cleared areas. Edge effects can influence ecological process by altering the flows of energy, moisture, temperature, materials or organisms and by providing access to spatially separated resources (Fletcher et al. 2007). In turn, this indirectly leads to changes in population structure, species interaction and community structure near edges (Fletcher et al. 2007).

Although the area to be cleared for surface infrastructure is not considered to fragment two or more patches of vegetation, it will increase the available edges for ecological changes to occur, particularly along the road networks. “New road works through bushland will increase sunlight and air temperature, which raises soil temperature and decreases soil moisture. This may prevent seeds of shade-tolerant species from germinating and favour other place species (i.e. those that thrive on increased light)” (Rowley et al. 1999:1). Additionally, vehicles utilising this road network have the potential to spread exotic flora species that will have an increased surface area in which to establish themselves.

Each length of road creates two edges as well as a clear corridor for fauna movement. This can be detrimental in regard to spread of invasive species such as foxes which are known to utilise roadways for movement (Saunders et al. 1997). Additionally, some native species can opportunistically take advantage of forest edges such as the Noisy Miner (*Manorina melanocephala*), which has recently listed as a Key Threatening Species under the TSC Act (‘Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners *Manorina melanocephala* (Latham 1802)’). These processes can lead to a decline in native wildlife through increased predation and competition (Rowley et al. 1999).

The overall implication of edge effects leads to a degraded vegetation community with an altered species composition of both flora and fauna.

The Project Application Area contains a network of tracks and cleared areas due to forestry practices and additional unformed trails opened up by unregulated motorbike use. The Project involves very few new tracks and cleared areas being created. Therefore, the contribution of the Project to impacts associated with edge effects is negligible.

6.4.3 Introduction of Invasive Species

Invasive fauna species have been detected within the Study Area during surveys. As discussed in Section 6.4.2, the construction of road networks and clearing for borehole sites as a result of the Project may increase accessibility into new forest areas by invasive species such as foxes, cats and dogs. Foxes, cats and dogs tend to travel along roads, tracks and cleared areas adjacent to, or within, bushland areas (Rowley

et al. 1999). Establishment of these species provides the opportunity for them to breed and thus increase predation levels and competition for resources with native wildlife.

The Project Application Area contains a network of tracks constructed for forestry and additional unformed trails opened up by unregulated motorbike use. The Project involves very few new tracks being created. Therefore, the contribution of the Project to the introduction of invasive species is negligible.

6.4.4 Erosion and Sedimentation

The primary cause of erosion is vegetation removal, which exposes topsoil to the elements of water and wind (Thompson 2013). Areas cleared for surface infrastructure will be predisposed to increased wind and water in the form of rainfall, ground water and surface flow. The proposed road networks for the Project in particular will experience increased erosion, as vehicular movement will degrade the state of the roads in conjunction with the elements. Excessive erosion can lead to increased runoff into the surrounding vegetation communities, with sensitive areas such as the Swamp EECs being affected.

Sedimentation can also occur as a result of pooling from altered soil landscapes. Sediment is also a pollutant in its own right and can release nitrogen and phosphorus into nearby water bodies, causing eutrophication (Morgan 2009). This is particularly important in areas in proximity to swamps.

In order to prevent the erosion and sedimentation impacting upon surrounding habitats, mitigation measures have been proposed and are detailed in **Section 7.1**.

6.5 Key Threatening Processes

Key Threatening Processes (KTPs) are listed under Schedule 3 of the TSC Act. There are nine KTPs that may be relevant to the Project, being:

- Alteration of the Natural Flow regimes of rivers, streams, floodplains and wetlands;
- Loss of hollow-bearing trees;
- Removal of dead wood and dead trees;
- Clearing of native vegetation;
- Anthropogenic climate change;
- Degradation of native riparian vegetation along NSW watercourses;
- Introduction and establishment of Exotic Rust Fungi of the order *Pucciniales* pathogenic on plants of the family Myrtaceae;
- Alteration of habitat following subsidence due to longwall mining; and
- Invasion of native plant communities by exotic perennial grasses.

"Alteration of the natural flow regimes of rivers, streams, floodplains and wetlands"

The Project is likely to incrementally contribute to the Key Threatening Process "Alteration of the natural flow regimes of rivers, streams, floodplains & wetlands" due to the expected level of subsidence along the watercourses within the Study Area. The impact of subsidence on the natural flows of the watercourses and the threatened species this may potentially affect has been previously discussed in **Section 6.2.3**. The cracking or tilting may divert water from parts of watercourses to sub-surface cracks, which often re-appear further downstream.

Predicted post mining grades are similar to the natural grades along the drainage lines. There are no predicted significant reductions or reversals of stream grade. It is not expected, therefore, that there would

be any adverse changes in ponding or scouring along the drainage lines resulting from the proposed mining. It is possible that there could be very localised areas along the drainage lines that could experience small increases in the levels of ponding.

The cracking or tilting that may occur has been found to not be of a magnitude that any observable or measurable changes to the riparian vegetation have been found. In most instances, surface cracking would tend to be naturally filled with soil during subsequent flow events, especially during times of heavy rainfall. Subsequently, these minor, localised and, as shown by past mining, isolated impacts are unlikely to impact upon threatened flora or fauna species that may occur therein.

"Loss of hollow-bearing trees"

The Project may require the removal of approximately 23.24 ha of native vegetation, which also contains hollow-bearing trees. The loss of tree hollows will trigger this KTP for several species that have been recorded, or have potential, to occur within the Study Area. This includes Broad-headed Snake (in the summer), Eastern Pygmy Possum, Squirrel Glider and Yellow-bellied Glider. This habitat feature is also likely to be utilised by hollow dependent species of microbats. All of these species are listed as being affected by this KTP within the final determinations. The impacts of this KTP, with consideration of the likely and numbers of hollow-bearing trees within the surface footprint, have been previously considered in **Section 6.1.3** and are considered for each of these threatened species within **Appendix 1** and **Appendix 2**. The Study Area occurs within an area of contiguous vegetation, providing a large expanse of habitat, which contains hollow-bearing trees. Whilst the Project does trigger this KTP, it would not lead to a local extinction of any of the threatened fauna considered. With the use of best practice tree felling techniques, the impacts will be primarily limited to loss of a relatively small amount of habitat and not of the inhabiting species.

"Removal of dead wood and dead trees"

The Project may require the removal of approximately 23.24 ha of native vegetation, which also contains dead wood and dead trees. The loss of dead wood and dead trees will trigger this KTP for several species that have been recorded, or have potential, to occur within the Study Area. Therefore, constituting a direct loss of potential habitat for threatened fauna including Spotted-tailed Quoll, Southern Brown Bandicoot and New Holland Mouse. This would also remove hunting habitats for species of owl and threatened woodland birds, such as Brown Treecreeper, Hooded Robin, Scarlet Robin and Flame Robin.

The impacts of this KTP, with consideration of the likely availability of this habitat resource for use by the above-mentioned threatened species within the locality, have been previously considered in **Section 6.1.3** and are considered for each of these threatened species within **Appendix 1** and **Appendix 2**. The Study Area occurs within an area of contiguous vegetation, providing a large expanse of habitat, which contains areas of dead wood and dead trees. Whilst the Project does trigger this KTP, it would not lead to a local extinction of any of the threatened fauna considered. A mitigation measure for this KTP is the placement of dead wood and felled trees, with a specific preference for trees containing hollows, within avoided habitats.

"Clearing of Native Vegetation"

The KTP 'Clearing of Native Vegetation' lists a number of resulting factors that have the potential to cause declines or local extinctions for a variety of threatened species or EECs. These factors include:

- Destruction of habitat results in loss of local populations of individual species;
- Fragmentation;
- Expansion of dryland salinity;
- Riparian zone degradation;

- Increased greenhouse gas emissions;
- Increased habitat for invasive species;
- Loss of leaf litter layer;
- Loss or disruption of ecological function; and
- Changes to soil biota.

Of the above list, the main result of the Project is *destruction of habitat of recorded or threatened species*. The Project will require the removal of approximately 23.24 ha of native vegetation. This involves the direct removal of occupied habitat for *P. hindii* and *V. blakelyi*. The Gang-Gang Cockatoo, Varied Sittella, Scarlet Robin and Flame Robin were also recorded within the proposed surface infrastructure footprint. Habitat for other recorded, or potentially occurring, threatened species also occurs within the proposed surface infrastructure footprint. As discussed in **Section 6.1.3**, the proposed loss of vegetation represents a small amount of habitat loss for those threatened species considered relevant to this Project. This small habitat loss is relative to the large amount of habitat available for these species in the locality. Consideration of the results in **Appendix 1** and **Appendix 2** has found that no significant impacts will occur to threatened flora and fauna. No EECs will be affected by the removal of vegetation.

"Anthropogenic Climate Change"

The total lifetime direct (Scope 1) GHG emissions from the Project are estimated to be approximately 42,647 CO2-e in any one year.

Indirect (Scope 2 and 3) emissions would be released in the process of mining coal, and through the transport and end use of the coal. The total lifetime indirect emissions (Scope 2 and 3) from mining coal and end use of the coal are estimated to be 1,018,551 t CO2-e, per annum.

Comparison of Project emissions with State and National GHG emission totals indicates that the APMEP is likely to represent approximately 0.03% of NSW GHG emissions when compared to the latest available emissions data (2010) (Scope 1) and 0.01% of Australian GHG emissions (Scope 1) (SLR 2013).

The linkages between emissions of CO2 from an individual project, resulting global CO2 concentrations and climate warming (as required within the DGRs for the Project) is not possible due to a host of uncertainties and a lag in the climate system. However, action by National Governments aimed at reducing GHG emissions by sector and national totals will result in mitigation of climate change, and accurate quantification of GHG emissions will aid the ongoing assessment of climate impacts and will reduce the impact on global climate warming influenced by all countries (SLR 2013).

"Degradation of native riparian vegetation along NSW watercourses"

The Project is unlikely to incrementally contribute to the KTP 'Degradation of native riparian vegetation along NSW watercourses' as the Project involves only possible minor subsidence of vegetation along streams. It is considered that the Project is unlikely to result in a decline or loss of extent of groundwater dependent species or those that occur within riparian habitats.

"Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae"

The Project may increase the level of stress and lower resistance of some members of the family Myrtaceae due to slight alteration of their habitat within the Study Area. Exotic Rust Fungi may be introduced into the Study Area by increased movement of heavy machinery, vehicles and workers across the Study Area. It is

expected that anti-contamination procedures be enacted for personnel and equipment to minimise the chance of infection.

Alteration of habitat following subsidence due to longwall mining

The Project is likely to incrementally contribute to the KTP 'Alteration of habitat following subsidence due to longwall mining'. A number of threatened species potentially occurring within the Study Area are listed within this KTP as being at risk. These include *Boronia deanei*, Blue Mountains Water Skink, Giant Dragonfly and Stuttering Frog. Newnes Plateau Shrub Swamp is also listed within the final determination of this KTP.

Subsidence monitoring within Angus Place has shown that nearly all measurements are less than those predicted. Based on the monitoring data, there is an approximate 95% confidence level that the maximum observed total subsidence will be less than the maximum predicted total subsidence. Flora and fauna monitoring since 2005 has not recorded any losses to threatened species populations or EECs as a result of subsidence. This is due to appropriate mine design to limit subsidence to acceptable levels. However, conservative predictions for maximum baseflow and standing water level changes in several shrub swamps as a result of subsidence have determined that potential low-scale changes to swamp hydrology is possible. The magnitude of these changes have, however, been considered against the likely capillary forces of the peat to maintain saturation. The predicted change to average water level is within the expected capillary forces such that the magnitudes of water table decline predicted in Adhikary and Wilkins (2013), is unlikely to result in drying of the peat layer. The conversion of perched water table flows into subsurface flows through voids is unlikely. Cracks may divert some water temporarily from swamps, but will initially fill with water before eventually filling with silt/peat from within the swamp, so that there should be no long-term or permanent impact on flows in the swamp. Therefore, the minor alterations to the hydrological regime predicted are unlikely to modify the vegetation communities present in the short or long term.

Invasion of native plant communities by exotic perennial grasses

The Project is unlikely to directly contribute to the KTP 'Invasion of native plant communities by exotic perennial grasses', due to only a small area of surface vegetation to be removed for the Project. However, some disturbed areas within the Study Area already contain exotic perennial grasses. The Project will provide an opportunity to enact a weed control program to ameliorate this KTP.

6.6 Cumulative Impacts

There are three underground mining operations being undertaken on the Newnes Plateau, including Clarence Mine, Angus Place Colliery and Springvale Colliery. The sites are all in relatively close proximity to one another and have the potential to result in a cumulative impact. Each mine requires surface infrastructure with resulting surface disturbance footprints. With any underground mine there is potential for impacts from subsidence which, to date, have been relatively minor with ongoing monitoring not detecting any significant impacts. Mining operations in this region have largely operated underground and when considered together in a regional context they have cleared only relatively minor areas of vegetation and habitat.

6.6.1 Vegetation

In addition to the maximum footprint of 23.24 ha for this mine extension projects, the following projects also have proposed or are undertaking vegetation clearing:

- Springvale Mine Extension Project (11.44 ha);
- The Angus Place Ventilation facility (15.3 ha);
- Springvale Bore 8 (4 ha of native vegetation at the site will be removed with 2.34 ha to be rehabilitated

thereafter); and

- The Clarence REA VI Project (4.2 ha).

6.6.2 Flora

A total 93 stems of *P. hindii* are likely to be removed as a result of the Springvale Bore 8 Dewatering Facility Project and a maximum of 1,405 stems for the Angus Place Colliery's Ventilation Shaft Facility Project. The Springvale Mine Extension Project or this Project will not remove any recorded *P.hindii* stems, however, a maximum of 23.24 ha of potential habitat may be removed. As discussed in **Section 3.2.5**, 14,866 *P. hindii* stems are known to occur within habitats that are not proposed to be removed. This count does not represent the total population of *P. hindii* on the Newnes Plateau, with many more locations shown to be occupied (OEH Atlas of NSW Wildlife records). Therefore, it is unlikely that the cumulative loss of individuals or habitats would impact the population such that it would be placed at risk of extinction.

Comprehensive management plans have been developed for the approved activities of the Angus Place Colliery's Ventilation Shaft Facility Project and Springvale Bore 8 Dewatering Facility, including a translocation program, rehabilitation program, and a research program to investigate the cultivation and the genetics of *P. hindii*. These programs will see the majority of the surface disturbance areas rehabilitated to original vegetation type, relocation of individuals impacted upon by the surface facilities, and the propagation and replanting of additional *P. hindii* within the surface disturbance areas and surrounding suitable habitat. Therefore, the cumulative impacts of these projects upon *P. hindii* have been substantially minimised.

6.6.3 Fauna

At Springvale Bore 8 Project, a range of threatened fauna species occur within the Study Area and its surrounds, including the Gang Gang Cockatoo (*Callocephalon fimbriatum*), Scarlet Robin (*Petroica boodang*), Flame Robin (*Petroica phoenicea*) and Masked Owl (*Tyto novaehollandiae*).

The Clarence REA VI field surveys resulted in the positive identification of two threatened fauna species, listed as Vulnerable under the TSC Act, namely the Gang-gang Cockatoo (*Callocephalon fimbriatum*) and the Eastern Pygmy Possum (*Cercartetus nanus*). Additionally, a scat potentially left by the threatened Spotted-tailed Quoll (*Dasyurus maculatus*) was found on site.

Previous flora surveys conducted by RPS (2010) over Angus Place Colliery Longwalls 900 and 910, to the west of the current proposed modification, recorded:

- Three threatened microchiropteran bat species, namely Large-eared Pied Bat (*Chalinolobus dwyeri*-TSC Act: Vulnerable, EPBC Act: Vulnerable*),* Eastern False Pipistrelle (*Falsistrellus tasmaniensis* TSC Act: Vulnerable) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*– -TSC Act: Vulnerable); and
- Four threatened bird species were recorded across the Study Area including: Scarlet Robin (*Petroica boodang* - NSW TSC Act: Vulnerable), Flame Robin (*Petroica phoenicea* - NSW TSC Act: Vulnerable), Varied Sittella (*Daphoenositta chrysoptera*- NSW TSC Act: Vulnerable) and Gang Gang Cockatoo (*Callocephalon fimbriatum* - NSW TSC Act: Vulnerable).

Open Forest habitat occurred across all the Study Area along with several outcrops of Hanging Swamp, which provides potential fauna habitat to a range of birds, amphibians, reptiles and invertebrates. A relatively low density of hollow-bearing trees occurred across the Study Area, as a consequence of past logging disturbance, however, habitat still occurs for arboreal marsupials, hollow dependent microchiropteran bat fauna and large forest owls. No hollow bearing trees were recorded within the development footprint for this Project.

On-going annual fauna monitoring over the Newnes Plateau has recorded a number of threatened fauna species, including the Squirrel Glider, Brown Treecreeper, Speckled Warbler and Sooty Owl. Comprehensive surveys over the Angus Place Expansion Study Area did not encounter these species, and habitats occurring within the Study Area are considered to provide only marginal opportunities for the three threatened bird species partly due to the relative scarcity of local records, although habitat within the Study Area was assessed as providing shelter and foraging opportunities for Squirrel Glider.

Within the Clarence REA VI surface facility, three threatened fauna species, including the Regent Honeyeater, Spotted-tailed Quoll and Large-eared Pied Bat, were identified with potential to occur or have known habitat within the site or its vicinity

The cumulative impact from these activities is considered to be negligible due to the comparatively low levels of impact expected to occur to their habitats. The majority of the surface infrastructure sites are relatively small and situated within existing vegetation and wherever possible situated alongside existing disturbance (i.e. access tracks). The removal of vegetation will not sever connectivity of any vegetation and the habitat values within the site i.e. fallen timber will be replaced or relocated to nearby habitat.

Each of these projects occurs within similar forest vegetation of the Newnes Plateau and provides similar fauna habitat opportunities. As discussed in **Section 6.1**, the proposed surface infrastructure occurs within an area of extensive vegetation providing considerable habitat opportunities and supporting those threatened flora and fauna species considered to have potential to be affected by the Project. Consequently, whilst the cumulative loss of 58.18 ha of vegetation equates to an impact upon potentially occurring threatened flora and fauna, due to the wider habitat availabilities, this is unlikely to be a significant impact.

6.6.4 Subsidence

The assessment of cumulative impacts has been undertaken throughout the subsidence and groundwater modelling assessments as a matter of course and the results presented are of cumulative impacts between the proposed Angus Place project, the proposed extension at Springvale and existing approved projects.

6.6.5 Mine Water Discharge

The cumulative effects of MWD were previously considered in **Section 6.3** above. This assessment has found that the increases in MWD are unlikely to impact upon threatened species or EECs.

6.7 Matters of National Environmental Significance

An EPBC Act Protected Matters Search was undertaken within the SEWPAC on-line database (accessed March 2013) to generate a list of those Matters of National Environmental Significance (MNES) from within 10 km of the Study Area. An assessment of those MNES relevant to biodiversity has been undertaken in accordance within *EPBC Act Policy Statement 1.1 Significant Impact Guidelines Matters of National Environmental Significance* (DoE, 2013). The Matters of National Environmental Significance protected under national environment law include:

- listed threatened species and communities;
- listed migratory species;
- Ramsar wetlands of international importance;
- Commonwealth marine environment;
- world heritage properties;
- national heritage places;
- the Great Barrier Reef Marine Park;

- nuclear actions; and
- a water resource, in relation to coal seam gas development and large coal mining development.

6.7.1 Nationally Listed Threatened, Migratory Species and Ecological Communities

Those nationally listed threatened species and ecological communities that are considered to have potential to be impacted upon are described in **Appendix 2**. **Table 6** lists the migratory species identified from database searches. Due to the high mobility of these migratory species, in relation to the low level impacts predicted to potential habitats, the impact upon these migratory species are unlikely to be significant.

6.7.2 Ramsar wetlands of international importance

There are no wetlands protected by international treaty (the Ramsar convention) arising from the EPBC Act Protected Matters Report generated for an area within 10 km of the Study Area.

6.7.3 Commonwealth Marine Environment

The Proposal will not have a significantly adverse effect on any Commonwealth marine area, as there are no such marine areas within the region. No impacts to Commonwealth marine area will therefore occur.

6.7.4 World Heritage Properties and National Heritage Places

The Gardens of Stone National Park is part of the Greater Blue Mountains Area (GBMA). It occurs to the immediate north of the Project Application and also occurs approximately 6 km to the east. The GBMA is a World Heritage Property and National Heritage Place. DoE (2013) provides Significant Impact Assessment criteria for World Heritage Properties and National Heritage Places. Those assessment criteria, which are relevant to biodiversity, are considered below.

As per DoE (2013), an action is likely to have a significant impact on natural heritage values of a World Heritage property if there is a real chance or possibility that the action will:

- reduce the diversity or modify the composition of plant and animal species in all or part of a World Heritage property;
- fragment, isolate or substantially damage habitat important for the conservation of biological diversity in a World Heritage property;
- cause a long-term reduction in rare, endemic or unique plant or animal populations or species in a World Heritage property; and
- fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in a World Heritage property.

An action is likely to have a significant impact on natural heritage values of a National Heritage place if there is a real chance or possibility that the action will:

- modify or inhibit ecological processes in a National Heritage place;
- reduce the diversity or modify the composition of plant and animal species in a National Heritage place;
- fragment or damage habitat important for the conservation of biological diversity in a National Heritage place;
- cause a long-term reduction in rare, endemic or unique plant or animal populations or species in a National Heritage place; and
- fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in a National Heritage place.

Road upgrading and clearing for, and installation of, infrastructure such as dewatering bores, a ventilation shaft, powerline easements and roads could affect the Newnes Plateau (which is adjacent to, but not within the GBMA), and therefore also reduce the wilderness quality within the GBMA. The closest point of any ESA is approximately 100 m from the GBMA. Additionally, the borehole compound that is closest to the GBMA will require just 1 ha to be cleared. The proposed clearing of 23.24 ha, at this proximity is unlikely to reduce the diversity or modify the composition of plant and animal species within the GBMA. However, habitats for fauna species that may occupy both the Project Application Area and the GBMA as part of their home range will be subject to a minor reduction in habitat due to proposed clearing.

An assessment of the potential impacts upon the GBMA as a result of subsidence is provided in MSEC (2014 section 5.15). The GBMA (the National Park) is located immediately to the north of the Extension Area, at a distance of 170 m from LW1014A, at its closest point to the proposed longwalls. Whilst the area closest to the proposed longwalls could experience very low levels of vertical subsidence (i.e. less than 20 mm), it is not predicted to experience any measureable conventional tilts, curvatures or strains (MSEC 2014 section 5.15).

Water courses within the eastern part of the Project Application Area flow into the GBMA via the Wolgan River and Carne Creek. The predicted changes in grade are small when compared to the existing natural grades along the alignment of the Wolgan River. It is unlikely, therefore, that there would be any significant changes in the levels of ponding, flooding or scouring of the river banks resulting from the extraction of the proposed longwalls (MSEC 2014 section 5.2.3.). The potential impacts to Carne Creek, due to extension of mining at Angus Place, are also regarded as insignificant (RPS 2014b section 6.4.1). Consequently, no impacts to water quality are anticipated to occur downstream within the GBMA.

Due to the above considerations, the Project is not expected to lead to indirect impacts from clearing, be significantly affected by subsidence or be affected by changes in water quality. Therefore, the Project is unlikely reduce the diversity or modify the composition of plant and animal species within any part of the GBMA.

With the exception of the existing tracks, the proposed surface facilities footprint is completely surrounded by native vegetation. The proposed clearing would therefore not pose a barrier for genetic dispersal for a population of any species that may also extend into the GBMA. No direct or indirect impacts are expected that would fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species, or habitat that is important for the conservation of biological diversity within the GBMA. Consequently, the Project is not expected to cause a long-term reduction in rare, endemic or unique plant or animal populations or species within the GBMA.

Clearing of native vegetation has been considered for its potential to affect the wilderness quality of the GBMA. Road upgrading and clearing for, and installation of, infrastructure such as dewatering bores, a ventilation shaft, powerline easements and roads could affect the Newnes Plateau (which is adjacent to, but not within the GBMA), and therefore also reduce the wilderness quality within the GBMA. The closest point of any ESA is approximately 100 m from the GBMA. The proposed clearing of 23.24 ha, at this proximity is unlikely to affect the wilderness quality of the GBMA. Additionally, the borehole compound that is closest to the GBMA will require just 1 ha to be cleared.

6.7.5 Great Barrier Reef Marine Park

The Proposal will not have a significantly adverse effect on Great Barrier Reef Marine Park, as this area is not within the region.

6.7.6 Nuclear Actions

No type of nuclear activity is proposed for the Study Area.

6.7.7 Water resource, in relation to coal seam gas development and large coal mining development.

An assessment of this MNES has been undertaken within RPS (2014a).

7.0 Mitigation Measures

7.1 Surface Disturbance

Due to the avoidance measures as discussed in **Section 5.1.1**, the Project can limit the required clearing to an area of 23.24 ha of native vegetation (see **Section 6.1.1**) and avoid removal of any threatened flora. Due to the unavoidable impacts of clearing 23.24 ha of native vegetation, mitigation measures have been developed to minimise the effects of this clearing. **Table 12** provides a summary of the potential impacts as a result of clearing and proposed associated mitigation measures.

Table 12 Threatened Flora Chance of Occurrence within Proposed Surface Footprint.

Impact	Mitigation Measures
Direct Impacts	
Impacts to flora (loss of species and habitat)	For those areas where hard surfaces are required, undertake stockpiling of soil to enable reestablishment of viable habitat following infrastructure decommissioning.
	During clearing, and where it would not interfere with operations, the removal of vegetation should be limited to above ground parts as much as possible. This will enable any vegetation that is able to resprout once works are completed to do so.
Impacts to fauna (loss of species and habitat)	Where possible, clearing activities will be timed to avoid removal of hollow-bearing trees during breeding season of threatened species.
	Employment of best practice methods for felling of hollow-bearing trees.
	Prioritise the retention of hollow-bearing tree within Asset Protection Zones associated with the dewatering bore sites.
	Placement of hollow logs and felled hollow-bearing trees within adjacent uncleared vegetation to provide additional habitat resources for terrestrial fauna.
Indirect Impacts (reduction in quality of habitats)	
Erosion and Sedimentation	Limiting the amount of exposed surfaces that may become eroded by weather and operations.
	Installation of erosion and runoff control measures around cleared and operational areas.
Dust	Implementation of dust control measures to protect adjacent retained vegetation communities.
Weed Incursion	Strict weed management, monitoring and control practices should to be implemented to minimise the spread of exotic species into natural areas within the sites.

7.2 Subsidence

Subsidence has the potential to cause modification to habitats, through various mechanisms, including surface cracking, slope instability causing erosion and changes to hydrological regimes. Most of the Study Area occurs as dry woodland, forest or heathy habitats. The risks of subsidence related impacts upon the

viability of the drier habitats are considered low.

Risks of subsidence related impacts are considered higher to those habitats that are more dependent on hydrological regimes, particularly riparian habitats and GDEs. This is due to the potential for subsidence to alter the hydrology of surface water or groundwater such that it may interfere with ecosystem function.

Additional habitat features that may be susceptible to high levels of subsidence include cliffs, pagodas and caves.

The Applicant has developed a reliable and detailed understanding of the environmental constraints from operating the Angus Place Colliery, which has been in operation for 34 years, and the resulting environmental management and monitoring programs associated with operation of the site. Utilising this understanding of the site, potential environmental constraints and opportunities have been taken into account by the Applicant during consideration of the proposed mine design.

A mine plan and design has been formulated using the extensive monitoring and baseline data available, which would maintain the viability of the Project whilst significantly reducing the risk of causing significant impacts to sensitive ecological areas. To achieve this, the following engineering controls have been applied:

- longwalls adjacent to Gardens of Stone National Park are to be extracted towards the National Park with potential ground movements progressively monitored and managed as required;
- LW 1004 and LW 1006 will be narrower with 261 m voids. The depths of cover directly above these proposed longwalls range from 330 to 420 m with resulting void width to depth ratios of 0.60 to 0.85, which is less than previous longwall development at Angus Place;
- LW 1001, LW 1002 and LW 1003 will be 285 m wide with minimum cutting height of 2.6 m using the existing longwall. On completion of these blocks, newly purchased longwall equipment will be used that is suited to extraction in low seam heights to be encountered as mining progresses; and
- LW1007 to LW 1019 will be 350 m wide, with chain pillars 55 m wide. Depths of cover range from 360 m to 420 m. The resulting void width to depth ratios are within the range of 0.85 to 1.0 m, which is similar to those for the previously extracted longwalls at Angus Place.

The mine plan and design has been selected to minimise environmental effects of the Project. This has included avoiding undermining Twin Gully Swamp altogether (see **Section 5.2**), with Tri Star and Trail 6 Swamps proposed to be undermined by longwall panels that are consistent with previous cases at both Angus Place and Springvale. It is noted that previous mine design within Angus Place and Springvale has resulted in no unacceptable impacts to any ecological features, including GDEs.

7.3 Monitoring and Management

The mine plan in the Project has been proactively designed with a high regard and full consideration of the ecological constraints present within the area. As such, impacts to the natural environment are expected to be minor. Notwithstanding, ongoing monitoring will be undertaken using techniques and measuring parameters that are suitably sensitive to detect changes caused by subsidence. The monitoring data will measure trending towards (or otherwise) equally sensitive trigger values. In the unlikely event that worst case scenarios occur, when a trigger is reached, appropriate responses will be in place as a contingency. The proposed monitoring has been detailed within the Draft Temperate Highland Peat Swamps on Sandstone Monitoring and Management Plan for LW415 - LW417 (Springvale Mine, April 2013). This monitoring and management plan will be expanded to incorporate the requirements of this Project. Systems will therefore be in place to provide a response when monitoring of important parameters shows that trigger values have been exceeded.

Important parameters which are being and will continue to be monitored are:

- Groundwater levels - using in-swamp piezometers to continuously monitor groundwater levels before, during and after mining, so that any mining-related impacts on the hydrogeological conditions could be detected;

- Surface water levels - using weirs, pygmy flow meters or flow depth monitoring instruments to measure water levels and flows within water courses above and below swamps, or where a definite channel flow can be observed within the swamps. These methods can be used to continuously monitor surface water levels before, during and after mining, so that any mining-related impacts on the surface hydrogeological conditions could be detected;
- Groundwater and surface water quality - monitoring Electrical Conductivity (field and laboratory), pH, salinity, a range of metal ion concentrations, total hardness and temperature at strategically chosen sites (see RPS 2014b) to detect any changes in groundwater/surface water that can be used as an indicator of adverse, mining-related impacts on the water chemistry;
- Subsidence levels and related geological and physical impacts from subsidence line surveys and photographic inspections across the landscape. This allows analysis of actual subsidence compared to predictions and provides the ability to observe whether areas of subsidence and related impacts may be affecting MNES or other important environmental features; and
- Biodiversity, including focus on THPSS extent and flora and fauna diversity in general – monitoring indicators of change of swamp vegetation including abundance and biodiversity of flora species, eucalypt cover, overall condition within vegetation plots, exotic species richness, changes in bare ground, as well as the use of high-resolution photography to better define species assemblage and condition changes. Changes to THPSS groundwater behaviour will play an important role in terms of a trigger. Fauna monitoring uses targeted and consistent fauna survey techniques within specified survey sites which have measured species diversity, habitat complexity and occurrences of individual species which can detect changes in these parameters as a result of mining and other non-mining related impacts such as climatic changes.

8.0 Conclusion

RPS has been engaged by Centennial Angus Place Pty Limited to prepare a Flora and Fauna Assessment for an Environmental Impact Statement (EIS) to be prepared for the proposed Angus Place Mine Extension Project.

Thirty-two native and exotic vegetation communities have been mapped within the Study Area. Of these, five communities are listed as Endangered Ecological Communities (EEC). However, just two EECs are within the predicted subsidence extents, namely Newnes Plateau Shrub Swamp (NPSS), listed under the TSC Act, and Temperate Highland Peat Swamp on Sandstone (THPSS), listed under the EPBC Act. Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland, which is listed under the TSC Act, was recorded over the low-lying areas within the west of the Study Area. This community has been mapped along the water courses, which may be influenced by mine water discharge.

A total of 15 threatened flora species listed under the TSC Act and/or EPBC Act have the potential to occur within the Study Area based on the habitats present and known habitat preferences of the threatened species. Of these 15 species, four were recorded during the present study, these being *Eucalyptus aggregata*, *Eucalyptus cannonii*, *Persoonia hindii* and *Veronica blakelyi*.

None of the threatened flora recorded will be cleared as part of the Project. However, two threatened flora species, *E. aggregata* (Black Gum) and *T. australe*, are regarded as having potential habitat along the water courses, which may be influenced by mine water discharge.

Following targeted surveys, an avoidance mapping exercise was undertaken to identify significant ecological features within the proposed footprint. This was provided to the Applicant such that ecological constraints could be analysed and avoided as required. Amongst the achievements of the avoidance considerations was the complete avoidance from direct clearing of all recorded *P. hindii* and all recorded *V. blakelyi*. The targeted surveys also identified and confirmed the presence of a hanging swamp within the ESAs and alterations to the design of surface facilities were also enacted to avoid this feature.

A total of 44 threatened fauna species listed under the TSC Act and/or EPBC Act have potential to occur within the Study Area, of these, 23 have been recorded within the Study Area by RPS or as part of annual fauna monitoring. The Project will remove approximately 23.24 ha of potential habitat for a number of threatened fauna species. Consideration of potential impacts under the TSC Act and EPBC Act has been considered with regard to the proposed clearing. As a consequence of the available surrounding habitat, the comparably small habitat losses, as well as the avoidance and mitigation measures proposed, the project is unlikely to have a significant impact on threatened species or EECs as a result of proposed vegetation clearing.

The mining layout has been designed such that the majority of the cliffs and pagoda complexes are located outside the 26.5 degree angle of draw line from the extents of the proposed longwalls. No impacts are expected to these features and, subsequently, no impacts would be expected to potential habitats of those threatened species that may utilise these habitats.

No significant impacts to the dry woodland and forest habitats are predicted as a result of subsidence. Destabilisation of slopes is unlikely to be substantial such that it would significantly affect threatened flora or fauna that may occupy woodland environments.

Impact Assessments of Subsidence (MSEC 2014) and Groundwater Impact Assessments (RPS 2014a) have been undertaken in relation to swamps. These assessments found that significant reductions or reversals of grade, that could otherwise cause ponding or scouring, are unlikely to occur. No losses of infiltrated water

and minimal divergence of surface water would be expected within shrub swamps or upstream drainage lines. This is due to the predicted limited depth of fracturing and dilation of bedrock. The predicted change to baseflow and average water level is within the expected capillary forces of peat swamps such that the magnitudes of water table decline predicted is unlikely to result in drying of the peat layer.

The Project is not expected to have a significant impact upon the hydrology of any hanging swamps. The reliance of these areas on perched aquifer systems effectively isolate them from any hydrological changes that may occur to the regional water table as a result of mining operations.

Assessments of impacts have been undertaken for those species that are dependent upon the swamp habitats. These species include *B. deanei*, Giant Dragonfly and Blue Mountains Water Skink. Assessment of impacts have concluded that the predicted changes in baseflow and average standing water levels are not of a magnitude that would cause the swamp habitats to become unsuitable for these species. Consequently, the Project is unlikely to significantly impact upon those threatened species that rely on the swamp habitats.

The Applicant has invested considerable time and money in monitoring and undertaking specialist studies in relation to their mining activities. From specialist studies, major geological structural zones can be confidently identified within the Angus Place mining and exploration leases. The Project has further reduced the impact risks with the addition of those mitigation measures listed above. Regular seasonal ecological monitoring since 2005 has also revealed no observable impacts on the flora and fauna recorded within undermined areas, including THPSS. The Project is not expected to have a significant impact upon any shrub swamps or hanging swamps such that their ecosystem functioning may be impaired. This prediction is supported by a high level of confidence in subsidence predictions as shown by post-mining subsidence monitoring data. Additionally, ongoing ground-water, surface water, flora and fauna monitoring of previously undermined swamps at Springvale have revealed no impacts to GDEs and associated habitats as a result of undermining these areas.

The potential impacts from increased mine water discharge include increases in flow and changes to water quality, particularly increases in salinity. The potential impact on geomorphology is low compared to the streambed velocity experienced in a typical large rainfall event. The current pH levels at the Angus Place discharge points are not expected to change as a result of the mine water discharge, remaining between 6.5 and 8.0. Therefore, pH is not expected to affect habitats or species. The salinity levels that may occur within receiving waters are well below salinity tolerance limits of *E. aggregata*, as well as *E. stellulata* and *E. viminalis*, which are all common canopy species within the Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland EEC. Habitats for *T. australe* may be found along the low lying areas adjacent to watercourses that may be affected by mine water discharge. However, expected increases in flows are below flood levels and will remain in bank. Therefore, potential habitats for this species would remain largely unaffected and salinity levels would be particularly low during natural flood events. Predicted salinity changes are therefore unlikely to significantly alter habitats for *E. aggregata*, *T. australe* and Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland.

The MNES, World Heritage Properties and National Heritage Places were assessed for potential impacts. The GBMA is a World Heritage Property and National Heritage Place immediately north of the Study Area. The proposed mine design criteria has included consideration of potential impacts to the GBMA and has been designed to avoid and reduce potential impacts. Given the implementation of required water management measures, and the predicted minor nature of the proposed impacts, it is unlikely that the Proposed Action will impact on the GBMA.

Potential impacts under the TSC Act and EPBC Act have been assessed with regard to the proposed longwall mining and surface infrastructure establishment and mine water discharge. A high level of confidence exists in subsidence predictions for the proposal and the results of ongoing monitoring show no significant subsidence related impacts within undermined areas. The clearing of 23.24 ha is proposed to

occur within areas, which are predominately along existing tracks and surrounded by vast extents of commensurate habitat. Mine water discharge will not be of a magnitude such that it would alter the morphology of the affected water courses and changes to water quality are within the tolerance limits of the species and habitats that are associated with these water courses. Consequently, the Project is unlikely to have a significant impact upon threatened species, EECs or other MNES.

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Appendix 1

TSC Act 7-Part Test of Significance

Section 5A of the EP&A Act lists seven factors that must be taken into account in the determination of the significance of potential impacts of proposed activities on 'threatened species, populations or ecological communities or their habitats' (threatened biota) listed under the TSC Act (DECC 2007). The '7-Part Test' is used to determine whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats and thus whether a Species Impact Statement (SIS) is required to be produced.

The significance of the impacts on those threatened species and EECs which have been recorded in the Study Area, or likely to occur, and are likely to utilise habitat to be potentially impacted by the proposed activities (see **Table 8**) have been assessed. The following communities and species have been considered:

Flora

- *Caesia parviflora* var. *minor;*
- *Lastreopsis hispida* (Bristly Shield Fern);
- *Acacia bynoeana* (Bynoe's Wattle);
- *Eucalyptus aggregata* (Black Gum);
- *Eucalyptus pulverulenta* (Silver-leaved Gum);
- *Genoplesium superbum* (Superb Midge Orchid);
- *Prasophyllum fuscum* (Tawny Leek Orchid);
- *Persoonia acerosa* (Needle Geebung);
- *Persoonia hindii;*
- *Prostanthera cryptandroides* subsp. *cryptandroides* (Wollemi Mintbush);
- *Boronia deanei* (Deane's Boronia);
- *Thesium australe* (Austral Toadflax); and
- *Veronica blakelyi.*

Fauna

- Giant Dragonfly (*Petalura gigantea*);
- Giant Burrowing Frog (*Heleioporus australiacus*);
- Stuttering Frog (*Mixophyes balbus*);
- Red-crowned Toadlet (*Pseudophryne australis*);
- Littlejohn's Tree Frog (*Litoria littlejohni*);
- Blue Mountains Water Skink (*Eulamprus leuraensis*);
- Rosenberg's Goanna (*Varanus rosenbergi*);
- Broad-headed Snake (*Hoplocephalus bungaroides*);
- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*);
- Little Lorikeet (*Glossopsitta pusilla*);
- Barking Owl (*Ninox connivens*);
- Powerful Owl (*Ninox strenua*);
- Masked Owl (*Tyto novaehollandiae*);
- Sooty Owl (*Tyto tenebricosa*);
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- Speckled Warbler (*Chthonicola sagittata*);
- Regent Honeyeater (*Anthochaera phrygia*);
- Painted Honeyeater (*Grantiella picta*);
- Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*);
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*);
- Varied Sitella (*Daphoenositta chrysoptera*);
- Hooded Robin (*Melanodryas cucullata*);
- Scarlet Robin (*Petroica boodang*);
- Flame Robin (*Petroica pheonicea*);
- Spotted-tailed Quoll (*Dasyurus maculatus maculatus*);
- Southern Brown Bandicoot (*Isoodon obesulus obesulus*);
- Koala (*Phascolarctos cinereus*);
- Eastern Pygmy Possum (*Cercartetus nanus*);
- Yellow-bellied Glider (*Petaurus australis*);
- Squirrel Glider (*Petaurus norfolcensis*);
- Brush-tailed Rock-wallaby (*Petrogale penicillata*);
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Little Pied Bat (*Chalinolobus picatus*);

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Eastern Cave Bat (*Vespadelus troughtoni*); and
- Eastern Freetail-bat (*Mormopterus norfolkensis*).

Threatened Ecological Communities

- Newnes Plateau Shrub Swamp (NPSS); and
- Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions.

(a) **In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.**

Threatened Flora

- *Caesia parviflora* var. *minor*

One Atlas of NSW Wildlife record of this species occurs within 10 km of the Study Area. The location description for this record identifies the plant as occurring at the northern end of Sunnyside Ridge. This record therefore lies within the Study Area. This variety may be more common than currently known, as Pale Grass-lilies are often not identified to variety level (OEH 2013a). Two other larger varieties of *C. parviflora* have been described and are more common and widespread. A small or stunted *C. parviflora* of another variety may potentially be mistaken for *C. parviflora* var. *minor*. Notwithstanding, a precautionary approach has been taken for this species.

If present, *C. parviflora* var. *minor* could occur within damp habitats, including within and surrounding shrub swamps and hanging swamps, as well as damp soaks within forests and woodlands. Therefore, if individuals of a local population of *C. parviflora* var. *minor* are to be impacted upon by proposed clearing, it is highly likely that the population would extend throughout the Newnes Plateau. This is supported by the only record, which places the only known population of this species approximately 600 m to the west of the proposed surface infrastructure footprint.

As discussed in **Section 6.2.2**, the Project is not expected to have a significant impact upon any shrub swamps or hanging swamps. This prediction is supported by a high level of confidence in subsidence predictions, as shown by post-mining subsidence monitoring data. Additionally ongoing ground-water, surface water, flora and fauna monitoring of previously undermined swamps and revealed no impacts to GDEs as a result of undermining these areas. Consequently, the Project will not affect the lifecycle of *C. parviflora* var. *minor* as a result of clearing or subsidence such that a local population of the species is likely to be placed at risk of extinction.

- *Lastreopsis hispida* (Bristly Shield Fern)

This species favours moist humus rich substrates in wet forest and rainforest gullies where it frequently grows on fallen logs. The closest record for this species is located at Mount Wilson. Notwithstanding, there is potential for this species to occur within the gully or wet vegetation within the Study Area. None of the preferred habitat type occurs within the ESAs. Consequently, this species is unlikely to occur therein and would not be impacted upon as a result of clearing. As this species occurs within closed moist forest, subsidence impacts are unlikely to affect the habitat for this species. Consequently, the Project is unlikely to affect the lifecycle of *L. hispida* as a result of clearing or subsidence, such that a local population of the species is likely to be placed at risk of extinction.

- *Acacia bynoeana* (Bynoe's Wattle)
- *Persoonia acerosa* (Needle Geebung)
- *Persoonia hindii*
- *Prostanthera cryptandroides* subsp. *cryptandroides* (Wollemi Mintbush)

These shrubs generally occur within dry woodland environments. As detailed in **Section 6.2.5**, the wooded habitats will not be greatly affected by subsidence related impacts. Tension cracks and soil destabilisation where this occurs may cause localised destabilisation of the root zone for some plants. It is noted, however, that these threatened flora species either respond positively to, or readily recover from disturbance or naturally occur within areas where the soil surface is naturally unstable, such as mountain scree slopes. Notwithstanding, any loss of threatened flora would be minimal and would not remove a significant proportion of the soil seed bank such that an area would become unviable to threatened flora species.

Of the above threatened flora species, only *P. hindii* was recorded close to the proposed surface infrastructure footprint. Throughout the Newnes Plateau RPS has recorded, or has been provided with records of, 14,866 stems of *P. hindii* stems (see **Section 3.3.5**). These occurrences include populations within close proximity to the surface infrastructure footprint, however, detailed avoidance mapping the design has been adjusted to ensure that no recorded individuals will be removed.

It is expected that the proposed action will not affect the lifecycle of *A. bynoeana*, *P. hindii*, *P. acerosa* and *P. cryptandroides* subsp. *cryptandroides* such that a local population of the species is likely to be placed at risk of extinction.

- *Eucalyptus aggregata* (Black Gum)

E. aggregata is found in the South Eastern Highlands Bioregion and the western fringe of the Sydney Basin Bioregion. This species prefers to grow on alluvial soils, on cold, poorly drained flats and hollows near creeks and small rivers. It often occurs with cold-adapted eucalypts such as *E. pauciflora* (Snow Gum), *E. viminalis* (Ribbon Gum) and *E. rubida* (Candlebark). Within the Study Area, it occurs as a component of MU 15 - Tableland Hollows Black Gum - Black Sally Open Forest.

No areas containing this species are proposed to be removed. This species is likely to occur along drainage lines and waterways that would be affected by mine water discharge. As discussed in **Section 6.3**, the salinity levels of the mine water are below the tolerance limits of this species. *E. aggregata* is therefore unlikely to be affected. Additionally, majority of MU 15 - Tableland Hollows Black Gum - Black Sally Open Forest has been mapped away from any water courses that may be affected by mine water discharge. Therefore, the Project is unlikely to affect the lifecycle of *E. aggregata* such that a local population of the species is likely to be placed at risk of extinction.

- *Eucalyptus pulverulenta* (Silver-leaved Gum)

This species occurs on the crests or upper slopes of moderately steep hillsides or mountains. It grows in shallow soils as an understorey plant in open forest, typically dominated by *E. mannifera*, *E. macrorhyncha*, *E. dives*, *E. sieberi* and *E. bridgesiana*. It often occurs on granite substrates. The nearest population is near Bowenfels, approximately 13 km south of the Study Area.

This species was not recorded within the ESAs and is therefore unlikely to occur. Additionally, the forest habitats in which this species occurs are unlikely to be affected by subsidence such that the habitat would become unsuitable for this species. Therefore, the Project is unlikely to affect the lifecycle of *E. pulverulenta* as a result of clearing or subsidence such that a local population of the species is likely to be placed at risk of extinction.

- *Genoplesium superbum* (Superb Midge Orchid)

G. superbum has been recorded within one location within 10 km of the Study Area. The OEH Atlas of NSW Wildlife record of this species has been denatured in order to protect this species from the risk of being collected. The habitat of the local occurrence of this species can be generally described as shrubby woodland on a slope. Habitats within the proposed surface infrastructure footprint therefore have potential to support this species. If present, the local population would extend outside the Study Area. The forest habitats in which this species occurs are unlikely to be affected by subsidence such that the habitat would become unsuitable for this species. If *G. superbum* is present within the proposed surface infrastructure footprint, it is highly likely that this species would also occupy parts of the extensive surrounding woodlands that exhibit similar sandy woodland habitats. The likely extent of the population to be removed would therefore be relatively minor. Therefore, the Project would not affect the lifecycle of *G. superbum* such that a local population of the species is likely to be placed at risk of extinction.

- *Prasophyllum fuscum* (Tawny Leek Orchid)
- *Boronia deanei* (Deane's Boronia)

B. deanei has been predominately recorded within Shrub Swamps within the Newnes Plateau, however, no records have been made within the Study Area. *P. fuscum* has not been recorded within the Study Area, and is largely restricted to 500-700 m above sea level, which is lower than heights found on the Newnes Plateau, however, the species has potentially suitable habitat along swamp margins.

As discussed in **Section 6.2.2**, maximum projected changes to baseflow and average standing ground water levels suggest that some areas of habitat for this species may be influenced by hydrological changes. Three of the four monitored swamps are predicted to have a decrease in baseflows and associated decrease of average standing water levels. However, all monitored swamps are still predicted to have a minimum depth in average standing groundwater levels above the ground surface (Adhikary and Wilkins 2013), which would still allow for the hydrology of the swamp system to support the peat layer that is critical to maintaining swamp ecosystem function. In addition, an analysis of the distribution of *Boronia deanei* within shrub swamps has indicated that the species prefers swamp margins away from areas of saturated soil (Fletcher and Erskine 2012), and along marginal sites with deep soil (Benson and Baird 2012). Similarly, *Prasophyllum fuscum* prefers swamp margins and can be found along the ecotones between swamps and grassy woodlands (TSSC 2008). This suggests that these species may be resistant to small reductions in groundwater levels that have been projected for this proposal. Given that any impacts to groundwater levels are unlikely to significantly impact upon the population of *Boronia deanei* within the Study Area and any populations of *Prasophyllum fuscum* that may exist within the Study Area, it is considered unlikely that the Project will affect the lifecycle of these species such that a local population is likely to be placed at risk of extinction.

- *Thesium australe* (Austral Toadflax)

T. australe is hemiparasitic on the roots of other plants, mainly *Themeda australis* and is generally confined to grassy woodlands, grasslands and damp sites. *T. australe* is found in small populations scattered through the eastern part of NSW. The closest known location of this species was recorded by RPS in the Blackmans Flat area, approximately 3 km to the west of the Study Area.

This species was not detected during current or previous surveys within the Study Area. However, grassy woodland habitat with *T. australis* is present and this species, therefore, has the potential to occur. No areas containing this species are proposed to be removed or undermined. This species has potential to occur along drainage lines and waterways that would be affected by mine water discharge. If present, habitats for this species are likely to be common and not restricted to those drainage lines that may be affected by mine water discharge. Therefore, the Project is unlikely to affect the lifecycle of *T. australe* such that a local population of the species is likely to be placed at risk of extinction.

- *Veronica blakelyi*.

Throughout the Newnes Plateau RPS has recorded 446 *V. blakelyi* plants. One individual *V. blakelyi* was recorded along a track within the ESAs. However, avoidance measures have been implemented to avoid this single recorded plant.

V. blakelyi was often recorded at the edge of shrub swamps and hanging swamps. As discussed in **Section 6.2.2**, the Project is not expected to have a significant impact upon any shrub swamps or hanging swamps. This prediction is supported by a high level of confidence in subsidence predictions, as shown by post-mining subsidence monitoring data. Additionally ongoing ground-water, surface water, flora and fauna monitoring of previously undermined swamps and revealed no impacts to GDEs as a result of undermining these areas. Consequently, the Project is unlikely to affect the lifecycle of *V. blakelyi* as a result of clearing or subsidence such that a local population of the species is likely to be placed at risk of extinction.

Threatened Fauna

- Giant Dragonfly (*Petalura gigantea*)

This species is found in permanent swamps and bogs with some water and open vegetation. This species is known to occur in Sunnyside Swamp (Benson and Baird 2012) and, therefore, it has technically been recorded within the Study Area. No habitat for this species occurs within the proposed surface infrastructure footprint, therefore no impacts as a result of proposed clearing is expected.

As discussed in **Section 6.2.2**, maximum projected changes to baseflow and average standing ground water levels suggest that some areas of habitat for this species may be influenced by hydrological changes. Three of the four monitored swamps are predicted to have a decrease in baseflows and associated decrease of average standing water levels. However, all monitored swamps are still predicted to have a minimum depth in average standing groundwater levels above the ground surface (Adhikary and Wilkins 2013), which would still allow for the hydrology of the swamp system to support the peat layer that is critical to maintaining swamp ecosystem function.

The Giant Dragonfly is known to construct burrows into the ground where it lays its eggs (oviposition) in the waterlogged substrate or under moist litter (Benson and Baird 2012). Burrow depth was recorded to range from 18 to 75 cm (Benson and Baird 2012), with some burrows showing evidence of adaptive burrow deepening by larvae of the species as a response to a lowering groundwater table. The maximum average depth of any projected changes to groundwater levels in potential habitat for this species is within the range of known burrowing depth for the Giant Dragonfly. It is therefore considered unlikely that the Project will affect the lifecycle of these species such that a local population is likely to be placed at risk of extinction.

- Giant Burrowing Frog (*Heleioporus australiacus*)
- Stuttering Frog (*Mixophyes balbus*)
- Littlejohn's Tree Frog (*Litoria littlejohni*)
- Red-crowned Toadlet (*Pseudophryne australis*)

The Giant Burrowing Frog has been recorded by call recognition in previous surveys within the Study Area (BMS 2011b). The location description provided was the 'Kangaroo Creek road crossing'. Additional scattered records occur throughout the Blue Mountains National Park. Preferred breeding habitat exists in the Study Area within the upland shrub swamps and creek lines. Suitable habitats occur widely through the Newnes Plateau and more preferred habitat, in the form of small headwater creek lines and slow flowing to intermittent creek-lines, occurs throughout the wider Blue Mountains area. The habitats within the Study Area are therefore a small proportion of the available habitat within the locality, much of which is conserved within the nearby national parks.

A Stuttering Frog has been recorded within the Springvale SMP area by call recognition (MKES 2004b). The

location description provided was the ' Wolgan River crossing', which may potentially refer to the crossing north of Sunnyside Swamp. Within the Study Area, the most suitable habitat for this species would be in proximity to the various watercourses. All vegetated areas provide potential terrestrial habitat for this species. Deeper gullies, with more permanent flowing water within the Blue Mountains area, including the Wolgan River and Carne Creek provide the most substantial areas of habitat for this species within the Study Area. Potential breeding habitat may occur within the more permanently water fed shrub swamps.

Fauna surveys carried out across the Study Area have failed to detect the presence of Littlejohn's Tree Frog. Also, no individuals have been recorded during eight years of fauna monitoring. The nearest records are approximately 20 km southeast of the Study Area, in the vicinity of Mount Wilson (OEH, 2013). Potential breeding habitat occurs within the shrub swamps and creek lines, and the remainder of the site could potentially be utilised as non-breeding habitat. Similar suitable habitats occur widely throughout the Newnes Plateau and the Blue Mountains area. No significant impacts are expected on shrub swamps or creek lines. Given the large amounts of suitable non-breeding habitat in the Study Area and surrounding region, the small amount of clearing for surface facilities and the localised subsidence it is considered that a local population of this species is unlikely to be placed at risk of extinction.

No records of Red-crowned Toadlet exist on the Newnes Plateau however scattered records are present within the connected forested areas, including Wollemi National Park. Potential suitable habitats exist within the Study Area. This species inhabits seepages at the base of large sandstone rocks and around soaks and other areas where water is collected (Tyler and Knight 2011).

No potential breeding habitat would be removed for the Giant Burrowing Frog, Stuttering Frog, Red-crowned Toadlet or Littlejohn's Tree Frog. The proposed clearing may, however, cause a loss of potential foraging habitat for these species.

Breeding habitat impacts may occur as a result of subsidence causing minor cracking and tilting. It is expected that fracturing of the bedrock would occur beneath some sections of the drainage lines, which are located directly above the proposed longwalls. Where the beds of the drainage lines have exposed bedrock, there may be some diversion of surface water flows into the dilated strata beneath them. Previous monitoring over undermined areas has shown some isolated incidences where this has happened (see **Section 6.2.3**). Similar events may occur as a result of the Project, however, these would also be isolated and often shortterm. Subsidence may also cause ponding in localised areas, which may create additional breeding opportunities for these species.

Suitable habitats for these species occur widely through the Newnes Plateau and more preferred habitat, in the form of small headwater creek lines and slow flowing to intermittent creek-lines, occurs throughout the wider Blue Mountains area. The habitats within the Study Area are therefore a small proportion of the available habitat within the locality, much of which is conserved within the nearby national parks. Consequently, the Project is unlikely to affect the lifecycle of Giant Burrowing Frog, Stuttering Frog, Red-crowned Toadlet or Littlejohn's Tree Frog as a result of clearing or subsidence such that a local population of these species is likely to be placed at risk of extinction.

- Blue Mountains Water Skink (*Eulamprus leuraensis*)

This species has been predominately recorded within Shrub Swamps within the Newnes Plateau, however, no records have been made within the Study Area. This species was not recorded within the proposed surface infrastructure footprint. The Blue Mountains Water Skink is considered to be reliant on the presence of permanent groundwater seepage and/or waterlogging within parts of the inhabited swamp, even during times of drought and is typically associated with the more waterlogged areas of the swamp (Benson and Baird 2012). Genetic studies have also determined that the species experiences little dispersal between swamps (Dubey and Shine 2009), and therefore the shrub swamps present within the Study Area may constitute several 'local populations' of the species.

As discussed in **Section 6.2.2**, maximum projected changes to baseflow and average standing groundwater levels suggest that some areas of habitat for this species may be influenced by hydrological changes. Three of the four monitored swamps are predicted to have a decrease in baseflows and associated decrease of

average standing water levels. However, all monitored swamps are still predicted to have a minimum depth in average standing groundwater levels above the ground surface (Adhikary and Wilkins 2013), which would still allow for the hydrology of the swamp system to support the peat layer that is critical to maintaining swamp ecosystem function. As the predicted changes in baseflows and associated maximum decrease of average standing water levels are unlikely to cause the preferred waterlogged habitats to dry, it is unlikely that the Project will affect the lifecycle of the Blue Mountains Water Skink such that it is likely to be placed at risk of extinction.

- Rosenberg's Goanna (*Varanus rosenbergi*)

This species is found in heath, open forest and woodland. It uses termite mounds for breeding. It shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens.

The proposed surface infrastructure footprint occurs within a large area containing contiguous forest, woodland, heath, swamp and rocky habitats. These habitats continue throughout the Newnes State Forest and into the Gardens of Stone National Park, Blue Mountains National Park and Wollemi National Park. Local populations of the Rosenberg's Goanna would extend into these adjacent protected habitats. Therefore, the losses of habitat and impacts to local populations of the Rosenberg's Goanna are small, relative to the available occupied habitats.

It is highly unlikely that subsidence related ground movements would affect woodland or forest habitats such that they would become in any way unsuitable for the Rosenberg's Goanna. No observable significant impacts to woodland habitats have occurred from subsidence within previously undermined areas of Springvale. Therefore, the Project is unlikely to impact local populations of the Rosenberg's Goanna such that it is likely to be placed at risk of extinction.

- Broad-headed Snake (*Hoplocephalus bungaroides*)

This species is nocturnal, sheltering by day in rock crevices and under flat sandstone rocks on exposed cliff edges, rocky outcrops and pagodas, which have been avoided by the proposed surface infrastructure. Areas to be cleared for surface infrastructure will likely remove tree hollows, which this species utilises for sheltering in summer. Subsidence will not impact habitats on site such that they become unsuitable for this species. Thus, the Project is unlikely to impact the local population of the Broad-headed Snake such that it is likely to be placed at risk of extinction.

- Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)
- Speckled Warbler (*Chthonicola sagittata*)
- Regent Honeyeater (*Anthochaera phrygia*)
- Painted Honeyeater (*Grantiella picta*)
- Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*)
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)
- Varied Sitella (*Daphoenositta chrysoptera*)
- Hooded Robin (*Melanodryas cucullata*)
- Scarlet Robin (*Petroica boodang*)

- Flame Robin (*Petroica pheonicea*)

All the above woodland bird species are likely to utilise the open forests that occur throughout the Study Area for foraging, and many species may also nest within the Study Area. Therefore, approximately 23.24 ha of potential habitat for these species may be removed.

The proposed surface infrastructure footprint occurs within a large area containing contiguous forest, woodland, heath, swamp and rocky habitats. These habitats continue throughout the Newnes State Forest and into the Gardens of Stone National Park, Blue Mountains National Park and Wollemi National Park. Local populations of these bird species would extend into these adjacent protected habitats. Therefore, the losses of habitat and impacts to local populations of these threatened woodland birds are considered small, relative to the available occupied habitats.

It is highly unlikely that subsidence related ground movements would affect woodland or forest habitats such that they would become in any way unsuitable for any of these woodland bird species. No observable significant impacts to woodland habitats have occurred from subsidence within previously undermined areas of Angus Place. Therefore, the Project is unlikely to impact on the local populations of these threatened woodland birds such that they are likely to be placed at risk of extinction.

- Barking Owl (*Ninox connivens*)
- Powerful Owl (*Ninox strenua*)
- Masked Owl (*Tyto novaehollandiae*)
- Sooty Owl (*Tyto tenebricosa*)

These forest owl species occur in wet or dry sclerophyll forests and woodlands in the coastal, tablelands and to the western plains of NSW, where they hunt for a range of mammalian prey. These species nest in large hollows (preferably Eucalypt trees). Roosting can also occur in dense canopy vegetation. These owls are predators of arboreal mammals such as Common Brushtail Possums, Sugar Gliders and microbats. In addition, some terrestrial mammals commonly taken include the Bush Rat, European Rabbit, and Brown Antechinus. A high density of small mammals (many of which are hollow-dependent), is required for a suitable foraging habitat for these forest owls.

Barking Owls, Powerful Owls, Masked Owls and Sooty Owls have all been recorded during current or previous surveys within the Study Area or within adjacent mines. Suitable prey species, particularly Greater Gliders, Common Ringtail Possums, and Bush Rats, were found to occur at relatively high densities in parts of the Study Area. The Forest Owl species are likely to forage in the Study Area periodically throughout the year, and the Study Area may form part of the territory of several individuals of different species.

The Project proposes the removal of 23.24 ha of woodland/forest habitat that may be used for hunting by these species and an estimated 418 hollow-bearing trees will be removed, some of which would be suitable for owls. The Project will therefore constitute a loss to potential roosting or nesting trees for these owl species. It is noted, however, that the threatened Barking Owl, Powerful Owl and Masked Owl have preferred hollow types, which involve hollows developing from the main stem of the tree. It is therefore less likely that actual preferred roost trees occur within the surface infrastructure footprint. The Sooty Owl prefers moist tall forests and therefore is unlikely to be affected by proposed clearing.

The proposed surface infrastructure footprint occurs within a large area containing contiguous forest, woodland, heath, swamp and rocky habitats. These habitats continue throughout the Newnes State Forest and into the Gardens of Stone National Park, Blue Mountains National Park and Wollemi National Park. Local populations of these owl species would extend into these adjacent protected habitats. Therefore, the losses of habitat and impacts to local populations of these threatened owls are considered small, relative to the available occupied habitats.

It is highly unlikely that subsidence related ground movements would affect woodland or forest habitats such that they would become in any way unsuitable for any of these owl species. No observable significant impacts to woodland habitats have occurred from subsidence within previously undermined areas of Angus Place. Therefore, the Project is unlikely to impact the local populations of these threatened owls such that it is likely to be placed at risk of extinction.

- Spotted-tail Quoll (*Dasyurus maculatus*)

Previous and current fauna surveys carried out by RPS across the Newnes Plateau have not recorded the presence of the Spotted-tailed Quoll. During the eight years of annual monitoring, which occurs over the Centennial tenements on the Newnes Plateau, this species has not been recorded. Notwithstanding, there is potential for these species to occur.

The proposed surface infrastructure footprint occurs within a large area containing contiguous forest, woodland, heath, swamp and rocky habitats. These habitats continue throughout the Newnes State Forest and into the Gardens of Stone National Park, Blue Mountains National Park and Wollemi National Park. Local populations of the Spotted-tailed Quoll would extend into these adjacent protected habitats. Therefore, the losses of habitat and impacts to local populations of the Spotted-tailed Quoll are considered small, relative to the available occupied habitats.

It is highly unlikely that subsidence related ground movements would affect woodland or forest habitats such that they would become in any way unsuitable for the Spotted-tailed Quoll. No observable significant impacts to woodland habitats have occurred from subsidence within previously undermined areas of Angus Place. Therefore, the Project is unlikely to impact local populations of the Spotted-tailed Quoll such that it is likely to be placed at risk of extinction.

- Southern Brown Bandicoot (*Isoodon obesulus obesulus*)

Previous and current fauna surveys carried out by RPS across the Newnes Plateau have not recorded the presence of the Southern Brown Bandicoot. Eight years of annual monitoring across Centennial mining areas in the Newnes Plateau has also not detected this species. However, this species is known to occur within the Blue Mountains National Park, with suitable habitat for this species occurring within the Study Area.

The proposed action will remove approximately 23.24 ha of potential foraging vegetation to accommodate surface infrastructure. Similar connected habitat is widely available for this species within the Study Area and in the adjoining Newnes Plateau and Greater Blue Mountains area. The predicted subsidence levels and surface cracking are not expected to adversely affect habitats for this species. Therefore, the Project is unlikely to have an adverse effect on the life cycle of the Southern Brown Bandicoot such that a viable local population of the species is likely to be placed at risk of extinction.

- Koala (*Phascolarctos cinereus*)

One Koala has been recorded within the Study Area during previous surveys (MKES 2008c).

A relatively small amount of habitat (0.16 ha) will be cleared for surface facilities, which contain a high proportion of secondary Koala feed trees. Similar connected habitat is widely available for this species throughout Newnes Plateau and adjacent national parks. The habitat features that this species utilises will not be impacted by subsidence. Thus, the proposal is unlikely to have adverse impacts on the Koala such that a local population is likely to be placed at risk of extinction.

- Eastern Pygmy Possum (*Cercartetus nanus*)

Eastern Pygmy Possums have been recorded within the Study Area during current and previous surveys. Open forests, shrub swamps, and dry heathlands throughout the site are suitable habitat for this species. Areas with a dense understorey of shrubs, particularly patches of dense *Banksia*, offer the best potential

foraging resources within the open forest habitats. Vegetation clearing for surface facilities will result in a localised loss of habitat in some open forests habitats (23.24 ha); however, extensive contiguous habitat is available in the Study Area. Large areas of similar habitat known to be utilised by this species exist in close proximity to the Study Area across the Newnes Plateau. Whilst it is likely that the Project will remove a proportion of habitat for a locally occurring population, this species has been recorded throughout the Newnes Plateau State Forests and it is also likely to be found in the adjacent national parks. Given these surrounding forested areas are contiguous with the vegetation found within the Study Area, it is probable that the local population of this species extends into these areas. Subsidence will not significantly impact forest habitats or dry heathlands. The habitat features on which Eastern Pygmy Possums rely within shrub swamps, namely the dense cover of nectar producing shrubs, are unlikely to be significantly affected by subsidence. Thus, the proposed action is unlikely to have an adverse effect on the local population of Eastern Pygmy Possums such that it is likely to be placed at risk of extinction.

- Yellow-bellied Glider (*Petaurus australis*)

Yellow-bellied Gliders have not been recorded within the Study Area. However, parts of the open forest habitat support tall, mature eucalypts that could provide habitat for this species. These areas of suitable habitat most often occur in gullies and similarly sheltered areas. The Project will clear 23.24 ha of native vegetation, most of which consists of only marginally suitable open forest habitats. Subsidence is not likely to impact habitats on site such that they become unsuitable for this species. Thus, the Project is unlikely to have adverse impacts on this species such that a local population is likely to be placed at risk of extinction.

- Squirrel Glider (*Petaurus norfolcensis*)

Squirrel Gliders have recorded within the Study Area during previous surveys (MKES 2006a). Squirrel Gliders are likely to utilise all of the open forest habitats on site for foraging and nest within hollow-bearing trees. 23.24 ha of this habitat will be cleared for surface infrastructure including some hollow-bearing trees. While this will represent a localised loss of habitat, extensive areas of suitable habitat will be retained in the Study Area and these are contiguous with habitats in the surrounding Newnes Plateau. Subsidence will not impact the open forest habitats. Therefore, the Project is unlikely to have an adverse effect on the life cycle of the Squirrel Glider such that a viable local population of the species is likely to be placed at risk of extinction.

- Brush-tailed Rock-wallaby (*Petrogale penicillata*)

Brush-tailed Rock-wallabies have not been recorded within the Study Area during current or previous surveys. Suitable habitat for this species occurs at a few locations, amongst the pagodas and rocky escarpments, which are found primarily at the edge of the Study Area.

The proposed clearing footprint is separated from rocky escarpments by approximately 400 m and would therefore not impact upon potential Brush-tailed Rock-wallaby habitat. Additionally, the mining layout has been designed such that the cliffs are located outside the 26.5 degree angle of draw line from the extents of the proposed longwalls. This avoidance measure will protect the most suitable habitats for this species.

Therefore, the Project is unlikely to impact a potentially occurring local population of the Brush-tailed Rock-wallaby such that it is placed at risk of extinction.

- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Little Pied Bat (*Chalinolobus picatus*)
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)
- Eastern Cave Bat (*Vespadelus troughtoni*)

The Large-eared Pied Bat and Eastern Bentwing Bat have been recorded foraging in the Study Area during the current survey. The Little Pied Bat has been recorded once within the Clarence lease area (BMS 2009d).

Eastern Cave Bats have potential to occur in the Study Area due to the presence of suitable habitat, although they have not been recorded during current or previous surveys. Cave-roosting bat species are likely to forage in habitats throughout the Study Area, and fissures and caves suitable for roosting are likely to be present in the rocky escarpments and cliff edges. Vegetation clearing for surface infrastructure will modify some foraging habitat, however, not such that the habitat would become unsuitable for foraging. Low levels of subsidence will occur throughout the Study Area, however, the cliff edges and rocky escarpments are outside the area of extraction of proposed longwalls and are unlikely to experience effects from subsidence that might damage habitat features vital for roosting. Thus, the proposed action is unlikely to have an adverse affect on the local populations of these cave-roosting species such that they are likely to be placed at risk of extinction.

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)

These hollow-roosting Bat species have been recorded foraging in the Study Area during current or previous surveys. The proposed action will remove approximately 23.24 ha of vegetation to accommodate surface infrastructure. However, those areas can still be utilised for foraging. Some hollow-bearing trees will also be cleared, reducing available roosting habitat. However, hollow-bearing trees have been recorded throughout the Study Area and are likely common in the surrounding Newnes Plateau, thus providing alternative roosting sites for the local population. Subsidence will not impact on the open forest habitats on site such that they become unsuitable for these bat species. Thus the Project is unlikely to have impact on the life-cycle of hollow-roosting bats such that a viable local population of these species is likely to be placed at risk of extinction.

(b) **In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,**

No endangered populations were identified or are likely to occur within the Study Area.

(c) **In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

(i) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

(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**

- Newnes Plateau Shrub Swamp

Newnes Plateau Shrub Swamps within the Study Area will not be impacted by vegetation clearing for surface infrastructure areas. Impact Assessments of Subsidence (MSEC 2014) and Groundwater Impact assessments (RPS 2014a) have been undertaken in relation to swamps. These assessments found that there is unlikely to be significant reductions or reversals of grade that could otherwise cause ponding or scouring. Additionally, it was found that the limited depth of fracturing and dilation of bedrock of shrub swamp or upstream drainage lines would not result in losses of infiltrated water and minimal divergence of surface water would occur. With regard to these findings, it is unlikely that the effects of subsidence would have a significant adverse effect on shrub swamps or hanging swamps.

The most significant reductions to average standing groundwater levels are predicted in Twin Gully Swamp. This swamp has a projected drop in average standing water levels from 12.4 cm to 10.6 cm above the soil surface. The post mining values predicted at Twin Gully Swamp therefore suggest that soil saturation would persist, maintaining water availability for flora and fauna, as well as soil anoxia, allowing for continued peat formation. All other monitored swamps have smaller projected decreases in average standing water levels and monitored swamps are projected to maintain average standing water levels above the surface. It is possible that these levels may naturally fall below the surface in certain locations of the swamp. However, highly organic peat soils with low bulk density capillary forces are likely to be saturated for some distance above the water table itself. Therefore, a possible reduction in the average standing water levels, by the magnitudes predicted in Adhikary and Wilkins (2013), is unlikely to result in drying of the peat layer. The Project is therefore unlikely 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 substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

- Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions

Approximately 118.04 ha of the EEC have been mapped within the Study Area. The Project will not require the removal of any areas of this EEC. However, an area of this community occurs at the edge of a drainage line that is fed by mine water discharge. As discussed in **Section 6.3**, the salinity levels and increased flows are unlikely to significantly impact this EEC. The Project is therefore unlikely 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 substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

(d) **In relation to the habitat of a threatened species, population or ecological community:**

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

Flora

- *Caesia parviflora* var. *minor*

Vegetation cleared for surface infrastructure will result in the removal of 23.24 ha of open forest habitat, a small portion of which may include damp areas that may be suitable for this species. *Caesia parviflora* var. *minor* may also occur in hanging swamps. The levels of subsidence predicted are unlikely to significantly change the distribution of stored surface waters or have any adverse changes in ponding or scouring within the swamps. Thus, the hanging swamps are unlikely to be modified such that they become unsuitable for this species.

- *Lastreopsis hispida* (Bristly Shield Fern)

Vegetation to be cleared for surface infrastructure is unlikely to support this species. Potential habitats elsewhere within the Study Area are not likely to be significantly impacted by subsidence.

- *Acacia bynoeana* (Bynoe's Wattle)

Potential habitat for this species within the Study Area includes dry sclerophyll communities including MU 7, 14, 26, 26a, 28, 29, 30, 32, 33, 35, and 37, along with heath communities within MU 44, 45, and 46. Therefore, approximately 23.24 ha of potential habitat may be removed as a result of the proposed clearing.

- *Persoonia acerosa* (Needle Geebung)

Vegetation clearing for surface infrastructure areas will result in the removal of 23.24 ha of open forest habitat which could support these two species. However, extensive targeted surveys within the areas to be cleared did not detect these species and no populations are known from the immediate vicinity. No significant impacts to open forests are predicted as a result of subsidence.

- *Eucalyptus aggregata* (Black Gum)

No areas of habitat for this species will be removed. Minor habitat modifications may be localised to the habitats that interact with the waterways receiving mine water discharge.

- *Eucalyptus pulverulenta* (Silver-leaved Gum)

Vegetation cleared for surface infrastructure is unlikely to support this species. Potential habitats elsewhere within the Study Area are not likely to be significantly impacted by subsidence.

- *Genoplesium superbum*

Vegetation cleared for surface infrastructure will result in the removal of 23.24 ha of open forest habitat, which may include habitat for this species. The open forests on site are not likely to be significantly impacted by subsidence.

- *Prasophyllum fuscum* (Tawny Leek Orchid)

This species has potential to occur along the damp margins of swamps within the Study Area. These habitats have potential to be modified as a result of subsidence. However, there are no significant predicted changes to scouring or ponding in these wetland environments as a result of subsidence. The predicted minor changes to baseflow and average standing water levels are not expected to result in changes to ecological function of the swamps habitats potentially suitable for this species. Therefore, no habitat is likely to be removed or modified as a result of the action proposed.

- *Persoonia hindii*

Vegetation clearing for surface infrastructure will remove 23.24 ha of open forest habitat which provides potential habitat for this species. Approximately 14,866 stems of *P. hindii* have been recorded by RPS or other consultants from open forests in the Newnes Plateau and are not known to be within any surface impact areas that may result in their removal.

- *Prostanthera cryptandroides subsp. cryptandroides*

Vegetation cleared for surface infrastructure is unlikely to support this species. Potential habitats elsewhere within the Study Area are not likely to be significantly impacted by subsidence.

- *Boronia deanei* (Deane's Boronia)

This species has potential to occur along the damp margins of creeks and within the shrub swamps in the Study Area. These habitats have potential to be modified as a result of subsidence. However, there are no significant predicted changes to scouring or ponding in these wetland environments as a result of subsidence. The predicted minor changes to baseflow and average standing water levels are not expected to result in changes to ecological function of the swamps habitats suitable for this species. Therefore, no habitat is likely to be removed or modified as a result of the action proposed.

- *Thesium australe* (Austral Toadflax)

No areas of habitat for this species will be removed. Minor habitat modifications may be localised to the habitats that interact with the waterways receiving mine water discharge.

- *Veronica blakelyi* syn. *Derwentia blakelyi*

Vegetation cleared for surface infrastructure will result in the removal of 23.24 ha of open forest/woodland habitat. The habitats on site are not likely to be significantly impacted by subsidence.

Fauna

- Giant Dragonfly (*Petalura gigantea*)

Preferred habitat for this species will not be affected by vegetation clearing. The predicted subsidence levels are unlikely to modify the swamp habitats on site such they become unsuitable for this species.

- Giant Burrowing Frog (*Heleioporus australiacus*)
- Stuttering Frog (*Mixophyes balbus*)
- Red-crowned Toadlet (*Pseudophryne australis*)
- Littlejohn's Tree Frog (*Litoria littlejohni*)

Vegetation clearing for surface infrastructure will occur along ridge tops, which is unlikely to be used by these species of frog. The Giant Burrowing Frog may use woodland and heath habitat up to 300 m from available breeding habitat. This would include areas of MU 3, 4, 7, 8, 11, 14, 15, 19, 20, 21, 26, 26a, 28, 29, 30, 35, 36, 37, 44, 45, 46, 50, 51, 53 and 54 within 300 m of a mapped creek-line all provide potential foraging habitat for this species, totalling approximately 22.33 ha of potential habitat for the Giant Burrowing Frog. The predicted minor changes to baseflow and average standing water levels are not expected to result in changes to ecological function of the swamps habitats potentially suitable for these species. Therefore, no habitat is likely to be removed or modified as a result of the action proposed.

- Blue Mountains Water Skink (*Eulamprus leuraensis*)

Preferred habitat for this species will not be affected by vegetation clearing. The predicted minor changes to baseflow and average standing water levels are not expected to result in changes to ecological function of the swamps habitats potentially suitable for this species. Therefore, no habitat is likely to be removed or modified as a result of the action proposed.

- Rosenberg's Goanna (*Varanus rosenbergi*)

This species is found in heath, open forest and woodland. It therefore may potentially utilise any of the habitats within the Study Area. Approximately 23.24 ha of potential habitat is proposed to be removed.

- Broad-headed Snake (*Hoplocephalus bungaroides*)

The exposed sandstone slabs and exfoliations occur within the Study Area within the Pagoda Rock Sparse Shrubland vegetation community (MU43) and, therefore, represents potential breeding habitat for the species. Forested and heath areas within 200 m of these sandstone outcrops represent potential foraging habitat for the species during the summer months and include areas of MU 3, 4, 7, 8, 11, 14, 15, 21, 26, 26a, 28, 29, 30, 32, 35, 37, 44 and 46. Approximately 0.63 ha of potential summer foraging habitat occurs within the proposed surface infrastructure footprint. The predicted subsidence levels are unlikely to modify and of the rocky habitats on site such they become unsuitable for this species.

- Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)
- Speckled Warbler (*Chthonicola sagittata*)

- Regent Honeyeater (*Anthochaera phrygia*)
- Painted Honeyeater (*Grantiella picta*)
- Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*)
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)
- Varied Sitella (*Daphoenositta chrysoptera*)
- Hooded Robin (*Melanodryas cucullata*)
- Scarlet Robin (*Petroica boodang*)
- Flame Robin (*Petroica pheonicea*)

23.24 ha of habitat for woodland birds will be cleared for surface infrastructure. Subsidence is not predicted to modify any of the habitats in the Study Area such that they are likely to become unsuitable for woodland bird species.

- Barking Owl (*Ninox connivens*)
- Powerful Owl (*Ninox strenua*)
- Masked Owl (*Tyto novaehollandiae*)
- Sooty Owl (*Tyto tenebricosa*)

23.24 ha of habitat for forest owls will be cleared for surface infrastructure. Subsidence is not predicted to modify any of the habitats in the Study Area such that they are likely to become unsuitable for forest owls.

- Spotted-tailed Quoll (*Dasyurus maculatus maculatus*)

Approximately 23.24 ha of suitable habitat for this species will be cleared for surface infrastructure. Subsidence will not modify any of the habitats on site such they would be unsuitable for Spotted-tailed Quolls.

- Southern Brown Bandicoot (*Isoodon obesulus obesulus*)

Approximately 23.24 ha of open forest habitat will be cleared for surface infrastructure. However, only a small portion of this area is likely to contain habitat features suitable for this species. The predicted subsidence levels are not expected to adversely modify habitats for this species.

- Koala (*Phascolarctos cinereus*)

Approximately 23.24 ha of suitable habitat for this species will be cleared for surface infrastructure. Subsidence will not modify any of the habitats on site such they would be unsuitable for Koalas.

- Eastern Pygmy Possum (*Cercartetus nanus*)

Approximately 23.24 ha of suitable habitat for this species will be cleared for surface infrastructure. Subsidence will not modify any of the habitats on site such they would be unsuitable for Eastern Pygmy Possums.

- Yellow-bellied Glider (*Petaurus australis*)
- 23.24 ha of open forest habitat will be cleared for surface infrastructure. However, only a small portion of this area is likely to contain habitat features suitable for this species. Approximately 23.24 ha of open forest habitat will be cleared for surface infrastructure though only a small portion of this area is likely to contain habitat features suitable for this species. The predicted subsidence levels are not expected to adversely modify habitats for this species.
- Squirrel Glider (*Petaurus norfolcensis*)

Approximately 23.24 ha of suitable habitat for this species will be cleared for surface infrastructure. The predicted subsidence levels are not expected to adversely modify habitats for this species.

- Brush-tailed Rock-wallaby (*Petrogale penicillata*)

The Study Area includes rocky escarpments and outcrops within the Pagoda Rock Sparse Shrubland vegetation community (MU43), which subsequently represents potential breeding habitat for the species. Forested areas within 200 m of these rocky outcrops represent potential foraging habitat for the species and include areas of MU 3, 4, 7, 8, 11, 14, 15, 21, 26, 26a, 28, 29, 30, 32, 35 and 37. Approximately, 0.63 ha of suitable foraging habitat occurs within 200 m of the proposed infrastructure footprint. The predicted subsidence levels are unlikely to modify and of the rocky habitats on site such they become unsuitable for this species.

Cave-roosting Bats

- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Little Pied Bat (*Chalinolobus picatus*)
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)
- Eastern Cave Bat (*Vespadelus troughtoni*)

Although 23.24 ha of open forest will be cleared, vegetation clearing for surface infrastructure is limited to small patches. These small patches of cleared land are not likely to modify the landscape such that it becomes unsuitable for foraging as cave-roosting bats can still forage over cleared areas and along the forest margins. Subsidence will not impact habitats such that they become unsuitable for foraging, and is not likely to significantly alter any roosting habitat in the rocky escarpments and cliffs.

Hollow-roosting Bats

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)

Vegetation clearing for surface infrastructure will likely include the removal of some hollow bearing trees, which provide potential roosting habitat for these species. Although 23.24 ha of open forest will be cleared, vegetation clearing for surface infrastructure is limited to small patches. These small patches of cleared land are not likely to modify the landscape such that it becomes unsuitable for foraging as hollow-roosting bats can still forage over cleared areas and along the forest margins. Subsidence will not impact habitats such that they become unsuitable for foraging.

- Newnes Plateau Shrub Swamp (NPSS)

The proposed installation of surface infrastructure is unlikely to directly affect this EEC as the infrastructure will be located primarily on the ridgetop and will not require the removal of any NPSS vegetation.

Monitoring of swamp water levels and surface water gauging has shown, over the life of the current mining operations, that no impacts to the swamps or surface water flows have occurred as a result mining to date at Angus Place (RPS 2014a). The Project has maintained those similarities with regard to mine design, with the addition of those avoidance and mitigation measures that have been discussed in this report.

Regular seasonal monitoring of the flora and fauna since 2005 have also revealed no observable impacts on the flora and fauna recorded within undermined areas, including Shrub Swamps. Therefore, the Project is unlikely to substantially modify the NPSSs present. This prediction is supported by a high level of confidence in subsidence predictions, as shown by post-mining subsidence monitoring data. Additionally, ongoing ground-water, surface water, and flora and fauna monitoring of previously undermined swamps and revealed no impacts to Shrub Swamps as a result of undermining these areas.

- Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions

No areas of this EEC are proposed to be removed.

(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**

With the exception of the existing track, the proposed surface facilities footprint is completely surrounded by native vegetation. The proposed clearing would therefore not pose a barrier for any of the species considered, both in terms of movement or genetic dispersal. The Project will not fragment or isolate and of the EECs considered.

(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**

- *Caesia parviflora* var. *minor*

One Atlas of NSW Wildlife record of this species occurs within 10 km of the Study Area. The location description for this record identifies the plant as occurring at the northern end of Sunnyside Ridge. This record therefore lies within the Study Area. As such, the known local population location for this species is not within any proposed clearing extent. If a population of this species extends into the area proposed for clearing, this would indicate a large occupied are that includes areas not to be impacted. Therefore, areas proposed to be removed are not likely to be important for the long-term survival of a local population of this species.

Lastreopsis hispidula (Bristly Shield Fern)

No habitat will be removed for this species. Additionally, the damp gully habitats where this species occurs will not be greatly modified by subsidence. As this species is supported by rotting vegetation, any minor changes, such as cracking would not disrupt the root system for this species. Therefore, no habitats that this species relies on, important or otherwise, will be affected such that the long-term survival of a local population of this species would be compromised.

- *Acacia bynoeana* (Bynoe's Wattle)
- *Persoonia acerosa* (Needle Geebung)
- *Prostanthera cryptandroides* subsp. *cryptandroides* (Wollemi Mintbush)

The forest/woodland habitat that will be cleared for surface infrastructure is widespread both within the Study Area and in the surrounding region. Due to the retention of large areas of suitable habitat within the Study Area and the predicted levels of subsidence, it is considered that the vegetation and habitat to be removed is not important to the long-term survival of these species in the locality.

- *Eucalyptus aggregata* (Black Gum)

This species occurs along the drainage lines that could be affected by mine water discharge. However, changes in water quality are predicted to be within the tolerance limits of this species. Therefore, no individuals of this species are expected to be removed or modified.

- *Eucalyptus pulverulenta* (Silver-leaved Gum)

E. pulverulenta is unlikely to occur within the proposed surface infrastructure footprint and therefore will not be impacted by proposed clearing. This species occurs on the crests or upper slopes of moderately steep hillsides or mountains. These habitats may experience minor slumping or cracking as a result of subsidence, however, the impacts would not greatly affect the habitats of this species, which is adapted to maintain a strong hold through their root system in steep landscapes. Therefore, no habitats that this species relies on,

important or otherwise, will be affected such that the long-term survival of a local population of this species would be compromised.

- *Genoplesium superbum* (Superb Midge Orchid)

One OEH Atlas of NSW Wildlife record of this species occurs within 10 km of the Study Area. Therefore, the known local population location for this species is not within any proposed clearing extent. If a population of this species extends into the area proposed for clearing, this may indicate a large occupied area that includes areas not to be impacted. Therefore, areas proposed to be removed are not likely to be important for the long-term survival of a local population of this species.

- *Prasophyllum fuscum* (Tawny Leek Orchid)

A few scattered records exist of *P. fuscum* in the region from near Mt Tomah in the east to the Mt Victoria – Blackheath – Katoomba area. This species has potential to occur within the swamp habitats which occurs within the Study Area. Due to the small area of occupancy of this species, its specific habitat requirements and association with swamp habitats, the potential habitat present within the Study Area is considered of high importance. However, the Project is not expected to have a significant impact upon habitat for this species.

- *Persoonia hindii*

Only currently unoccupied potential habitat for this species will be removed. RPS has recorded, or has been provided with, 14,866 records of *P. hindii* stems across the Newnes Plateau. Whilst the Project constitutes a loss habitat within the proposed footprint, is not important for the long-term survival of this species.

- *Boronia deanei* (Deane's Boronia)

This species has been observed in the margins of swamps within a 10 km radius of the Study Area such as Carne West Swamp, Carne Central Swamp, Gang Gang Swamp South West and Gang Gang Swamp East (Benson and Baird 2012). No records exist within the Study Area. No impacts that would compromise the viability of potential habitats for this species are predicted to occur.

- *Thesium australe* (Austral Toadflax)

The recorded occurrence of *T. australe* within the region is limited to a population recorded near Blackmans Flat, approximately 3 km west of the Study Area. Very little information is available of the regional distribution of this rare species but it has been predicted to occur from Katoomba in the south to just above Kandos in the north. However, this is only based on the occurrence of potentially suitable habitat such as damp grasslands and grassy woodlands with *T. australis* present. These habitats are widespread within the region and the limited amount of potential habitats within the Study Area would therefore not be of high importance to this species. The long-term survival of this species is unlikely to be affected by the Project.

- *Veronica blakelyi*

No individuals will be removed by the project. Most records of *V. blakelyi* made by RPS occur at the edges of shrub swamps. As the habitats to be removed are not occupied and are primarily located away from the most common habitat types, the habitats to be removed are not important for the long-term survival of a local population of this species.

Threatened Fauna

- Giant Dragonfly (*Petalura gigantea*)

Important habitat for the Giant Dragonfly within the Study Area is restricted to the shrub swamps. As discussed in **Section 6.2.2**, the Project is not expected to have a significant impact upon any shrub swamps,

such that their ecosystem functioning may be impaired. This prediction is supported by a high level of confidence in subsidence predictions, as shown by post-mining subsidence monitoring data. Additionally ongoing ground-water, surface water, flora and fauna monitoring of previously undermined swamps and revealed no impacts to shrub swamps as a result of undermining these areas. Therefore, any alterations to potentially important habitats from subsidence, will not affect the long-term survival of the Giant Dragonfly in the locality.

- Giant Burrowing Frog (Heleioporus australiacus)
- Stuttering Frog (*Mixophyes balbus*)
- Littlejohn's Tree Frog (*Litoria littlejohni*)
- Red-crowned Toadlet (*Pseudophryne australis*)

The important potential habitats for these threatened frog species are within and in close proximity to watercourses and swamp habitats. The records made during fauna monitoring for Giant Burrowing Frog and Stuttering Frog have been recorded in these habitats. No clearing is proposed within these habitat types. Whilst some modifications to creekline flows may occur, previous monitoring has shown that these do not alter the habitats themselves. Therefore, any alterations to potentially important habitats from subsidence, will not affect the long-term survival of these species in the locality.

Blue Mountains Water Skink (*Eulamprus leuraensis*)

This species is restricted to the Blue Mountains and Newnes Plateau in NSW. It occurs in elevated habitats, generally in shrub or hanging swamps, but can also occur in open forest, open scrub or heath. Larger, wetter swamps in close proximity to other inhabited swamps are more likely to be occupied by this species. Shrub swamps of the Newnes Plateau are highly important for the long term survival of this species in the locality. This species has not been recorded within the Study Area, but is known to the south of the Study Area in Carne West Swamp, Gang Gang Swamp East, Carne Central Swamp, Murrays Swamp and Pine Swamp.

Given the limited known distribution of a local population, any occupied or potential shrub swamp habitat is important for this species. As discussed in **Section 6.2.2**, the Project is not expected to have a significant impact upon any shrub swamps, such that their ecosystem functioning may be impaired. This prediction is supported by a high level of confidence in subsidence predictions, as shown by post-mining subsidence monitoring data. Additionally ongoing ground-water, surface water, flora and fauna monitoring of previously undermined swamps and revealed no impacts to shrub swamps as a result of undermining these areas. The predicted minor changes to baseflow and average standing water levels are not expected to result in changes to ecological function of the swamps habitats potentially suitable for these species. Therefore, the Project is not expected to affect the long-term survival of the Blue Mountains Water Skink in the locality.

- Rosenberg's Goanna (*Varanus rosenbergi*)

This species has potential habitat throughout the Newnes Plateau and surrounding national parks. The open forest habitat that will be cleared for surface infrastructure areas is not important to the long-term survival of this species in the locality. Alterations to habitats from subsidence, will not affect the long-term survival of these species in the locality.

- Broad-headed Snake (*Hoplocephalus bungaroides*)

Broad-headed Snakes select refuge based on seasonal temperature differences, preferring cooler tree hollows on top of plateaus and below cliffs during summer, and warmer sun-exposed sandstone slabs and exfoliations during winter. These rock features are considered as the important habitat features for this species. The proposed clearing footprint does not have areas of particularly rocky habitats, thus limited sheltering use by reptiles with this habitat preference, such as the Broad-headed Snakes, is expected. This

species also utilises tree hollows in summer, however, this habitat feature is more abundant and therefore this a less important habitat feature for this species.

The small numbers of pagodas that occur within the angle of draw are unlikely to experience any adverse impacts resulting from the extraction of the proposed longwalls. There is potential for some rock falls, however, as the Broad-headed Snake uses flat sandstone rocks, steeper more unstable rocks are likely to be less utilised. Therefore, any alterations to potentially important habitats from subsidence will not affect the long-term survival of the Broad-headed Snake in the locality.

Woodland/Forest Birds

- Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)
- Speckled Warbler (*Chthonicola sagittata*)
- Regent Honeyeater (*Anthochaera phrygia*)
- Painted Honeyeater (*Grantiella picta*)
- Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*)
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)
- Varied Sitella (*Daphoenositta chrysoptera*)
- Hooded Robin (*Melanodryas cucullata*)
- Scarlet Robin (*Petroica boodang*)
- Flame Robin (*Petroica pheonicea*)

These species have potential habitat throughout the Newnes Plateau and surrounding national parks. The open forest habitat that will be cleared for surface infrastructure areas is not important to the long-term survival of any woodland bird species in the locality. Alterations to habitats from subsidence will not affect the long-term survival of these species in the locality.

Forest Owls

- Barking Owl (*Ninox connivens*)
- Powerful Owl (*Ninox strenua*)
- Masked Owl (*Tyto novaehollandiae*)
- Sooty Owl (*Tyto tenebricosa*)

These species have potential habitat throughout the Newnes Plateau and surrounding national parks. The open forest habitat that will be cleared for surface infrastructure areas is not important to the long-term survival of forest owls in the locality. Alterations to habitats from subsidence will not affect the long-term survival of these species in the locality.

Forest Dwelling Mammals

- Spotted-tailed Quoll (*Dasyurus maculatus*)
- Southern Brown Bandicoot (*Isoodon obesulus obesulus*)
- Eastern Pygmy Possum (*Cercartetus nanus*)
- Yellow-bellied Glider (*Petaurus australis*)

- Squirrel Glider (*Petaurus norfolcensis*)

The above forest dwelling mammals have suitable foraging and/or breeding habitat within the Study Area. The proposed clearing to install the surface infrastructure will remove approximately 23.24 ha of forest habitat. However, large tracts of similar forest types and the habitats they contain occur throughout the Newnes State Forest and adjacent national parks. Due to the of large areas of protected habitats within the locality, and the low levels of subsidence expected, it is considered that the vegetation and habitat to be removed or modified is not important to the long-term survival of these species in the locality.

- Koala (*Phascolarctos cinereus*)

The Koala has been recorded once within the Study Area (MKES 2008c). This species is more often found on the lower slopes, where known Koala feed trees, such as *E. viminalis* and *E. albens* are more prevalent. The habitat to be removed or modified is not important to the long-term survival of this species in the locality.

- Brush-tailed Rock-wallaby (*Petrogale penicillata*)

No areas of important habitat (escarpments) for a potential occurring population of this species will be removed or modified.

Cave-roosting Bats

- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Little Pied Bat (*Chalinolobus picatus*)
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)
- Eastern Cave Bat (*Vespadelus troughtoni*)

The open forest habitat that will be cleared for surface infrastructure areas is not important to the long-term survival of cave-roosting bats in the locality. Alterations to habitats from subsidence will not affect the long-term survival of these species in the locality.

Hollow-roosting Bats

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)

The open forest habitat that will be cleared for surface infrastructure areas is not important to the long-term survival of hollow-roosting bats in the locality. Alterations to habitats from subsidence will not affect the long-term survival of these species in the locality.

Endangered Ecological Communities

- Newnes Plateau Shrub Swamp (NPSS)

Any area occupied by NPSS is regarded as important for this EEC. As discussed in **Section 6.2.2**, the Project is not expected to have a significant impact upon any shrub swamps, such that their ecosystem functioning may be impaired. This prediction is supported by a high level of confidence in subsidence predictions, as shown by post-mining subsidence monitoring data. Additionally, ongoing ground-water, surface water, flora and fauna monitoring of previously undermined swamps and revealed no impacts to NPSS as a result of undermining these areas. The predicted minor changes to baseflow and average standing water levels are not expected to result in changes to ecological function of the swamps habitats potentially suitable for these species. Therefore, the Project is unlikely to affect the long-term survival of this EEC in the locality.

- Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions

No areas of this EEC are proposed to be to be removed for the proposed surface infrastructure. Approximately 118.04 ha of this EEC have been mapped within the Study Area. Therefore, the area to be removed is not important for the long-term survival of the species in the locality.

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

No areas of critical habitat have been declared within the Study Area.

(f) **Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan**

Flora

None of the threatened flora species considered to have potential to occur have recovery plans prepared.

Fauna

- Stuttering Frog (*Mixophyes balbus*)

Stuttering Frog has a National Recovery Plan prepared. The objectives of this plan are:

(i) Determine the distribution, habitat requirements, conservation status, taxonomy, population demography and genetic structure of Stuttering Frog populations.

(ii) Identify and address the causal factors of the decline, and prevent the local extinction of important populations of the Stuttering Frog across its geographic range.

(iii) Build community support for the Stuttering Frog recovery program.

The Project is unlikely to significantly intervene with the above objectives.

- Blue Mountains Water Skink (*Eulamprus leuraensis*)

Blue Mountains Water Skink has a Recovery Plan prepared. The objectives of this plan are:

(i) To establish the full extent of the distribution of the Blue Mountains Water Skink.

(ii) To improve our understanding of the population status of the Blue Mountains Water Skink by monitoring representative populations.

(iii) To minimise the risk of the Blue Mountains Water Skink declining in the long term by the implementation of a range of activities to ameliorate the impact of factors considered to be detrimentally affecting the species or its habitat.

(iv) To raise awareness of the conservation status of the Blue Mountains Water Skink and to involve the broader community and key groups such as landholders and managers, local and State government agencies, public authorities and researchers in the recovery program for the species.

(v) To improve the management of Blue Mountains Water Skink populations and habitat based on an improved understanding of its biology and ecology.

(vi) To reassess the conservation status of the Blue Mountains Water Skink.

A mine design and mitigation measures are proposed such that the Project would not intervene with the above objectives.

- Regent Honeyeater (*Anthochaera phrygia*)

One specific objective listed under the Regent Honeyeater Recovery plan 1999-2003 (Menkhorst et al. 1999) states that 'maintaining and enhancing the value of Regent Honeyeater habitat at Key sites and throughout their former range'. The proposal removes potential foraging habitat for this species, and is therefore inconsistent with this recovery plan.

- Large Forest Owls (Powerful Owl, Masked Owl and Sooty Owl)

As some potential habitat will be removed during the proposed action, the proposal would be inconsistent with objective 5 (minimise loss and fragmentation of owl habitat areas) of the Large Forest Owl Recovery Plan, due to loss of potential habitat for these species.

- Southern Brown Bandicoot (*Isoodon obesulus obesulus*)

The overall objective of recovery is to minimise the probability of extinction of the Southern Brown Bandicoot in the wild and to increase the probability of populations becoming self-sustaining in the long term. Within the duration of this Recovery Plan, the specific objectives for the recovery of the Southern Brown Bandicoot are to:

(i) Ensure that existing bandicoot populations and their habitat are protected and managed;

(ii) Identify threats and threat abatement management practices to assist the recovery of the Southern Brown Bandicoot;

(iii) Determine the distribution, abundance and population structure of the Southern Brown Bandicoot;

(iv) Identify the key attributes of existing or potential habitat that are important for the Southern Brown Bandicoot;

(v) Evaluate population responses of the Southern Brown Bandicoot to recovery actions, and adapt actions as required;

(vi) Build a network of government and non-government organisations and individuals to facilitate recovery of the Southern Brown Bandicoot;

(vii) Manage and review Recovery Plan implementation;

(viii) Promote public awareness of and involvement in the Southern Brown Bandicoot recovery program.

(ix) Assess the requirement for captive populations.

This species has not been recorded within the Study Area. The Project does not contravene any of the above objectives.

- Yellow-bellied Glider (*Petaurus australis*)

The overall objective of this Recovery Plan is to achieve multiple viable populations of the Yellow-bellied Glider dispersed throughout its range in NSW and across environmental gradients.

(i) To co-ordinate the recovery of the Yellow-bellied Glider in NSW

(ii) To encourage and assist in improving the protection and management of the Yellow-bellied Glider and its habitat

(iii) To identify and monitor significant populations of the specie

(iv) To facilitate strategic research into the ecology of the Yellow-bellied Glider that is relevant to its conservation

(v) To increase community awareness of the Yellow-bellied Glider and encourage community involvement in its conservation

This species has not been recorded within the Study Area. The Project does not contravene any of the above objectives.

- Spotted-tailed Quoll (*Dasyurus maculatus maculatus*)

As approximately 23.24 ha of potential habitat will be removed during the current proposal, the proposal would be inconsistent with objective 4.1 (reduce the rate of loss and fragmentation of Spotted-tailed Quoll habitat) of the Spotted-tailed Quoll Draft Recovery Plan (Long and Nelson, 2004).

- Brush-tailed Rock-wallaby (*Petrogale penicillata*)

The specific objectives of this Recovery Plan are to:

(i) Increase recruitment at priority sites;

(ii) Decrease the rate of decline in range and abundance;

(iii) Prevent the decline of the species to a level at which it would risk becoming extinct in the wild; and

(iv) Increase knowledge to enable more effective management of the species.

As the Project will avoid habitat for this species, both in terms of subsidence and clearing, the Project is not regarded as intervening with the recovery objectives of this species.

- Large-eared Pied Bat (*Chalinolobus dwyeri*)

Of the threatened bat species (listed above) under consideration, Large-eared Pied Bat has a National Recovery Plan. The objectives of this plan are:

(i) Identify priority roost and maternity sites for protection.

(ii) Implement conservation and management strategies for priority sites.

(iii) Educate the community and industry to understand and participate in the conservation of the Large-eared Pied Bat.

(iv) Research the Large-eared Pied Bat to augment biological and ecological data to enable conservation management.

(v) Determine the meta-population dynamics throughout the distribution of the large-eared Pied Bat.

The Project will not impact upon this species and ongoing monitoring will occur.

(g) **Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

Key Threatening Processes (KTPs) are listed under Schedule 3 of the TSC Act 1995. There are nine KTPs that have the potential to affect the site as a consequence of the Project, namely:

- Alteration of the Natural Flow regimes of rivers, streams, floodplains and wetlands;
- Loss of hollow-bearing trees;
- Removal of dead wood and dead trees;
- Clearing of native vegetation;
- Anthropogenic climate change;
- Degradation of native riparian vegetation along NSW watercourses;
- Introduction and establishment of Exotic Rust Fungi of the order *Pucciniales* pathogenic on plants of the

family Myrtaceae;

- Alteration of habitat following subsidence due to longwall mining; and
- Invasion of native plant communities by exotic perennial grasses.

These KTPs have been previously addressed in **Section 6.4**.

Appendix 2

EPBC Act: Assessments of Significance

Table 8 identified seven nationally threatened flora species, 12 nationally threatened fauna species and one EEC have potential to be impacted upon by the Project. These species/EEC are:

Threatened Flora

- *Acacia bynoeana* (Bynoe's Wattle), listed as Vulnerable;
- *Boronia deanei* subsp. *deanei* (Deane's Boronia), listed as Vulnerable;
- *Eucalyptus pulverulenta* (Silver-leaved Gum), listed as Vulnerable;
- *Persoonia acerosa* (Needle Geebung), listed as Vulnerable;
- *Prasophyllum fuscum* (Tawny Leek Orchid), listed as Vulnerable;
- *Prostanthera cryptandroides* (Wollemi Mintbush), listed as Vulnerable; and
- *Thesium australe* (Austral toadflax), listed as Vulnerable.

Threatened Fauna

- Giant Burrowing Frog (*Heleioporus australiacus*), listed as Vulnerable;
- Stuttering Frog (*Mixophyes balbus*), listed as Vulnerable;
- Littlejohn's Tree Frog (*Litoria littlejohni*), listed as Vulnerable;
- Blue Mountains Water Skink (*Eulamprus leuraensis*), listed as Endangered;
- Broad-headed Snake (*Hoplocephalus bungaroides*), listed as Vulnerable;
- Regent Honeyeater (*Anthochaera phrygia*), listed as Endangered;
- Large-eared Pied Bat (*Chalinolobus dwyeri*), listed as Vulnerable;
- Spotted-tailed Quoll (*Dasyurus maculatus maculatus*) listed as Endangered;
- Southern Brown Bandicoot (*Isoodon obesulus obesulus*), listed as Endangered;
- Brush-tailed Rock-wallaby (*Petrogale penicillata*), listed as Vulnerable;
- Koala (*Phascolarctos cinereus*), listed as Vulnerable; and
- New Holland Mouse (*Pseudomys novaehollandiea*), listed as Vulnerable.

Endangered Ecological Communities

- Temperate Highland Peat Swamps on Sandstone, listed as Endangered.

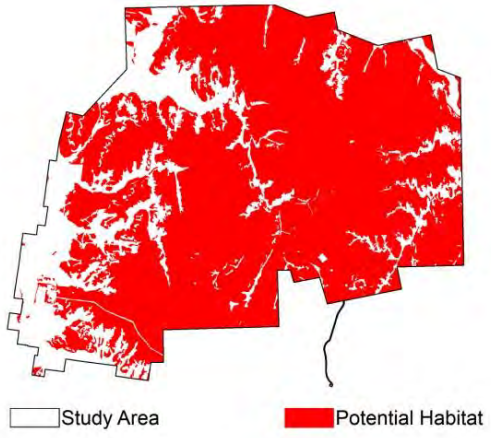
Acacia bynoeana **Bynoe's Wattle**

Acacia bynoeana (Bynoe's Wattle) is listed as Vulnerable under the EPBC Act. This species was not detected during current or previous surveys. However, the species is considered cryptic and can be difficult to detect even when flowering. The species is known to have a stronghold in the Blue Mountains in areas including Faulconbridge, Hazelbrook-Bell and Wentworth Falls. Two very old records (1940) exist to the south of the Study Area.

This species grows in heath and dry sclerophyll forest. The substrate is typically sand and sandy clay, often with ironstone gravels and is usually very infertile and well-drained.

On-site Habitat

Potential habitat for this species within the Study Area includes dry sclerophyll communities including MU 7, 14, 26, 26a, 28, 29, 30, 32, 33, 35, and 37, along with heath communities within MU 44, 45, and 46.



Regional Habitat

Acacia bynoeana has a relatively widespread distribution within the region. As previously mentioned, two old records (1940) exist approximately 6 km from the Study Area. A more recent record was found near Mount Wilson, approximately 18 km east of the Study Area. Several records of *A. bynoeana* exist along the Great Western Highway near Faulconbridge, Hazelbrook-Bell and Wentworth Falls. However, this clustering of records is probably due to the higher frequency of surveys conducted for development within that area. The distribution of this species is therefore likely to be more widespread than these known records suggest. In addition, due to the difficulty of detecting *A. bynoeana*, it is likely that there are more populations within the region. Consequently, the potential habitat located within the Study Area, is not considered of high importance to the species.

Potential Habitat	Area (ha)
Within Study Area	8,269.87
Within subsidence extents	2,318.88
Within proposed infrastructure footprint	23.24

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. If a population of *A. bynoeana* was to occur within the Study Area, it could be considered a '*population that is near the limit of the species' range*', as the location would be at its known western limit. As such, this species is further assessed using the Significant Impact Criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

Acacia bynoeana has not been recorded within any areas proposed to be cleared. However, if this species were present, the removal of a small amount (23.24 ha) would not lead to a long-term reduction of the size of a potentially occurring population.

Surface cracking of soils is expected to be similar to those observed above the previously extracted longwalls at Angus Place and Springvale Collieries, which were typically within the range of less than 5 mm to 25 mm (MSEC 2014 section 4.5.). The heath and woodland areas, where this species has potential to occur, are unlikely to be affected by this magnitude of cracking such that these habitats would become unsuitable and result in a long-term decrease in the size of a potentially occurring population of *A. bynoeana*.

(b) **Reduce the area of occupancy of the species;**

This species has not been recorded within the Study Area. Only in the unlikely scenario that this species occurs within the ESAs is there a chance that a proportion of habitat would be removed.

(c) **Fragment an existing important population into two or more populations;**

With the exception of the existing track, the proposed surface facilities footprint is completely surrounded by native vegetation. The proposed clearing would therefore not pose a barrier for genetic dispersal for any of the species considered.

(d) **Adversely affect habitat critical to the survival of a species;**

No areas of critical habitat have been identified within the Study Area.

(e) **Disrupt the breeding cycle of a population;**

The small area of potential habitat to be removed and the minor predicted modification to potential habitats from subsidence would not disrupt the breeding cycle of a population of *A. bynoeana* if present.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

Acacia bynoeana has not been recorded within the Study Area. Only in the unlikely scenario that this species occurs within the ESAs is there a risk that a proportion of a population would decline, but only in the short term.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

A variety of weed species may be harmful to *A. bynoeana.* Despite the high vehicle activity and numerous tracks that occur within the Study Area, the incidences of weeds are low. The Project is unlikely to contribute to an increase of weeds. Notwithstanding, weed management, monitoring and control practices have been recommended in this report.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

Interfere substantially with the recovery of the species.

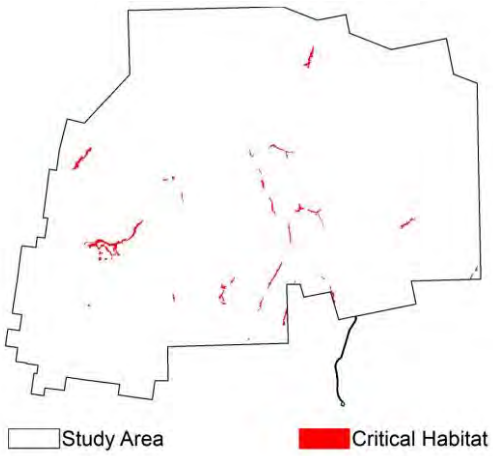
This species has not been recorded within the Study Area. The small amount of proposed clearing and the limited effects of subsidence upon the habitats are unlikely to interfere with the recovery of *A. bynoeana*.

Boronia deanei **Deane's Boronia**

Boronia deanei (Deane's Boronia), listed as Vulnerable under the EPBC Act. *Boronia deanei* is a small erect shrub to 1.5 m tall typically found in high elevation areas of the Blue Mountains, north of Clarence and Kanangra-Boyd National Park, NSW. The species grows on the margins of high altitude swamps, in wet heath on sandstone and in drier open forest. Habitat for this species within the Study Area is considered to be Newnes Plateau Shrub Swamp.

On-site Habitat

All areas of Newnes Plateau Shrub Swamp (MU 50) located within the Study Area are considered to provide critical habitat for this species.



Regional Habitat

The potential population of *B. deanei* found within the Study Area is likely part of a larger population within the region with the nearest records existing approximately 3 km to the east and 8 km south-east of the Study Area. In addition, another disjunct population is found approximately 60 km south within the Kanangra-Boyd National Park. Due to the limited distribution of the species and its specific habitat requirements of high altitude shrub swamps, wet heath or open forests (with peaty soils on sandstone), the habitat found within the Study Area is considered of high importance.

Location	Area (ha)
Within Study Area	63.71
Within subsidence extents	10.33
Within proposed infrastructure footprint	0.00

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. The population of *B. deanei* within the Study Area can be considered a '*population that is near the limit of the species' range*', as the location is at its northern limit. As such, all *B. deanei* detected within the Study Area are considered to be part of an important population and is further assessed using the Significant Impact Criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

As discussed in **Section 6.2.2**, maximum projected changes to baseflow and average standing ground water levels suggest that some areas of habitat for this species may be influenced by hydrological changes. However, all monitored swamps are still predicted to have a minimum depth in average standing groundwater levels above the ground surface (Adhikary and Wilkins 2013), which would still allow for the hydrology of the swamp system to support the peat layer that is critical to maintaining swamp ecosystem function. In addition, an analysis of the distribution of *B. deanei* within shrub swamps has indicated that the species prefers swamp margins away from areas of saturated soil (Fletcher and Erskine 2012), and along marginal sites with deep soil (Benson and Baird 2012). Any impacts to groundwater levels are therefore unlikely to lead to a long-term decrease in the size of a potentially occurring population of *B. deanei*.

(b) **Reduce the area of occupancy of the species;**

This species has not been recorded within the Study Area. The Project is not expected to reduce the area of occupancy of *B. deanei*.

(c) **Fragment an existing important population into two or more populations;**

No areas of potential or known habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

All potential swamp habitats for *B. deanei* can be regarded as critical to the survival of these species. No areas of critical habitat will be adversely affected such that it would compromise the survival of these species.

(e) **Disrupt the breeding cycle of a population;**

The minor predicted impacts of potential habitats from subsidence would not disrupt the breeding cycle of a population if present.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted impacts of potential habitats from subsidence would not decrease the availability or quality of habitat to the extent that the species is likely to decline.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

The Project is unlikely to introduce diseases that may cause this species to decline.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere substantially with the recovery of the species.**

The Project is unlikely to interfere with the recovery of *B. deanei*.

Eucalyptus pulverulenta **Silver-leaved Gum**

Eucalyptus pulverulenta (Silver-leaved Gum) is listed as Vulnerable under the EPBC Act. This species was not detected during current or previous surveys within the Study Area. The nearest population is near Bowenfels, approximately 13 km south of the Study Area.

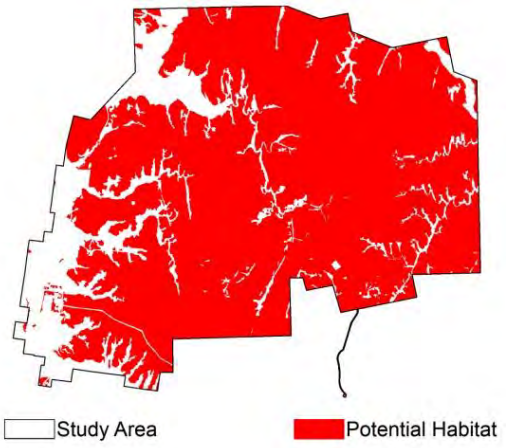
This species occurs on the crests or upper slopes of moderately steep hillsides or mountains. It grows in shallow soils as an understorey plant in open forest, typically dominated by *E. mannifera*, *E. macrorhyncha*, *E. dives*, *E. sieberi* and *E. bridgesiana*. It often occurs on granite substrates. As this species can occur on steep terrain, there is potential that individuals could occur within the Study Area. However, as these areas could not be accessed due the dangerous terrain, it could not be verified whether the species occurred or not.

On-site Habitat

Vegetation communities considered to provide potential habitat include the open forest communities of MU 7, 14, 26, 26a, 28, 29, 30, 32, 33, 35 and 37, along with the associated heath communities of MU 43, 44, 45 and 46.

Regional Habitat

Eucalyptus pulverulenta has a disjunct distribution to the south-west of Lithgow. The closest population exist near Bowenfels, approximately 13 km south of the Study Area. Located approximately 50 km further west from this population is another cluster of records (near Bathurst). This species has a more western distribution than the Study Area and the potential habitat present is therefore not considered of high importance to the species.



Potential Habitat	Area (ha)
Within Study Area	8,779.33
Within subsidence extents	2,321.08
Within proposed infrastructure footprint	23.24

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. If a population of *E. pulverulenta* was to occur within the Study Area, it could be considered a '*population that is near the limit of the species' range',* as the location would be at its northern limit. As such, this species was further assessed using the Significant Impact Criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

Eucalyptus pulverulenta has not been recorded within any areas proposed to be cleared. Surface cracking of soils is expected to be similar to those observed above the previously extracted longwalls at Angus Place and Springvale Collieries, which were typically within the range of less than 5 mm to 25 mm (MSEC 2014 section 4.5.). The woodland areas where this species has potential to occur are unlikely to be affected by this magnitude of cracking such that these habitats would become unsuitable and result in a long-term decrease in the size of a potentially occurring population of *E. pulverulenta*.

(b) **Reduce the area of occupancy of the species;**

This species has not been recorded within the Study Area. Only in the unlikely scenario that this species occurs within the ESAs is there a chance that a proportion of habitat would be removed.

(c) **Fragment an existing important population into two or more populations;**

With the exception of the existing track, the proposed surface facilities footprint is completely surrounded by native vegetation. The proposed clearing would therefore not pose a barrier for genetic dispersal for any of the species considered.

(d) **Adversely affect habitat critical to the survival of a species;**

No areas of critical habitat have been identified within the Study Area.

(e) **Disrupt the breeding cycle of a population;**

The small area of potential habitat to be removed, and the minor predicted modification to potential habitats from subsidence, would not disrupt the breeding cycle of a population of *E. pulverulenta* if present.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

Eucalyptus pulverulenta has not been recorded within the Study Area. Only in the unlikely scenario that these species occurs within the ESAs is there a chance that a proportion of a population would decline, but only in the short term.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

A variety of weed species may be harmful to *E. pulverulenta.* Despite the high vehicle activity and numerous tracks that occur within the Study Area, the incidences of weeds are low. The Project is unlikely to contribute to an increase of weeds. Notwithstanding, weed management, monitoring and control practices have been recommended in this report.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere substantially with the recovery of the species.**

This species has not been recorded within the Study Area. The small amount of proposed clearing and the limited effects of subsidence upon the habitats are unlikely to interfere with the recovery of *E. pulverulenta*.

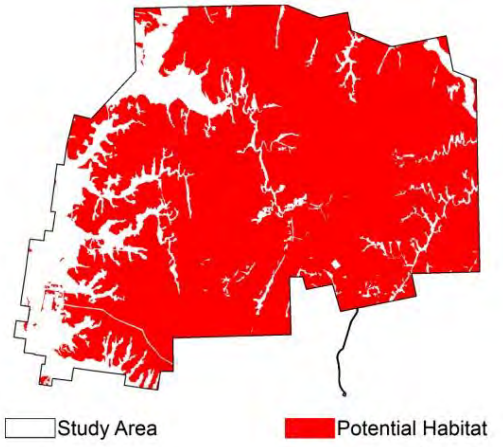
Persoonia acerosa **Needle Geebung**

Persoonia acerosa (Needle Geebung) is listed as Vulnerable under the EPBC Act. This species was not detected during current or previous surveys within the Study Area. It is known from the Blue Mountains in the Newnes Plateau south through Kings Tableland to Hilltop and east to the lower Mountains. As this species is known to occur on the Newnes Plateau and suitable dry sclerophyll habitat occurs within the Study Area, it is considered to have potential to occur.

Persoonia acerosa occurs in dry sclerophyll forest, scrubby low-woodland and heath, generally on clayey sandstone and laterites of the Narrabeen Group (NPWS 2000). It is strongly associated with disturbance margins such as road and trail verges.

On-site Habitat

Large areas of the Study Area are considered to provide potential habitat for this species, including the dry sclerophyll forest and woodland communities of MU 7, 14 26, 26a, 28, 29, 30, 32, 33 and 37, along with the heath communities of MU 43, 44, 45 and 46.



Regional Habitat

The closest records of this species exist on Newnes Plateau near Waratah Ridge Road, approximately 9 km south-east of the Study Area. *Persoonia acerosa* has also been recorded near Clarence, approximately 11 km south of the Study Area. Several other records occur throughout the region with a stronghold in the Katoomba – Wentworth Falls – Springwood area and the Mt Victoria – Blackheath area. Due to the relatively widespread distribution of *P. acerosa* and its wide-ranging preferred habitat, the potential habitat within the Study Area is not considered of high importance to the species.

Potential Habitat	Area (ha)
Within Study Area	8,692.16
Within subsidence extents	2,321.08
Within proposed infrastructure footprint	23.24

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. If a population of *P. acerosa* was to occur within the Study Area, it could be considered a '*population that is near the limit of the species' range',* as the location would be at its northern limit. As such, this species was further assessed using the Significant Impact Criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

Persoonia acerosa has not been recorded within any areas proposed to be cleared. However, if this species were present, the removal of a small amount (23.24 ha) would not lead to a long-term reduction of the size of a potentially occurring population.

Surface cracking of soils is expected to be similar to those observed above the previously extracted longwalls at Angus Place and Springvale Collieries, which were typically within the range of less than 5 mm to 25 mm (MSEC 2014 section 4.5.). The woodland and heath areas where this species has potential to occur are unlikely to be affected by this magnitude of cracking such that these habitats would become unsuitable and result in a long-term decrease in the size of a potentially occurring population of *P. acerosa*.

(b) **Reduce the area of occupancy of the species;**

This species has not been recorded within the Study Area. Only in the unlikely scenario that this species occurs within the ESAs is there a chance that a proportion of habitat would be removed.

(c) **Fragment an existing important population into two or more populations;**

With the exception of the existing track, the proposed surface facilities footprint is completely surrounded by native vegetation. The proposed clearing would therefore not pose a barrier for genetic dispersal for any of the species considered.

(d) **Adversely affect habitat critical to the survival of a species;**

No areas of critical habitat have been identified within the Study Area.

(e) **Disrupt the breeding cycle of a population;**

The small area of potential habitat to be removed and the minor predicted modification to potential habitats from subsidence would not disrupt the breeding cycle of a population of *P. acerosa* if present.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

Only in the unlikely scenario that these species occurs within the ESAs is there a chance that a proportion of a population would decline, but only in the short term.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

A variety of weed species may be harmful to *P. acerosa.* Despite the high vehicle activity and numerous tracks that occur within the Study Area, the incidences of weeds are low. The Project is unlikely to contribute to an increase of weeds. Notwithstanding, weed management, monitoring and control practices have been recommended in this report.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere substantially with the recovery of the species.**

This species has not been recorded within the Study Area. The small amount of proposed clearing and the limited effects of subsidence upon the habitats are unlikely to interfere with the recovery of *P. acerosa*.

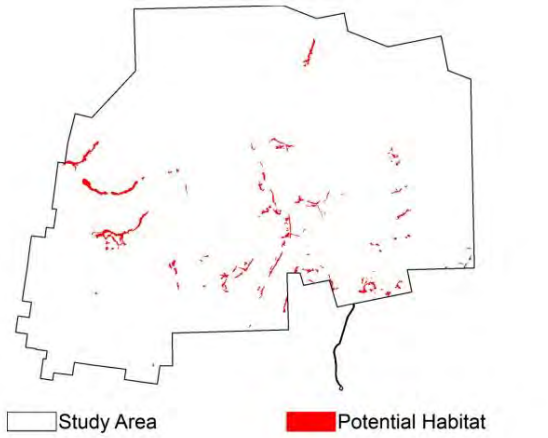
Prasophyllum fuscum **Tawny Leek Orchid**

Prasophyllum fuscum (Tawny Leek Orchid) is listed as Vulnerable under the EPBC Act. This species was not detected during current or previous surveys within the Study Area. It is restricted to the Blue Mountains, Hawkesbury sandstone and the Burrawang district in NSW. This species can only be detected during its flowering period (September-December), however, it doesn't necessarily flower each year. As suitable swamp habitat for this species occurs, there is potential for this species to occur within the Study Area and be impacted.

It occurs on the margins of swamps and heaths and often along seepage lines at about 500-700 m above sea level. It is known to grow in moist sandy soil over sandstone amongst sedges and grasses and is assumed to be currently restricted to the Blue Mountains.

On-site Habitat

Areas of swamp and moist heath that occur within the Project Application Area are considered to be potential habitat for this species and include MU 50, 51 and 53.



Regional Habitat

A few scattered records exist of *Prasophyllum fuscum* in the region from near Mt Tomah in the east to the Mt Victoria – Blackheath – Katoomba area. This species is known to occur within the *Temperate Highland Peat Swamps on Sandstone* EEC, which occurs within the Study Area. Due to the small area of occupancy of this species, its specific habitat requirements and association with the THPSS EEC, the potential habitat present within the Study Area is considered of high importance.

Potential Habitat	Area (ha)
Within Study Area	133.81
Within subsidence extents	20.04
Within proposed infrastructure footprint	0.00

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. If a population of P. fuscum was to occur within the Study Area, it could be considered a ‘populations that are necessary for maintaining genetic diversity’ as the species is locally rare (possible extinct). As such, this species is further assessed using the significant impact criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

No likely habitat for *P. fuscum* occurs within the ESAs. As discussed in **Section 6.2.2**, the Project is not expected to have a significant impact upon any swamps, such that the changes in hydrology would remain within natural water level and baseflow variations. This prediction is supported by a high level of confidence in subsidence predictions, as shown by post-mining subsidence monitoring data. Additionally, ongoing ground-water, surface water, flora and fauna monitoring of previously undermined swamps and revealed no impacts to GDEs as a result of undermining these areas. Consequently, the Project will not lead to a long-term decrease in the size of a population of *P. fuscum*.

(b) **Reduce the area of occupancy of the species;**

The Project is not expected to reduce the area of occupancy of *P. fuscum*.

(c) **Fragment an existing important population into two or more populations;**

No areas of potential or known habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

All potential or known swamp habitats for *P. fuscum* can be regarded as critical to the survival of these species. In consideration of the subsidence predictions (MSEC 2014) and predicted changes to swamp hydrology (RPS 2014a), it is unlikely that areas of critical habitat will be adversely affected such that it would compromise the survival of these species.

(e) **Disrupt the breeding cycle of a population;**

In consideration of the subsidence predictions (MSEC 2014) and predicted changes to swamp hydrology (RPS 2014a), it is unlikely that the Project will disrupt the breeding cycle of a population of *P. fuscum*.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

In consideration of the subsidence predictions (MSEC 2014) and predicted changes to swamp hydrology (RPS 2014a), it is unlikely that the Project would decrease the availability or quality of habitat to the extent that this species is likely to decline.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

A variety of weed species may be harmful to *P. fuscum.* Despite the high vehicle activity and numerous tracks that occur within the Study Area, the incidences of weeds are low. The Project is unlikely to contribute to an increase of weeds. Notwithstanding, weed management, monitoring and control practices have been recommended in this report.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere substantially with the recovery of the species.**

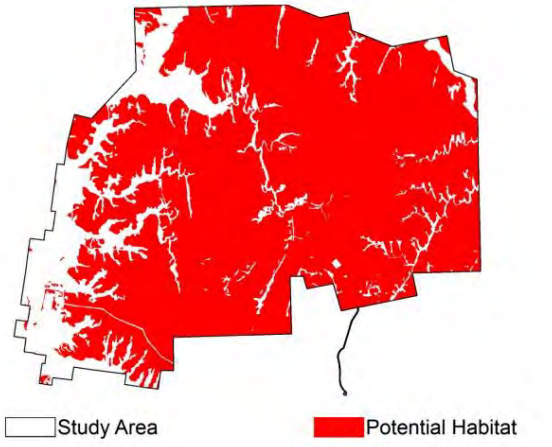
The Project is unlikely to interfere with the recovery of *P. fuscum*.

Prostanthera cryptandroides **Wollemi Mintbush**

Prostanthera cryptandroides (Wollemi Mintbush) is listed as Vulnerable under the EPBC Act. This species was not detected during current or previous surveys within the Study Area. *Prostanthera cryptandroides* is distributed between Lithgow and Sandy Hollow on the NSW central west slopes, central tablelands and western parts of the central coast botanical regions. It is known from Wollemi National Park and Gardens of Stone National Park. Habitats in which *P. cryptandroides* is found include dry sclerophyll forest, open forest dominated by E*. fibrosa*, Narrabeen Rocky Heath, Narrabeen Acacia Woodland, Narrabeen Exposed Woodland, Open heath and open shrubland.

On-site Habitat

Large areas of the Study Area are considered to provide potential habitat for this species including the dry sclerophyll open forest and woodland communities of MU 7, 14 26, 26a, 28, 29, 30, 32, 33 and 37, along with the heath communities of MU 43, 44, 45 and 46.



Regional Habitat

The nearest record of *Prostanthera cryptandroides* exists within Gardens of Stone National Park, approximately 5 km north-east of the Study Area. A group of individuals have also been recorded in Wollemi National Park approximately 20 km north of the Study Area. Another disjunct population is found in Sandy Hollow, 100 km north of the Study Area.

Due to the relatively widespread distribution of *P. cryptandroides* and its wide-ranging preferred habitat, the potential habitat within the Study Area is not considered of high importance to the species.

Potential Habitat	Area (ha)
Within Study Area	8,692.16
Within subsidence extents	2,321.08
Within proposed infrastructure footprint	23.24

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. If a population of *P. cryptandroides* was to occur within the Study Area, it could be considered a '*population that is near the limit of the species' range*', as the location would be at its southern limit. As such, this species was further assessed using the Significant Impact Criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

Prostanthera cryptandroides has not been recorded within any areas proposed to be cleared. However, if this species were present, the removal of a small amount (23.24 ha) would not lead to a long-term reduction of the size of a potentially occurring population.

Surface cracking of soils is expected to be similar to those observed above the previously extracted longwalls at Angus Place and Springvale Collieries, which were typically within the range of less than 5 mm to 25 mm (MSEC 2014 section 4.5.). The woodland areas where this species has potential to occur are unlikely to be affected by this magnitude of cracking such that these habitats would become unsuitable and result in a long-term decrease in the size of a potentially occurring population of *P. cryptandroides*.

(b) **Reduce the area of occupancy of the species;**

This species has not been recorded within the Study Area. Only in the unlikely scenario that this species occurs within the ESAs is there a chance that a proportion of habitat would be removed.

(c) **Fragment an existing important population into two or more populations;**

With the exception of the existing track, the proposed surface facilities footprint is completely surrounded by native vegetation. The proposed clearing would therefore not pose a barrier for genetic dispersal for any of the species considered.

(d) **Adversely affect habitat critical to the survival of a species;**

No areas of critical habitat have been identified within the Study Area.

(e) **Disrupt the breeding cycle of a population;**

The small area of potential habitat to be removed and the minor predicted modification to potential habitats from subsidence would not disrupt the breeding cycle of a population of *P. cryptandroides,* if present.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

P. cryptandroides has not been recorded within the Study Area. Only in the unlikely scenario that these species occurs within the ESAs is there a chance that a proportion of a population would decline, but only in the short term.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

A variety of weed species may be harmful to *P. cryptandroides.* Despite the high vehicle activity and numerous tracks that occur within the Study Area, the incidences of weeds are low. The Project is unlikely to contribute to an increase of weeds. Notwithstanding, weed management, monitoring and control practices have been recommended in this report.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere substantially with the recovery of the species.**

This species has not been recorded within the Study Area. The small amount of proposed clearing and the limited effects of subsidence upon the habitats are unlikely to interfere with the recovery of *P. cryptandroides*.

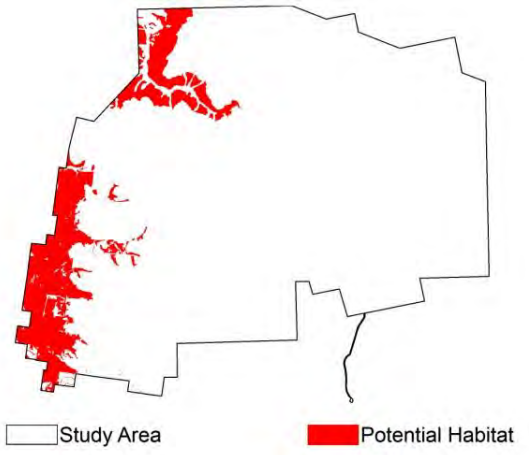
Thesium australe **Austral toadflax**

Thesium australe (Austral toadflax) is listed as Vulnerable under the EPBC Act. This species is hemiparasitic on the roots of other plants, mainly *Themeda australis* and is generally confined to grassy woodlands, grasslands and damp sites. *Thesium australe* is found in small populations scattered through the eastern part of NSW. The closest known location of this species was recorded by RPS in the Blackmans Flat area, approximately 3 km to the north-west.

This species was not detected during current or previous surveys within the Study Area. However, grassy woodland habitat with *T. australis* is present and this species has therefore potential to occur.

On-site Habitat

Potential habitat for this species within the Study Area includes the grassy open woodland communities of MU 11, 15, 19, 20, 21 and 33, along with the cleared areas (MU 62) in the west of the Study Area.



Regional Habitat

The recorded occurrence of *T. australe* within the region is limited to a population recorded near Blackmans Flat approximately 3 km north-west of the Study Area. Very little information is available of the regional distribution of this rare species but it has been predicted to occur from Katoomba in the south to just above Kandos in the north. However, this is only based on the occurrence of potentially suitable habitat such as damp grasslands and grassy woodlands with *T. australis* present. These habitats are widespread within the region and the limited amount of potential habitats within the Study Area would therefore not be of high importance to this species.

Potential Habitat	Area (ha)
Within Study Area	1,019.37
Within subsidence extents	0.00
Within proposed infrastructure footprint	0.00

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. If a population of *T. australe* was to occur within the Study Area, it could be considered a '*populations that are necessary for maintaining genetic diversity',* as the species is poorly recorded locally. As such, this species is further assessed using the Significant Impact Criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

No likely habitat for *T. australe* occurs within the ESAs or subsidence extents. This species has potential to occur along drainage lines and waterways that would be affected by mine water discharge. If present, habitats for this species are likely to be common and not restricted to those drainage lines that may be affected by mine water discharge. Therefore, the Project is unlikely to affect the lifecycle of *T. australe* such that it would lead to a long-term decrease in the size of a population of this species.

(b) **Reduce the area of occupancy of the species;**

The Project is not expected to reduce the area of occupancy of *T. australe*.

(c) **Fragment an existing important population into two or more populations;**

No areas of potential or known habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

Little information is available on the habitat availability and occupancy for *T. australe* in the locality of the Study Area. Consequently, habitat that may be defined as critical habitat can not be easily identified or quantified. Areas containing sufficient densities of *T. australis* are known to support populations of this species locally. However, no areas with this habitat attribute have been recorded within the subsidence extents or ESAs. Whilst suitable habitat may occur within the floodplain of the Coxs River, no adverse impacts to floodplain vegetation is expected as a result of proposed increases in mine water discharge into this river system. Therefore, whilst areas of habitat within the west of the Study Area may contain critical habitat for this species, no potential habitats will be adversely affected such that it would compromise the survival of this species.

(e) **Disrupt the breeding cycle of a population;**

The minor predicted modification to potential habitats from subsidence would not disrupt the breeding cycle of a population, if present.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted modification to potential habitats from subsidence would not decrease the availability or quality of habitat to the extent that the species is likely to decline.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

A variety of weed species may be harmful to *T. australe*. Despite the high vehicle activity and numerous tracks that occur within the Study Area, the incidences of weeds are low. The Project is unlikely to contribute to an increase of weeds. Notwithstanding, weed management, monitoring and control practices have been recommended in this report.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere substantially with the recovery of the species.**

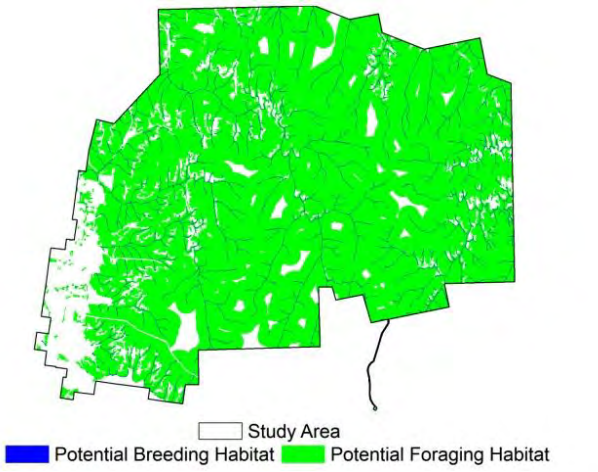
The Project is unlikely to interfere with the recovery of *T. australe*.

Heleioporus australiacus **Giant Burrowing Frog**

The Giant Burrowing Frog (*Heleioporus australiacus*) is listed as Vulnerable under the EPBC Act. The current distribution of the Giant Burrowing Frog is from Olney State Forest north of Sydney extending along the coast and ranges into the highlands of Victoria. The northern population has a marked preference for sandstone ridge-top habitat and broader upland valleys. In these locations, the frog is associated with small headwater creek lines and along slow flowing to intermittent creek-lines. The vegetation is typically woodland, open woodland and heath and may be associated with 'hanging swamp' seepage lines and where small pools form from the collected water. This species spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites.

On-site Habitat

The species' association with creek-lines of an intermittent to perennial nature allows for all mapped creeklines within the Study Area to represent potential breeding habitat for this species. Furthermore, given the species' ability to utilise woodland and heath habitat up to 300m from available breeding habitat, areas of MU 3, 4, 7, 8, 11, 14, 15, 19, 20, 21, 26, 26a, 28, 29, 30, 35, 36, 37, 44, 45, 46, 50, 51, 53 and 54 within 300 m of a mapped creek-line all provide potential foraging habitat for this species.



Regional Habitat

Scattered records of this species occur throughout the region with a possible strong hold existing within the Katoomba – Wenthworth Falls – Springwood areas. The closest record of the species is found 12 km north-east within the Wollemi National Park and 22 km south-east within the Blue Mountains National Park. Due to its widespread distribution within conservation lands in the region, the potential habitat occurring within the Study Area would not be of high importance to the species.

Potential Habitat	Area (ha)	
	Breeding Habitat	Foraging Habitat
Within Study Area	280.35	8,947.35
Within subsidence extents	49.73	2,208.71
Within proposed infrastructure footprint	0.33	22.33

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. The local populations of the Giant Burrowing Frog could be considered a '*population that is near the limit of the species' range*', as the location is at their western limit. As such, this species are further assessed using the Significant Impact Criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

Preferred breeding habitat of the Giant Burrowing Frog is within the Shrub Swamp habitats and connecting creek lines, with less preferred habitat within the remaining drainage lines within the Study Area. The remainder of the Study Area could potentially be utilised as non-breeding habitat. Fracturing of the bedrock could occur beneath some sections of the drainage lines which are located directly above the proposed longwalls. This may divert flows further downstream and caused localised hydrological changes to certain areas of potential riparian habitats of this species. The effects to swamps are expected to be small and are unlikely to significantly alter the usage of these areas by this species. The vegetation clearing for the surface infrastructure footprint may remove potential foraging and sheltering habitat for this species.

Localised subsidence or surface cracking is unlikely to affect any potential breeding habitat. However, a small amount of non-breeding habitat may be impacted within the surface infrastructure footprint. This, however, is surrounded by significantly large areas of commensurate non-breeding habitat that will not be modified by the Project. Therefore, the Project is unlikely to lead to a long-term decrease in the size of a population of Giant Burrowing Frog.

(b) **Reduce the area of occupancy of the species;**

The habitats in which Giant Burrowing Frog have potential to occur are not expected to become modified to an extent that they would become unsuitable for this species. Therefore, the Project would not reduce the area of occupancy of the Giant Burrowing Frog.

(c) **Fragment an existing important population into two or more populations;**

No areas of potential or known habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

The abundance of potential habitat within the Newnes State Forest and neighbouring National Parks suggests that the habitats within the Study Area are not critical to the survival of the Giant Burrowing Frog.

(e) **Disrupt the breeding cycle of a population;**

The minor predicted modification to potential habitats from subsidence would not disrupt the breeding cycle of a population of Giant Burrowing Frog, if present.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted modification to potential habitats from subsidence would not decrease the availability or quality of habitat to the extent that this species is likely to decline.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

The Project is unlikely to contribute to an increase in invasive species that may be harmful to this species.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere substantially with the recovery of the species.**

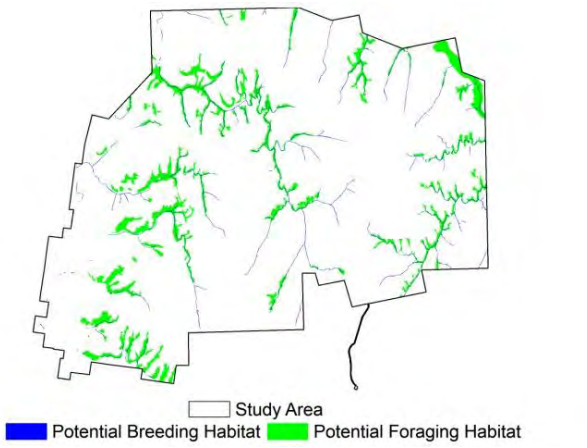
The Project is unlikely to interfere with the recovery of the Giant Burrowing Frog.

Mixophyes balbus **Stuttering Frog**

The Stuttering Frog (*Mixophyes balbus*), also known as the Southern Barred Frog, is listed as Vulnerable under the EPBC Act. It is distributed from far northern NSW to northeast Victoria, along the Great Dividing Range. The Stuttering Frog occurs in wet forests usually above 100 m, predominately near slow-flowing mountain streams. It is also found in moist gullies within areas of dry forests, sometimes utilising very small trickles of water, which hardly flow. There has been a single record from Springvale Colliery, during the monitoring surveys. A Stuttering Frog was heard calling within Sunnyside Swamp MKES (2004b).

On-site Habitat

Potential breeding habitat for the Stuttering Frog within the Study Area is limited to the perennial and semi-perennial watercourses that run through a variety of vegetation communities including dry sclerophyll open forests, woodlands, heaths and swamps. Foraging habitat is also available within the associated moist forests of MU 3, MU 4 and MU 8.



Regional Habitat

OEH Atlas of NSW Wildlife data indicates that this species is known from only a few locations within the region. The closest record exists within Sunnyside Swamp and the second record is located within the Blue Mountains National Park, approximately 18 km north of the Study Area. Deep gullies with permanent flowing water within the Blue Mountains area provide substantial areas of habitat. However, the swamps present within the Study Area may provide important breeding habitat for this species in the form of reliable water sources. Streams and other riparian zones have been determined as critical to the survival of the species (Hunter & Gillespie 2011). The habitat present within the Study Area is therefore of high importance to the Stuttering Frog.

Location	Area (ha)	
	Breeding Habitat	Foraging Habitat
Within Study Area	105.43	678.15
Within subsidence extents	16.00	20.71
Within proposed infrastructure footprint	0.03	0.00

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. The local populations of the Stuttering Frog could be considered a '*population that is near the limit of the species' range*', as the location is at their western limit. As such, these species are further assessed using the Significant Impact Criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

Preferred breeding habitat of the Stuttering Frog is within the Shrub Swamp habitats and connecting creek lines, with less preferred habitat within the remaining drainage lines within the Study Area. The remainder of the Study Area could potentially be utilised as non-breeding habitat.

Given the large amounts of available habitat within the Study Area, localised subsidence or surface cracking is unlikely to affect any potential breeding habitat. However, a small amount of non-breeding habitat may be impacted within the surface infrastructure footprint. This, however, is surrounded by significantly large areas of commensurate non-breeding habitat, which will not be modified by the Project. Therefore, the Project is unlikely to lead to a long-term decrease in the size of a population of Stuttering Frog.

(b) **Reduce the area of occupancy of the species;**

The habitats in which the Stuttering Frog have potential to occur are not expected to become modified to an extent that they would become unsuitable for this species. Therefore, the Project would not reduce the area of occupancy of the Stuttering Frog, with the exception of a small amount (0.03 ha) of potential habitat being cleared.

(c) **Fragment an existing important population into two or more populations;**

No areas of potential or known habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

The abundance of potential habitat within the Newnes State Forest and neighbouring National Parks suggests that the habitats within the Study Area are not critical to the survival of the Stuttering Frog.

(e) **Disrupt the breeding cycle of a population;**

The minor predicted modification to potential habitats from subsidence would not disrupt the breeding cycle of a population of Stuttering Frog, if present.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted modification to potential habitats from subsidence would not decrease the availability or quality of habitat to the extent that this species is likely to decline.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

The Project is unlikely to contribute to an increase in invasive species, such as foxes and cats, that may be harmful to this species.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere substantially with the recovery of the species.**

The Project is unlikely to interfere with the recovery of the Stuttering Frog.

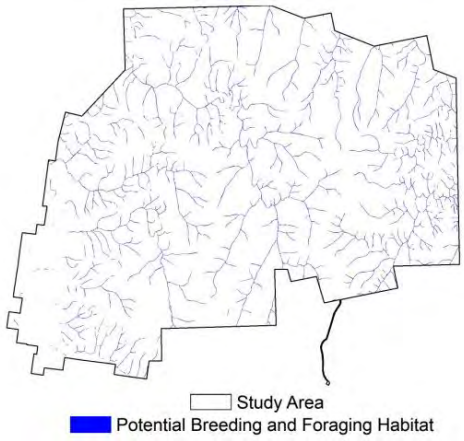
Litoria littlejohni **Littlejohn's Tree Frog**

The Littlejohn's Tree Frog (*Litoria littlejohni*) is listed as Vulnerable under the EPBC Act. This species is known to inhabit the eastern seaboard of New South Wales and Victoria from scattered locations between the Watagan Mountains, NSW to Buchan, Victoria. Fauna surveys carried out across the Study Area did not detect the presence of the Littlejohn's Tree Frog. Also, no individuals have been encountered during the eight years of monitoring undertaken across the Centennial mining lease areas.

The Littlejohn's Tree Frog appears to be restricted to sandstone woodland and heath communities at mid to high altitude. Similar suitable habitats occur widely throughout the Newnes Plateau and more preferred habitat in the form of small headwater creek-lines and slow flowing to intermittent creek-lines occurs throughout the wider Blue Mountains area.

On-site Habitat

The species' association with creek-lines of an intermittent to perennial nature allows for all mapped creeklines within the Study Area to represent potential breeding and foraging habitat for this species. These include small areas of MU 3, 4, 7, 8, 11, 14, 15, 20, 21, 26, 26a, 28, 29, 30, 32, 33, 35, 37, 44, 46, 50, 51, 53 and 54 that immediately adjoin (within <5m) of a mapped creek-line.



Regional Habitat

The closest record of this species is from 1963, near Mt Wilson, approximately 21 km south-east of the Study Area. A more recent record (2007) exists within the south-eastern part of Wollemi National Park, 30 km to the south-east. In addition, five records occur 55 km south-east of the Study Area. Suitable habitats occur widely throughout the Newnes Plateau and more preferred habitat, in the form of small headwater creek lines and slow flowing to intermittent creek-lines, occurs throughout the wider Blue Mountains area. The potentially suitable habitats within the Study Area are therefore considered to be a small proportion of the available habitat within the locality, much of which is conserved within the nearby national parks.

Potential Habitat	Area (ha)
	Breeding and Foraging Habitat
Within Study Area	280.33
Within subsidence extents	49.73
Within proposed infrastructure footprint	0.33

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. The local populations of the Littlejohn's Tree Frog could be considered a '*population that is near the limit of the species' range*', as the location is at their western limit. As such, this species are further assessed using the Significant Impact Criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

Preferred breeding habitat of the Littlejohn's Tree Frog is within the creek-lines and shrub swamps. Given the large amounts of available habitat within the Study Area, localised subsidence or surface cracking is unlikely to affect any potential breeding habitat. However, a small amount (0.03 ha) of potential habitat may be impacted within the surface infrastructure footprint. This, however, is surrounded by significantly large areas of commensurate habitat, which will not be modified by the Project. Therefore, the Project is unlikely to lead to a long-term decrease in the size of a population of Littlejohn's Tree Frog.

(b) **Reduce the area of occupancy of the species;**

The habitats in which Littlejohn's Tree Frog have potential to occur are not expected to become modified to an extent that they would become unsuitable for this species. Therefore, the Project would not reduce the area of occupancy of these species, with the exception of a small amount habitat being cleared.

(c) **Fragment an existing important population into two or more populations;**

No areas of potential or known habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

The abundance of potential habitat within the Newnes State Forest and neighbouring National Parks suggests that the habitats within the Study Area are not critical to the survival of the Littlejohn's Tree Frog.

(e) **Disrupt the breeding cycle of a population;**

The minor predicted modification to potential habitats from subsidence or clearing would not disrupt the breeding cycle of a population of Littlejohn's Tree Frog, if present.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted modification to potential habitats from subsidence or clearing would not decrease the availability or quality of habitat to the extent that this species is likely to decline.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

The Project is unlikely to contribute to an increase in invasive species, such as foxes and cats, that may be harmful to this species.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere substantially with the recovery of the species.**

The Project is unlikely to interfere with the recovery of the Littlejohn's Tree Frog.

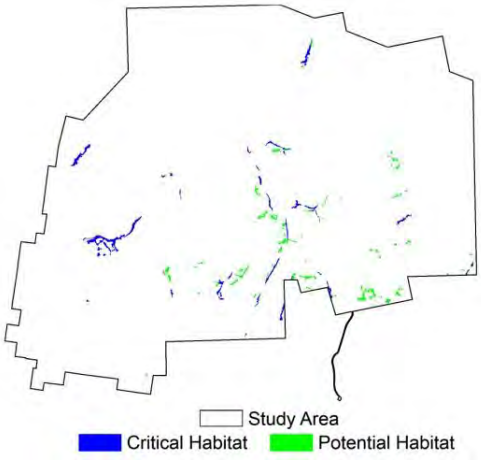
Eulamprus leuraensis **Blue Mountains Water Skink**

The Blue Mountains Water Skink (*Eulamprus leuraensis*) is listed as Endangered under the EPBC Act. It is restricted to areas of the Blue Mountains and Newnes Plateau in NSW. Thirty populations of the Blue Mountains Water Skink are known between Newnes and Hazelbrook in the Blue Mountains region. The species is restricted to isolated and naturally fragmented habitats of permanent sedge and shrub 'hanging' swamps. These develop at moderate to high altitudes on sloping rock faces composed of Narrabeen sandstone (Wells and Wellington 1984). In the Blue Mountains, the skink has been found in dense clumps of swamp sedges or herbs (characterised by *Gymnoschoenus sphaerocephalus*, *Lepidosperma limicola* and *Xyris ustulata*) growing on peaty soils derived from sandstone.

The Blue Mountains Water Skink is considered to be reliant on the presence of permanent groundwater seepage and/or waterlogging within parts of the inhabited swamp, even during times of drought, and is typically associated with the more waterlogged areas of the swamp (Benson and Baird 2012). On Newnes Plateau, it has been found in Shrub Swamps bordering streams flowing over sandstone and surrounded by tall open forest. This species has not been recorded within the Survey Area.

On-site Habitat

Given the species' preference for shrub swamps on the Newnes Plateau, all areas of MU 50 – Newnes Plateau Shrub Swamp are considered to provide critical habitat for this species. Despite no records existing for the species within hanging swamps on the Newnes Plateau, these swamps (MU 51 – Newnes Plateau Hanging Swamp) are still considered to provide potential habitat.



Regional Habitat

OEH Atlas of NSW Wildlife data indicates two strongholds of the Blue Mountains Water Skink within the region. A number of records exist within the Newnes State Forest along with records within 4 km to the north-west, north-east, east and south-east. A second stronghold is indicated within the Blue Mountains National Park (Blackheath – Katoomba – Wentworth Falls) within a distance 44 km from the Study Area. Whilst there are large areas of potential habitats linking these areas, recent genetic work has confirmed that the populations found on the Newnes Plateau are morphologically and genetically different from the populations found in the Blue Mountains National Park and dispersal between populations are very rare. The creeks and swamps of the Study Area are therefore of high importance to the populations found on the Newnes Plateau.

Location	Area (ha)	
	Critical Habitat	Potential Habitat
Within Study Area	63.71	49.75
Within subsidence extents	10.33	9.71
Within proposed infrastructure footprint	0.00	0.00

Impact Assessment

(a) **Lead to a long-term decrease in the size of a population;**

As discussed in **Section 6.2.2**, maximum projected changes to baseflow and average standing ground water levels suggest that some areas of habitat for this species may be influenced by hydrological changes. However, all monitored swamps are still predicted to have a minimum depth in average standing groundwater levels above the ground surface (Adhikary and Wilkins 2013), which would still allow for the hydrology of the swamp system to support the peat layer that is critical to maintaining swamp ecosystem function. As the predicted changes in baseflows and associated maximum decrease of average standing water levels are unlikely to cause the preferred waterlogged habitats to dry, the Project is unlikely to lead to a long-term decrease in the size of a potentially occurring population of the Blue Mountains Water Skink.

No suitable habitat for the Blue Mountains Water Skink species occurs within the surface infrastructure footprint proposed for clearing. Therefore, the project is not expected to lead to a long-term decrease in the size of a population of the Blue Mountains Water Skink.

(b) **Reduce the area of occupancy of the species;**

The habitats in which the Blue Mountains Water Skink have potential to occur are not expected to become modified to an extent that they would become unsuitable for this species. Therefore, the Project would not reduce the area of occupancy of the Blue Mountains Water Skink.

(c) **Fragment an existing population into two or more populations;**

No areas of potential or known habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

All potential or known swamp habitats for Blue Mountains Water Skink can be regarded as critical to the survival of the species. No areas of critical habitat will be adversely affected such that it would compromise the survival of this species.

(e) **Disrupt the breeding cycle of a population;**

The minor predicted modification to potential habitats from subsidence would not disrupt the breeding cycle of a population, if present.

(f) **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted modification to potential habitats from subsidence would not decrease the availability or quality of habitat to the extent that the species is likely to decline.

(g) **Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;**

The Project is unlikely to contribute to an increase in invasive species, such as foxes and cats, that may be harmful to this species.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere with the recovery of the species.**

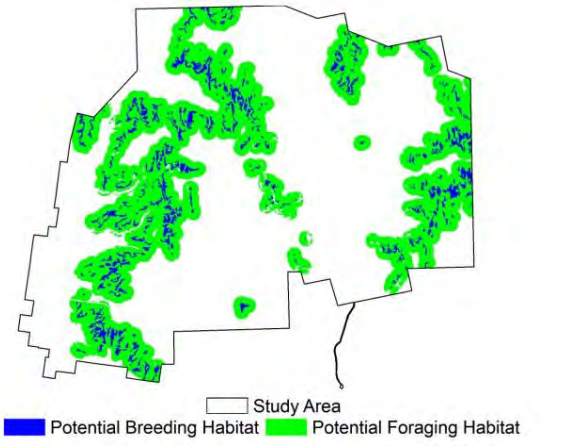
The Project is unlikely to interfere with the recovery of the Blue Mountains Water Skink.

Hoplocephalus bungaroides **The Broad-headed Snake**

The Broad-headed Snake (*Hoplocephalus bungaroides*) is listed as Vulnerable under the EPBC Act. This species was not detected during current or previous surveys within the Study Area. Broad-headed Snakes select refuge based on seasonal temperature differences, preferring cooler tree hollows on top of plateaus and below cliffs during summer, and warmer sun-exposed sandstone slabs and exfoliations during winter. These rock features are the important habitat features for this species.

On-site Habitat

The exposed sandstone slabs and exfoliations occur within the Study Area within the Pagoda Rock Sparse Shrubland vegetation community (MU43) and therefore represents potential breeding habitat for the species. Forested and heath areas within 200m of these sandstone outcrops represent potential foraging habitat for the species during the summer months and include areas of MU 3, 4, 7, 8, 11, 14, 15, 21, 26, 26a, 28, 29, 30, 32, 35, 37, 44 and 46.



Regional Habitat

The Broad-headed Snake has a widespread distribution within the region with the closest record existing within the Newnes State Forest, approximately 2 km north of the Study Area. Additional records exist within the neighbouring Ben Bullen State Forest and Gardens of Stone National Park, within a distance of 7 km from the Study Area. A number of scattered records are also found in the Blue Mountains National Park. Due to the large areas of suitable habitat present within neighbouring national parks, the potential habitat within the Study Area would not be of high importance to this species.

Location	Area (ha)	
	Breeding Habitat	Foraging Habitat
Within Study Area	519.45	3,395.96
Within subsidence extents	2.19	136.75
Within proposed infrastructure footprint	0.00	0.63

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. If a population of the Broad-headed Snake was to occur within the Study Area, it could be considered a '*population that is near the limit of the species' range*', as the location would be at its western limit. As such, this species is further assessed using the Significant Impact Criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

The small numbers of pagodas that occur within the angle of draw are unlikely to experience any adverse impacts resulting from the extraction of the proposed longwalls. While there is potential for some rock falls, the Broad-headed Snake uses flat sandstone rocks, steeper more unstable rocks are likely to be less utilised.

This species is nocturnal, sheltering by day in rock crevices and under flat sandstone rocks on exposed cliff edges, rocky outcrops and pagodas have been avoided by the proposed surface infrastructure. Areas to be cleared for surface infrastructure are likely to remove tree hollows, which this species utilises for sheltering in summer. However, woodland within 200 m of sandstone of escarpments is more likely to be utilised by this species in summer, which only covers 0.63 ha of habitat of the proposed footprint. Therefore, any alterations to potential habitats from subsidence and the small amount of clearing of potential summer refuge habitat will not lead to a long-term decrease in a Broad-headed Snake population.

(b) **Reduce the area of occupancy of the species;**

The area of habitat availability and therefore, potential occupancy may be incrementally reduced by 0.63 ha.

(c) **Fragment an existing important population into two or more populations;**

No areas of potential habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

The abundance of potential habitat within the Newnes State Forest and neighbouring National Parks suggests that the habitats within the Study Area are not critical to the survival of the Broad-headed Snake.

(e) **Disrupt the breeding cycle of a population;**

The minor predicted modification to potential habitats from subsidence and the small loss of potential summer sheltering habitat would not disrupt the breeding cycle of a population of Broad-headed Snake.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted modification to potential habitats from subsidence and the small loss of potential summer sheltering habitat would not constitute a decrease in the availability or quality of habitat to the extent that the species is likely to decline.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

The Project is unlikely to contribute to an increase in invasive species that may be harmful to this species.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere substantially with the recovery of the species.**

The Project is unlikely to interfere with the recovery of the Broad-headed Snake.

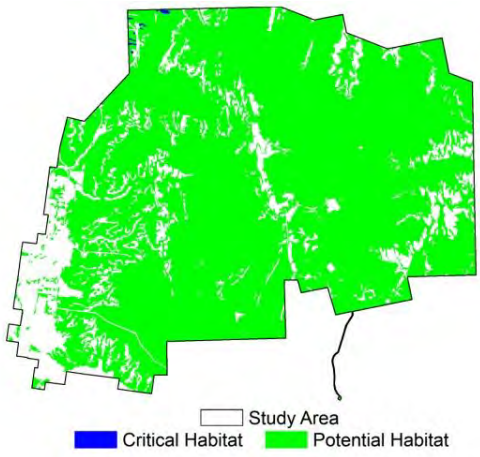
Anthochaera phrygia **Regent Honeyeater**

The Regent Honeyeater (*Anthochaera phrygia*) is listed as Endangered under the EPBC Act. Regent Honeyeaters are endemic to South-east Australia, extending from south-east Queensland to central Victoria. This distribution is extremely segmented (SEWPAC 2013a). Preferred habitat includes Box-Ironbark eucalypt woodland and dry sclerophyll forest (SEWPAC 2013a). Seasonal movements appear to be dictated by the flowering of various species of *Eucalyptus* sp. that are characteristic of the dry forests and woodlands of South-Eastern Australia.

The Regent Honeyeater are well known as occurring in the Capertee area, individuals are recorded in more easterly habitat, particularly in areas characterised by winter-flowering *Eucalyptus* ssp. when westerly habitats are experiencing extended dry periods. As such, this species may occur in Newnes Plateau forests on an intermittent basis.

On-site Habitat

Vegetation communities within the Study Area that are commensurate with the White Box-Yellow Bow-Blakely's Red Gum Forest EEC are considered to provide critical habitat to the survival of this species. These communities include MU 19 and 20 within the far north-west of the site. All other remnant eucalypt woodland and forest communities provide potential foraging and breeding habitat for this species.



Regional Habitat

The Regent Honeyeater has been well-documented from the Capertee and Glen Alice area, located within approximately 38 km north of the Study Area. One record exists within the Wolgan State Forest, approximately 1.5 km, and another record near Ben Bullen, approximately 9 km north-west of the Study Area. Due to the widespread distribution of winter-flowering Eucalypt species within the region, the potential habitats in the Study Area would not be of high importance to this species.

Location	Area (ha)	
	Critical Habitat	Potential Habitat
Within Study Area	7.35	9,007.71
Within subsidence extents	0.00	2,311.73
Within proposed infrastructure footprint	0.00	23.24

Impact Assessment

(a) **Lead to a long-term decrease in the size of a population;**

Approximately 23.24 ha of potential habitat for these species may be removed. The proposed surface infrastructure footprint occurs within a large area containing contiguous forest, woodland, heath, swamp and rocky habitats. These habitats continue throughout the Newnes State Forest and into the Gardens of Stone National Park, Blue Mountains National Park and Wollemi National Park. Therefore, the loss of habitat and impacts to the Regent Honeyeater population is considered small, relative to the available occupied habitats.

It is highly unlikely that subsidence related ground movements would affect woodland or forest habitats such that they would become in any way unsuitable for the Regent Honeyeater. No observable significant impacts to woodland habitats have occurred from subsidence within previously undermined areas of Springvale. Therefore, the Project is unlikely to impact the Regent Honeyeater population such that it is likely to lead to a long-term decrease in the size of a population.

(b) **Reduce the area of occupancy of the species;**

The project is unlikely to reduce the area of occupancy of this highly mobile species.

(c) **Fragment an existing population into two or more populations;**

The project is unlikely to fragment populations of this highly mobile species.

(d) **Adversely affect habitat critical to the survival of a species;**

Eucalyptus albens (White Box), Eucalyptus melliodora (Yellow Box), *Eucalyptus leucoxylon* (Yellow Gum) and *Eucalyptus sideroxylon* (Mugga Ironbark) growing in high quality sites, where nectar production is copious and relatively predictable appear to be critical to the survival of the Regent Honeyeater (Menkhorst, P., N. Schedvin & D. Geering 1999). None of these tree species have been recorded within the proposed subsidence extents or the ESAs. Therefore, no critical habitat will be affected.

(e) **Disrupt the breeding cycle of a population;**

The minor predicted modification to potential habitats from subsidence would not disrupt the breeding cycle of a population of the Regent Honeyeater, if present.

(f) **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted modification to potential habitats from subsidence and the small loss of potential woodland habitat from clearing would not constitute a decrease in the availability or quality of habitat to the extent that the species is likely to decline.

(g) **Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;**

The Project is unlikely to contribute to an increase in invasive species that may be harmful to this species.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere with the recovery of the species.**

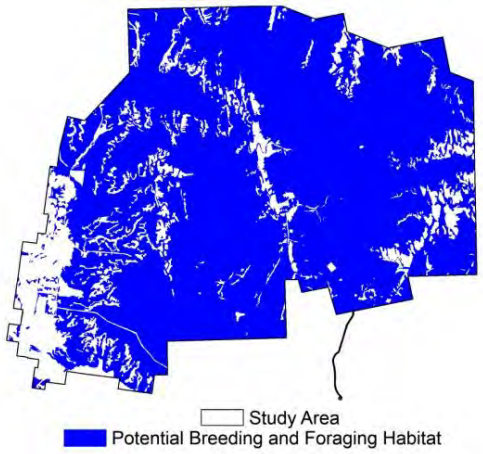
The Project is unlikely to interfere with the recovery of the Regent Honeyeater.

Pseudomys novaehollandiae **New Holland Mouse**

The New Holland Mouse (*Pseudomys novaehollandiae*) is listed as Vulnerable under the EPBC Act. It 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 dry open heathlands, eucalypt forests and woodlands with a dense leguminous understorey and sandy soils, and vegetated sand dunes. Populations are at highest densities in areas which are in early to mid-regeneration stages after disturbances such as fire (Murphy 2005).

On-site Habitat

All forest, woodland and heath vegetation communities located within the Study Area are considered to provide potential foraging and breeding habitat for this species, including forested areas of MU 3, 4, 7, 8, 11, 14, 15, 19, 20, 21, 26, 26a, 28, 29, 30, 32, 33, 35, 37 and 54, along with the heath communities of MU 44, 45, 46 and 53.



Regional Habitat

The New Holland Mouse is very rare within the region, with one record found approximately 21 km north and another record approximately 35 km south-east of the Study Area. Due to the presence of large, neighbouring areas of conservation lands, the potential habitats found within the Study Area would not be of high importance to the New Holland Mouse.

Location	Area (ha)
	Potential Breeding and Foraging Habitat
Within Study Area	9,064.27
Within subsidence extents	2,333.59
Within proposed infrastructure footprint	23.24

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. If a population of the New Holland Mouse was to occur within the Study Area, it could be considered a '*populations that are near the limit of the species range*' as the location would be at its western limit (excluding a disjunct population at Goobang). As such, this species is further assessed using the significant impact criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

The predicted subsidence levels and surface cracking is not expected to adversely affect habitats for this species. In addition, this species has been found to tolerate disturbances where habitats are allowed to recover. A small area, relative to the extensive amounts of potential habitat within the locality, is proposed to be cleared to accommodate required surface infrastructure (23.24 ha). The Project is therefore not expected to lead to a long-term decrease in the size of a population of the New Holland Mouse, if present.

(b) **Reduce the area of occupancy of the species;**

The area of habitat availability and therefore, potential occupancy may be incrementally reduced by 23.24 ha as a result of the Project.

(c) **Fragment an existing important population into two or more populations;**

No areas of potential habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

The abundance of potential habitat within the Newnes State Forest and neighbouring National Parks suggests that the habitats within the Study Area are not critical to the survival of the New Holland Mouse. Those areas of habitat that may be used by this species will not be adversely affected such that they would become unsuitable for these species, with the exception of a small loss of potential habitat.

(e) **Disrupt the breeding cycle of a population;**

The minor predicted modification to potential habitats from subsidence and the clearing of 23.24 ha would not disrupt the breeding cycle of a population of the New Holland Mouse.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted modification to potential habitats from subsidence and the small loss of potential woodland habitat from clearing would not constitute a decrease in the availability or quality of habitat to the extent that the species is likely to decline.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

The Project is unlikely to contribute to an increase in invasive species, such as cats, foxes and wild dogs, that may be harmful to this species.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere substantially with the recovery of the species.**

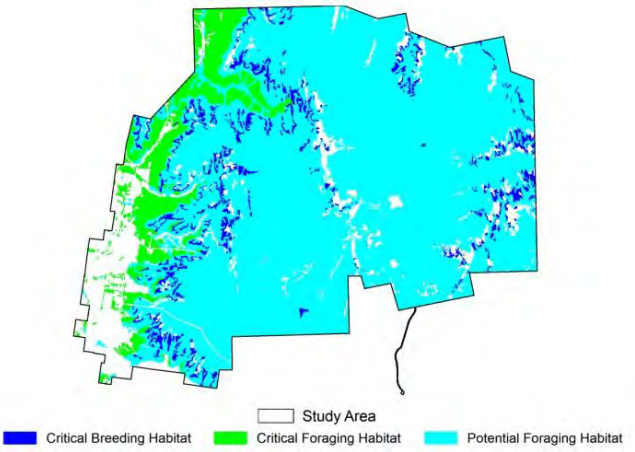
The Project is unlikely to interfere with the recovery of the New Holland Mouse.

Chalinolobus dwyeri **Large-eared Pied Bat**

The Large-eared Pied Bat (*Chalinolobus dwyeri*) is listed as Vulnerable under the EPBC Act. It is mainly found in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. Records of this species exist in dry sclerophyll forest and woodland, both to the east and west of the Great Divide. This species has been recorded on the Newnes Plateau by RPS. RPS has also recorded this species through Anabat detection in the Blackmans Flat area, approximately 3 km to the west. This species has also been recorded on numerous occasions during annual monitoring throughout the Newnes Plateau (BMS 2010a, 2011a).

On-site Habitat

Critical breeding habitat for this species within the Study Area is considered to occur amongst the caves and overhangs found within the Pagoda Rock Sparse Shrubland community (MU43). Critical foraging habitat is also considered to occur in remnant vegetation communities located along the valley floor in the western portion of the Study Area. These communities include areas of MU 15, 19, 20, 21, 32, 33, 35 and 37. All other areas of forest and woodland communities across the Study Area are considered to provide potential foraging habitat for the species.



Location	Area (ha)		
	Critical Breeding Habitat	Critical Foraging Habitat	Potential Foraging Habitat
Within Study Area	514.20	870.72	8,144.34
Within subsidence extents	2.19	0.00	2,311.73
Within proposed infrastructure footprint	0.00	0.00	23.24

Regional Habitat

The Large-eared Pied Bat has a widespread distribution within the region with several records from the neighbouring Wollemi National Park and Gardens of Stone National Park to the north and the Blue Mountains National Park to the south of the Study Area. Three records exist within the Study Area. Due to the presence of large, neighbouring areas of conservation lands, the potential habitats found within the Study Area would not be of high importance to the species.

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. If a population of the Large-eared Pied Bat was to occur within the Study Area, it could be considered a '*population that is near the limit of the species' range*', as the location would be at its western limit. As such, this species is further assessed using the Significant Impact Criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

Mine design will aim to protect the integrity of the structures that provide potential habitat to the Large-eared Pied Bat, namely cliffs minor cliffs and pagodas. It is unlikely, therefore, that the cliffs, minor cliffs and pagodas, where caves are most likely concentrated, would experience any adverse impacts resulting from the extraction of the proposed longwalls. The Project includes clearing of native vegetation for installation of required surface facilities. Those areas can still be utilised for foraging. The Project is therefore not expected to lead to a long-term decrease in the size of a population of the Large-eared Pied Bat.

(b) **Reduce the area of occupancy of the species;**

The project will not reduce the area of occupancy of this species.

(c) **Fragment an existing important population into two or more populations;**

No areas of potential habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

Sandstone cliffs and fertile wooded valley habitat within close proximity of each other, as well as any maternity roosts, should be considered habitat critical to the survival of the Large-eared Pied Bat (Department of Environment and Resource Management 2011). Compressive strains of 0.5 mm/m, or less, are unlikely to have any adverse impacts on the cliffs or pagoda complexes (MSEC 2014 section 5.7.3.). Therefore, no impacts would be expected to possible critical habitat, such as cave roosting sites. The areas proposed to be cleared are predominately along ridgelines and therefore not critical habitat for the Large-eared Pied Bat.

(e) **Disrupt the breeding cycle of a population;**

The mining layout has been designed such that the majority of the cliffs and pagoda complexes are located outside the 26.5 degree angle of draw line from the extents of the proposed longwalls. The Project will therefore not damage potential breeding locations, such as caves and, consequently, not disrupt the breeding cycle of the Large-eared Pied Bat.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted modification to potential habitats from subsidence and the small loss of potential hunting habitat would not constitute a decrease in the availability or quality of habitat to the extent that the species is likely to decline.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

The Project is unlikely to contribute to an increase in invasive species, such as cats, that may be harmful to these species.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce disease that may cause these to decline species.

(i) **Interfere substantially with the recovery of the species.**

The Project is unlikely to interfere with the recovery of the Large-eared Pied Bat.

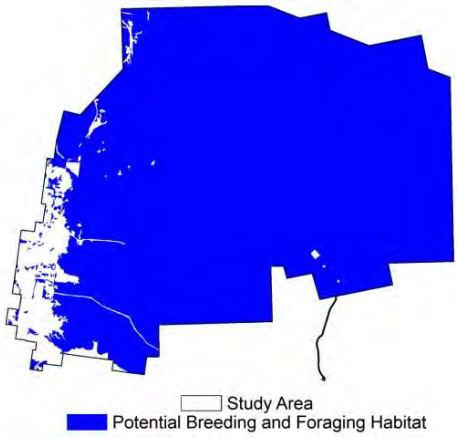
Dasyurus maculatus maculatus **Spotted-tailed Quoll**

The Spotted-tailed Quoll (*Dasyurus maculatus maculatus*) is listed as Endangered under the EPBC Act. The nominated subspecies *D. maculatus maculatus* occurs from southern Queensland to Tasmania. This species is one of the largest carnivorous marsupials. Previous and current fauna surveys carried out by RPS across the Newnes Plateau have not recorded the presence of the Spotted-tailed Quoll. The eight years of annual monitoring, which occurs over the Centennial tenements on the Newnes Plateau has also not recorded this species. Notwithstanding, numerous records of Spotted-tailed Quoll exist within a 10 km radius of the Study Area, as well as suitable habitat. Similarly, extensive tracts of suitable habitat would occur throughout the Blue Mountains area.

The Spotted-tailed Quoll is found in a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Nests are made in rock caves and hollow logs or trees, and basking sites are usually found nearby.

On-site Habitat

All remnant vegetation communities located within the Study Area are considered to provide potential foraging and breeding habitat for this species. This includes all areas of MU 3, 4, 7, 8, 11, 14, 15, 19, 20, 21, 26, 26a, 28, 29, 30, 32, 33, 35, 37, 50, 51, 53 and 54.



Regional Habitat

OEH Atlas of NSW Wildlife data indicates a widespread distribution of the Spotted-tailed Quoll throughout the region with a stronghold in the Blue Mountains National Park. Two records exist within the Study Area. Additional nearby records are indicated within 4-10 km south-east of the Study Area. Due to its general habitat preferences and the presence of large, neighbouring areas of conservation lands, the potential habitats found within the Study Area would not be of high importance to the Spotted-tailed Quoll.

Location	Area (ha)
	Potential Breeding and Foraging Habitat
Within Study Area	10,094.39
Within subsidence extents	2,364.01
Within proposed infrastructure footprint	23.24

Impact Assessment

(a) **Lead to a long-term decrease in the size of a population;**

The Project includes clearing of native vegetation for installation of required surface facilities. The total proposed footprint approximately 23.24 ha, however given much if this area includes exiting tracks, the required existing clearing will be substantially less. Similar connected habitat is widely available for this species. The expected subsidence levels is not expected to adversely affect habitats for this species. Therefore, the Project is unlikely to lead to a long-term decrease in the size of a population of the Spotted-tailed Quoll.

(b) **Reduce the area of occupancy of the species;**

The area of habitat availability and therefore, potential occupancy may be incrementally reduced by 23.24 ha as a result of the Project.

(c) **Fragment an existing population into two or more populations;**

No areas of potential habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

The abundance of potential habitat within the Newnes State Forest and neighbouring National Parks suggests that the habitats within the Study Area are not critical to the survival of the Spotted-tailed Quoll. Notwithstanding, those areas of habitat that may be used by this species will not be adversely affected such that they would become unsuitable for these species, with the exception of a small loss of potential hunting habitat.

(e) **Disrupt the breeding cycle of a population;**

The minor predicted modification to potential habitats from subsidence and the clearing of 23.24 ha would not disrupt the breeding cycle of a population of the Spotted-tailed Quoll, if present.

(f) **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted modification to potential habitats from subsidence and the small loss of potential woodland habitat from clearing would not constitute a decrease in the availability or quality of habitat to the extent that the species is likely to decline.

(g) **Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;**

The Project is unlikely to contribute to an increase in invasive species, such as foxes or wild dogs, that may be harmful to this species.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere with the recovery of the species.**

The Project is unlikely to interfere with the recovery of the Spotted-tailed Quoll.

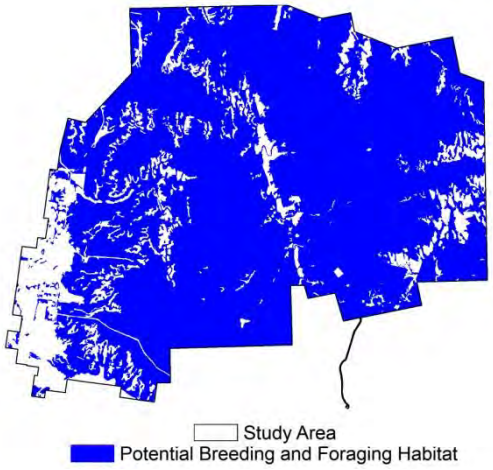
Isoodon obseculus obseculus **Southern Brown Bandicoot**

The Southern Brown Bandicoot (*Isoodon obseculus obseculus*) is listed as Endangered under the EPBC Act. It is found in a variety of habitats including dry sclerophyll forests, grasslands, heathlands, scrub and regenerating areas with adequate ground cover. A sandy (soft) substrate is preferred, and areas with a regular mosaic fire regime appear to offer the best habitat. They are nocturnal, and sleep by day in a nest of heaped vegetation with a hollow centre. The nest is usually concealed in a depression or amongst dense vegetation or ground litter.

Previous and current fauna surveys carried out by RPS across the Newnes Plateau has not recorded the presence of the Southern Brown Bandicoot. The nearest two records of this species are within the Blue Mountains National Park near Blackheath, approximately 31 km to the south of the Study Area. Both records are derived from hair analysis in fox scats dated from 1986 (DECCW 2011).

On-site Habitat

All vegetation communities located within the Study Area that include a dense ground cover are considered to provide potential foraging and breeding habitat for this species. As a result, all forest and woodland communities within the Project Area are considered potential habitat including MU 3, 4, 7, 8, 11, 14, 15, 19, 20, 21, 26, 26a, 28, 29, 30, 32, 33, 35, 37 and 54, along with the dense heath communities of MU 45 and 46 and well-drained areas of the shrub swamp community MU 50.



Regional Habitat

OEH Atlas of NSW Wildlife data shows only four records of the Southern Brown Bandicoot. The two closest records are located approximately 34 km south-east of the Study Area. However, these records were based on hair samples which may limit their accuracy. Two additional records are found within the Blue Mountains National Park, within a distance of approximately 50 km south-east of the Study Area. Due to its general habitat preferences and the presence of large, neighbouring areas of conservation lands, the potential habitats found within the Study Area would not be of high importance to the Southern Brown Bandicoot.

Location	Area (ha)
	Potential Breeding and Foraging Habitat
Within Study Area	9,107.40
Within subsidence extents	2,343.91
Within proposed infrastructure footprint	23.24

Impact Assessment

(a) **Lead to a long-term decrease in the size of a population;**

The Project includes clearing of native vegetation for installation of required surface facilities. The total proposed footprint approximately 23.24 ha. Similar connected habitat is widely available for this species. The expected subsidence levels and surface cracking is not expected to adversely affect habitats for this species. Therefore, the Project is unlikely to lead to a long-term decrease in the size of a population of the Southern Brown Bandicoot.

(b) **Reduce the area of occupancy of the species;**

The area of habitat availability and therefore, potential occupancy may be incrementally reduced by 23.24 ha as a result of the Project.

(c) **Fragment an existing population into two or more populations;**

No areas of potential habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

The abundance of potential habitat within the Newnes State Forest and neighbouring National Parks suggests that the habitats within the Study Area are not critical to the survival of the Southern Brown Bandicoot. Notwithstanding, those areas of habitat that may be used by this species will not be adversely affected such that they would become unsuitable for this species, with the exception of a small loss of potential habitat.

(e) **Disrupt the breeding cycle of a population;**

The minor predicted modification to potential habitats from subsidence and the clearing of 23.24 ha would not disrupt the breeding cycle of a population of the Southern Brown Bandicoot, if present.

(f) **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted modification to potential habitats from subsidence and the small loss of potential woodland habitat from clearing would not constitute a decrease in the availability or quality of habitat to the extent that the species is likely to decline.

(g) **Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;**

The Project is unlikely to contribute to an increase in invasive species, such as foxes or wild dogs, that may be harmful to this species.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere with the recovery of the species.**

The Project is unlikely to interfere with the recovery of the Southern Brown Bandicoot.

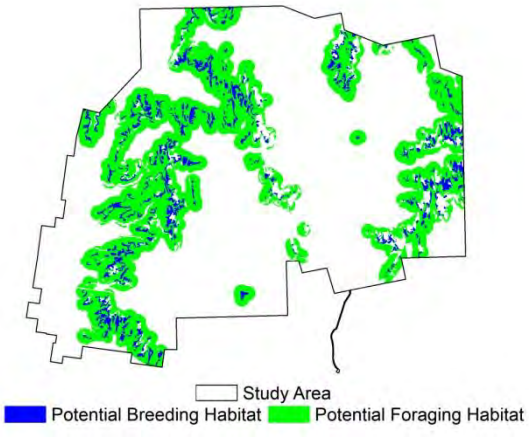
Petrogale penicillata **Brush-tailed Rock Wallaby**

The Brush-tailed Rock Wallaby (*Petrogale penicillata*) is listed as Vulnerable under the EPBC Act. This species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. It shelters or basks during the day in rock crevices, caves and overhangs and are most active at night.

Some suitable habitat exists within the Study Area, in the form of rock pagodas and escarpments, although this limited to a few locations. Records of this species occur throughout the Gardens of Stone and Wollemi National Park, particularly along the escarpments formed by rivers, including the Capertee River, Wolgan River and Colo River. It is considered that the presence of this species is possible within the Study Area, however has not been recorded.

On-site Habitat

The Study Area includes rocky escarpments and outcrops within the Pagoda Rock Sparse Shrubland vegetation community (MU43), which subsequently represents potential breeding habitat for the species. Forested areas within 200 m of these rocky outcrops represent potential foraging habitat for the species and include areas of MU 3, 4, 7, 8, 11, 14, 15, 21, 26, 26a, 28, 29, 30, 32, 35 and 37.



Regional Habitat

The Brush-tailed Rock Wallaby has a relatively widespread distribution within the region. One record exists within the Study Area. A number of records exist within the neighbouring Blue Mountains National Park and Wollemi National Park. Due to the presence of large, neighbouring areas of conservation lands, the potential habitats found within the Study Area would not be of high importance to the Brush-tailed Rock Wallaby.

Location	Area (ha)	
	Breeding Habitat	Foraging Habitat
Within Study Area	519.45	3,036.93
Within subsidence extents	2.19	132.88
Within proposed infrastructure footprint	0.00	0.63

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. If a population of the Brush-tailed Rock Wallaby was to occur within the Study Area, it could be considered a '*populations that are necessary for maintaining genetic diversity*' as the location is rare with disjunct populations. As such, this species is further assessed using the Significant Impact Criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

The small numbers of cliffs and pagodas that occur within the angle of draw are unlikely to experience any adverse impacts resulting from the extraction of the proposed longwalls. There is potential for some rock falls, however, due to the agility and mobility of the Brush-tailed Rock Wallaby, isolated rock falls would cause the rocky habitats to become unsuitable for this species.

Areas to be cleared for surface infrastructure (0.63 ha) may remove a small amount of potential foraging habitat. However, due to the abundance of similar foraging habitat adjacent to potential cliff line and pagoda habitats, this removal is unlikely to lead to a long-term decrease in the size of a population of Brush-tailed Rock Wallaby.

(b) **Reduce the area of occupancy of the species;**

The area of habitat availability and therefore, potential occupancy at times of feeding may be incrementally reduced by 0.63 ha as a result of the Project.

(c) **Fragment an existing important population into two or more populations;**

No areas of potential habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

The abundance of potential habitat within the Newnes State Forest and neighbouring National Parks suggests that the habitats within the Study Area are not critical to the survival of the Brush-tailed Rock Wallaby. Notwithstanding, those areas of habitat that may be used by this species will not be adversely affected such that they would become unsuitable for these species.

(e) **Disrupt the breeding cycle of a population;**

The minor predicted modification to potential habitats from subsidence and the small loss of potential feeding habitat would not disrupt the breeding cycle of a population of Brush-tailed Rock Wallaby, if present.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted modification to potential habitats from subsidence and the small loss of potential feeding habitat would not constitute a decrease in the availability or quality of habitat to the extent that the species is likely to decline.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

The Project is unlikely to contribute to an increase in invasive species, such as foxes and wild dogs, that may be harmful to these species.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere substantially with the recovery of the species.**

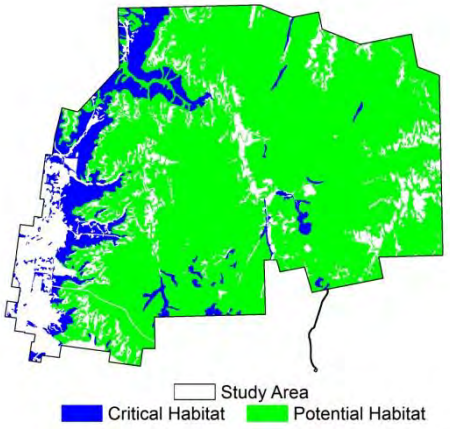
The Project is unlikely to interfere with the recovery of the Brush-tailed Rock Wallaby.

Phascolarctos cinereus **Koala**

The Koala (*Phascolarctos cinereus*) is listed as Vulnerable under the EPBC Act. This species inhabits a range of eucalypt woodlands and forests across the eastern portion of Australia, from coastal and inland QLD through NSW and into Victoria. The population in NSW is mainly confined to the central and north coasts with some populations remaining west of the Great Dividing Range in Gunnedah and surrounds.

On-site Habitat

Vegetation communities that have over 50% of canopy trees from any of the feed tree species listed above are considered to represent critical habitat for the Koala. Communities within the Study Area that are considered likely to represent critical habitat include MU 11, 14, 15, 20, 21, 33, 35, 37 and 54. All other woodland habitats may also contain Koala feed trees, providing potential habitat.



Regional Habitat

Although Koalas are rare within the region, scattered records exist throughout the area. Apart from the two records found within the Study Area, two records are found within approximately 2 km east and 2 km south-west. Additional records exist approximately within 5 km north of the Study Area. Due to the presence of large, neighbouring areas of conservation lands, the potential habitats found within the Study Area would not be of high importance to the Koala.

Location	Area (ha)	
	Critical Habitat	Potential Habitat
Within Study Area	1,054.73	7,958.06
Within subsidence extents	54.82	2,256.92
Within proposed infrastructure footprint	0.16	23.08

Under the EPBC Act significant impact guidelines, a population of a Vulnerable species must be considered to be an 'important population' to require further assessment of impact. OEH Atlas of NSW Wildlife records show Koala occurring to the north and south of the Study Area. Therefore, the population may be '*necessary for maintaining genetic diversity*'. As such, this species is further assessed using the significant impact criteria below.

Impact Assessment

(a) **Lead to a long-term decrease in the size of an important population;**

The removal of a small amount (23.08ha) of habitat containing mostly low densities of Koala feed trees would not lead to a long-term reduction in the size of a potentially occurring population. The expected subsidence level is not expected to adversely affect habitats for this species. Therefore, the Project is unlikely to lead to a long-term decrease in the size of a population of the Koala.

(b) **Reduce the area of occupancy of the species;**

The area of habitat and therefore potential occupancy may be incrementally reduced by 23.08 ha.

(c) **Fragment an existing important population into two or more populations;**

No areas of potential habitat will become fragmented as a result of the Project.

(d) **Adversely affect habitat critical to the survival of a species;**

Habitat critical to the survival of the koala is considered to be any form of landscape corridor which is essential to the dispersal of koalas between forest or woodland habitats (SEWPAC 2012). Critical habitat is also defined as areas of forest or woodland where:

- Primary Koala food tree species (as defined in DECC 2008b) comprise at least 30% of the overstorey trees;
- Primary Koala food tree species comprise less than 30% of the overstorey trees, but together with secondary food tree species comprise at least 50% of the overstorey trees;
- Primary food tree species are absent but secondary food tree species (as defined in DECC 2008b) alone comprise at least 50% of the overstorey trees;
- The above qualities may be absent in a forest or woodland but other essential habitat features are present and adjacent to areas exhibiting the above qualities (e.g. Koalas in the Pilliga are known to escape the heat of the day by taking refuge in white cypress pines, which are not food trees); or
- A relatively high density of Koalas is supported, regardless of the presence of food tree species. Koala population densities vary across their range and regional data should be used to judge relative density.

Approximately 0.16 ha of critical habitat occurs within the proposed surface infrastructure footprint.

(e) **Disrupt the breeding cycle of a population;**

The Project is unlikely to disrupt the breeding cycle of a population of the Koala.

(f) **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The minor predicted modification to potential habitats from subsidence and the small loss of potential woodland habitat from clearing would not constitute a decrease in the availability or quality of habitat to the extent that the species is likely to decline.

(g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

The Project is unlikely to contribute to an increase in invasive species that may be harmful to this species.

(h) **Introduce disease that may cause the species to decline; or**

The Project is unlikely to introduce diseases that may cause this species to decline.

(i) **Interfere substantially with the recovery of the species.**

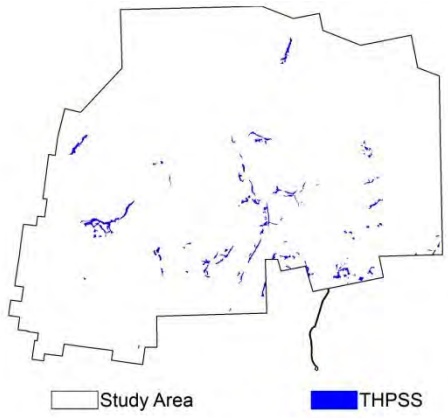
The Project is unlikely to interfere with the recovery of the Koala.

Temperate Highland Peat Swamps on Sandstone

Mapping undertaken by DEC (2006) and ground-truthed by RPS shows that the Project contains THPSS. THPSS is typically situated on peat substrates in drainage lines between open forested slopes and is dominated by shrubs such as *Epacris paludosa* (Swamp Epacris), *Grevillea acanthifolia* and occasional occurrences of *Leptospermum lanigerum* (Woolly Tea Tree) and *Baeckea diosmifolia* (Fringed Baeckea). Understorey vegetation is dominated by the sedges *Baumea rubiginosa* (Twig Rush), *Baloskion australe* and *Empodisma minus* and the fern *Gleichenia dicarpa* (Pouched Coral Fern).

On-site Habitat

The THPSS located with the subsidence impact area comprise hanging swamps and shrub swamps.



Regional Habitat

The current known extent of all THPSS totals approximately 3,000 ha (DEH 2005). Within the region, this includes swamps within the Newnes Plateau and Blue Mountains Swamps to the east of the Project Application Area. Due to the relatively limited distribution, any habitats occupied by this community would be considered to be of high importance.

Location	Area (ha)
	Critical Habitat
Within Study Area	113.46
Within subsidence extents	20.04
Within proposed infrastructure footprint	0

Impact Assessment

(a) **Reduce the extent of an ecological community**

THPSS within the Study Area will not be impacted by vegetation clearing for surface infrastructure areas. Impact assessments of subsidence (MSEC 2014) and groundwater impact assessments (RPS 2014a) have been undertaken in relation to swamps. These assessments found that there is unlikely to be significant reductions or reversals of grade that could otherwise cause ponding or scouring. Additionally, it was found that the limited depth of fracturing and dilation of bedrock of shrub swamp or upstream drainage lines would not result in losses of infiltrated water and minimal divergence of surface water would occur. With regard to these findings, it is unlikely that the effects of subsidence would have a significant adverse effect on shrub swamps or hanging swamps.

The most significant reductions to average standing groundwater levels are predicted in Twin Gully Swamp. This swamp has a projected drop in average standing water levels from 12.4 cm to 10.6 cm above the soil surface. The post mining values predicted at Twin Gully Swamp therefore suggest that soil saturation would persist, maintaining water availability for flora and fauna, as well as soil anoxia, allowing for continued peat formation. All other monitored swamps have smaller projected decreases in average standing water levels and monitored swamps are projected to maintain average standing water levels above the surface. It is possible that these levels may naturally fall below the surface in certain locations of the swamp. However, highly organic peat soils with low bulk density capillary forces are likely to be saturated for some distance above the water table itself. Therefore, a possible reduction in the average standing water levels, by the magnitudes predicted in Adhikary and Wilkins (2013), is unlikely to result in drying of the peat layer. The Project is therefore unlikely to reduce the extent of an ecological community.

Section 7.3.5 of the Groundwater Impact Assessment identifies that the hanging swamps present within the Study Area are associated with the perched aquifer system and not the regional water table. As a result, these systems are heavily reliant on rainfall recharge to the perched aquifer system and are independent of changes to groundwater table levels and associated baseflow modifications.

(b) **Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;**

The Project will not clear any areas of THPSS and therefore not cause fragmentation of this community.

(c) **Adversely affect habitat critical to the survival of an ecological community;**

Any adverse effects to the THPSS, such as minor cracking of the bedrock, is not expected to be of a magnitude that it would significantly impact this EEC.

(d) **Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;**

The abiotic factors that are necessary for the survival of the THPSS (i.e. ground water and surface water) will remain within the expected capillary forces of the THPSS. Therefore, the magnitudes of water table decline predicted in Adhikary and Wilkins (2013), are unlikely to result in drying of the peat layer.

(e) **Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;**

The Project will not cause a substantial change in the species composition of the THPSS.

(f) **Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:**

- **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**
- **Interfere with the recovery of an ecological community.**

The quality and integrity of the THPSS is not expected to be reduced as a result of the Project.

Appendix 3

Known and Expected Fauna Species List

Below is a list of fauna species that could be *reasonably* expected to be found within the Study Area at some occasion. This approach has been taken given that it is unlikely that *all* potentially occurring species will be recorded within an area during formal fauna surveys (due to seasonality, climatic limitations, crypticism etc).

Family sequencing and taxonomy follow for each fauna class:

Birds – Simpson and Day (2011).

Herpetofauna – Wilson and Swan (2011).

Mammals - Strahan (ed.) (1995) and Churchill (1998).

✓ - Species observed or indicated by scats, tracks etc. within the Study Area during this investigation.

* - Indicates an introduced species

Known and Expected Bird List

Appendix Key: **1** = Results of ecological investigations conducted within the Study Area
✓ = Species Detected
* = introduced species
(C) = listed as CAMBA species
(J) = listed as JAMBA species
(E) = listed as Endangered in NSW.
(V) = listed as Vulnerable in NSW.
(EV) = Species listed under the Commonwealth EPBC Act as Vulnerable
(EE) = Species listed under the Commonwealth EPBC Act as Endangered
(EM) = Species listed under the Commonwealth EPBC Act as Migratory
(EMa) = Species listed under the Commonwealth EPBC Act as Marine
Species indicated in **BOLD** font are those threatened species known from within Lithgow LGA (Atlas of NSW Wildlife data)

Data Source: ✓ = Species recorded during this survey

Family Name	*Scientific Name*	Common Name	Recorded
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill	✓
	Acanthiza lineata	Striated Thornbill	✓
	Acanthiza nana	Yellow Thornbill	✓
	Acanthiza pusilla	Brown Thornbill	✓
	Acanthiza reguloides	Buff-rumped Thornbill	✓
	Aphelocephala leucopsis	Southern Whiteface	
	Calamanthus pyrrhopygius	Chestnut-rumped Heathwren	
	Gerygone fusca	Western Gerygone	
	Gerygone mouki	Brown Gerygone	
	Gerygone olivacea	White-throated Gerygone	
	Origma solitaria	Rockwarbler	✓
	Pycnoptilus floccosus	Pilotbird	
	Pyrrholaemus saggitatus	**Speckled Warbler (V)**	
	Sericornis citreogularis	Yellow-throated Scrubwren	
	Sericornis frontalis	White-browed Scrubwren	✓
	Sericornis magnirostris	Large-billed Scrubwren	
	Smicrornis brevirostris	Weebill	✓
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk	
	Accipiter fasciatus	Brown Goshawk	✓
	Accipiter novaehollandiae	Grey Goshawk	
	Aquila audax	Wedge-tailed Eagle	
	Elanus axillaris	Black-shouldered Kite	
	Haliaeetus leucogaster	White-bellied Sea-Eagle	
	Haliastur sphenurus	Whistling Kite	
	Hieraaetus morphnoides	Little Eagle	
	Lophoictinia isura	**Square-tailed Kite (V)**	
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	

Family Name	*Scientific Name*	Common Name	Recorded
Alaudidae	*Alauda arvensis**	Eurasian Skylark	
	Mirafra javanica	Horsfield's Bushlark	
Alcedinidae	*Alcedo azurea*	Azure Kingfisher	
	Dacelo novaeguineae	Laughing Kookaburra	✓
	Todiramphus sanctus	Sacred Kingfisher	✓
Anatidae	*Anas gracilis*	Grey Teal	
	Anas rhynchotis	Australasian Shoveler	
	Anas superciliosa	Pacific Black Duck	
	Aythya australis	Hardhead	
	Biziura lobata	Musk Duck	
	Chenonetta jubata	Australian Wood Duck	✓
	Cygnus atratus	Black Swan	
	Malacorhynchus membranaceus	Pink-eared Duck	
	Oxyura australis	**Blue-billed Duck (V)**	
Apodidae	*Hirundapus caudacutus*	White-throated Needletail (EM)	
Ardeidae	*Ardea pacifica*	White-necked Heron	
	Egretta novaehollandiae	White-faced Heron	
	Nycticorax caledonicus	Nankeen Night Heron	
Artamidae	*Artamus cinereus*	Black-faced Woodswallow	
	Artamus cyanopterus	Dusky Woodswallow	
	Artamus leucorynchus	White-breasted Woodswallow	
	Artamus superciliosus	White-browed Woodswallow	
	Cracticus nigrogularis	Pied Butcherbird	✓
	Cracticus torquatus	Grey Butcherbird	
	Gymnorhina tibicen	Australian Magpie	✓
	Strepera graculina	Pied Currawong	✓
	Strepera versicolor	Grey Currawong	✓
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	✓
	Cacatua sanguinea	Little Corella	
	Callocephalon fimbriatum	**Gang-Gang Cockatoo (V)**	✓
	Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	✓
	Calyptorhynchus lathami	**Glossy Black-Cockatoo (V)**	
	Eolophus roseicapillus	Galah	
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	✓
	Coracina papuensis	White-bellied Cuckoo-shrike	
	Coracina tenuirostris	Cicadabird	✓
	Lalage tricolor	White-winged Triller	
Caprimulgidae	*Eurostopodus mystacalis*	White-throated Nightjar	✓
Charadriidae	*Elseyornis melanops*	Black-fronted Dotterel	
	Vanellus miles	Masked Lapwing	
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola	

Family Name	*Scientific Name*	Common Name	Recorded
Climacteridae	*Climacteris erythrops*	Red-browed Treecreeper	✓
	Climacteris picumnus victoriae	**Brown Treecreeper (eastern subspecies) (V)**	
	Cormobates leucophaea	White-throated Treecreeper	✓
Columbidae	*Geopelia cuneata*	Diamond Dove	
	Geopelia humeralis	Bar-shouldered Dove	
	Geopelia placida	Peaceful Dove	
	Leucosarcia melanoleuca	Wonga Pigeon	✓
	Macropygia amboinensis	Brown Cuckoo-Dove	
	Ocyphaps lophotes	Crested Pigeon	
	Phaps chalcoptera	Common Bronzewing	
	Phaps elegans	Brush Bronzewing	
Coraciidae	*Eurystomus orientalis*	Dollarbird	
Corcoracidae	*Corcorax melanorhamphos*	White-winged Chough	✓
Corvidae	*Corvus coronoides*	Australian Raven	✓
	Corvus mellori	Little Raven	
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	✓
	Cacomantis variolosus	Brush Cuckoo	
	Chalcites basalis	Horsfield's Bronze-Cuckoo	✓
	Chalcites lucidus	Shining Bronze-Cuckoo	
	Chalcites osculans	Black-eared Cuckoo	
	Cuculus pallidus	Pallid Cuckoo	
	Cuculus saturatus	Oriental Cuckoo	
	Eudynamys orientalis	Pacific Koel	
	Scythrops novaehollandiae	Channel-billed Cuckoo	
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird	
Estrildidae	*Lonchura castaneothorax*	Chestnut-breasted Mannikin	
	Neochmia modesta	Plum-headed Finch	
	Neochmia temporalis	Red-browed Finch	
	Stagonopleura bella	Beautiful Firetail	
	Stagonopleura guttata	**Diamond Firetail (V)**	
	Taeniopygia bichenovii	Double-barred Finch	
	Taeniopygia guttata	Zebra Finch	
Eupetidae	*Cinclosoma punctatum*	Spotted Quail-thrush	
	Psophodes olivaceus	Eastern Whipbird	
Falconidae	*Falco berigora*	Brown Falcon	
	Falco cenchroides	Nankeen Kestrel	
	Falco longipennis	Australian Hobby	
	Falco peregrinus	Peregrine Falcon	
	Falco subniger	Black Falcon	
Fringillidae	*Carduelis carduelis**	European Goldfinch	
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow	

Family Name	*Scientific Name*	Common Name	Recorded
	Hirundo neoxena	Welcome Swallow	
	Petrochelidon ariel	Fairy Martin	
	Petrochelidon nigricans	Tree Martin	✓
Laridae	*Larus novaehollandiae*	Silver Gull	
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	✓
	Malurus lamberti	Variegated Fairy-wren	
	Stipiturus malachurus	Southern Emu-wren	
Megapodiidae	*Alectura lathami*	Australian Brush-turkey	
Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater	
	Acanthorhynchus tenuirostris	Eastern Spinebill	✓
	Anthochaera carunculata	Red Wattlebird	✓
	Anthochaera chrysoptera	Little Wattlebird	✓
	Entomyzon cyanotis	Blue-faced Honeyeater	
	Epthianura albifrons	White-fronted Chat	
	Gliciphila melanops	Tawny-crowned Honeyeater	
	Grantiella picta	**Painted Honeyeater (V)**	
	Lichenostomus chrysops	Yellow-faced Honeyeater	✓
	Lichenostomus fuscus	Fuscous Honeyeater	
	Lichenostomus leucotis	White-eared Honeyeater	✓
	Lichenostomus melanops	Yellow-tufted Honeyeater	
	Lichenostomus penicillatus	White-plumed Honeyeater	
	Manorina melanocephala	Noisy Miner	
	Manorina melanophrys	Bell Miner	
	Meliphaga lewinii	Lewin's Honeyeater	✓
	Melithreptus brevirostris	Brown-headed Honeyeater	
	Melithreptus gularis gularis	**Black-chinned Honeyeater (eastern subspecies) (V)**	
	Melithreptus lunatus	White-naped Honeyeater	✓
	Myzomela sanguinolenta	Scarlet Honeyeater	
	Philemon citreogularis	Little Friarbird	
	Philemon corniculatus	Noisy Friarbird	✓
	Phylidonyris niger	White-cheeked Honeyeater	
	Phylidonyris novaehollandiae	New Holland Honeyeater	✓
	Phylidonyris pyrrhoptera	Crescent Honeyeater	
	Plectorhyncha lanceolata	Striped Honeyeater	
	Xanthomyza phrygia	**Regent Honeyeater (E, E*)**	
Menuridae	*Menura novaehollandiae*	Superb Lyrebird	✓
Meropidae	*Merops ornatus*	Rainbow Bee-eater	
Monarchidae	*Myiagra cyanoleuca*	Satin flycatcher	✓
	Grallina cyanoleuca	Magpie-lark	
	Monarcha melanopsis	Black-faced Monarch	
Motacillidae	*Anthus australis*	Australian Pipit	

Family Name	*Scientific Name*	Common Name	Recorded
Muscicapidae	*Turdus merula**	Eurasian Blackbird	
	Zoothera lunulata	Bassian Thrush	
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird	✓
Neosittidae	***Daphoenositta chrysoptera***	**Varied Sittella**	✓
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole	✓
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	✓
	Falcunculus frontatus	Eastern Shrike-tit	
	Pachycephala pectoralis	Golden Whistler	✓
	Pachycephala rufiventris	Rufous Whistler	✓
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	✓
	Pardalotus striatus	Striated Pardalote	✓
Passeridae	*Passer domesticus**	House Sparrow	
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican	
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	✓
	Melanodryas cucullata	Hooded Robin	
	Melanodryas cucullata cucullata	**Hooded Robin (south-eastern form) (V)**	
	Microeca fascinans	Jacky Winter	
	Petroica boodang	**Scarlet Robin (V)**	✓
	Petroica goodenovii	Red-capped Robin	
	Petroica phoenicea	**Flame Robin (V)**	✓
	Petroica rosea	Rose Robin	
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant	
	Phalacrocorax melanoleucos	Little Pied Cormorant	
	Phalacrocorax sulcirostris	Little Black Cormorant	
	Phalacrocorax varius	Pied Cormorant	
Phasianidae	*Coturnix pectoralis*	Stubble Quail	
	Coturnix ypsilophora	Brown Quail	
Podargidae	*Podargus strigoides*	Tawny Frogmouth	✓
Podicipedidae	*Podiceps cristatus*	Great Crested Grebe	
	Poliocephalus poliocephalus	Hoary-headed Grebe	
	Tachybaptus novaehollandiae	Australasian Grebe	
Pomatostomidae	*Pomatostomus superciliosus*	White-browed Babbler	
	Pomatostomus temporalis temporalis	**Grey-crowned Babbler (eastern subspecies) (V)**	
Psittacidae	*Alisterus scapularis*	Australian King-Parrot	✓
	Glossopsitta concinna	Musk Lorikeet	
	Glossopsitta pusilla	Little Lorikeet	
	Lathamus discolor	**Swift Parrot (E,E*)**	
	Melopsittacus undulatus	Budgerigar	
	Neophema pulchella	**Turquoise Parrot (V)**	
	Platycercus adscitus eximius	Eastern Rosella	✓

Family Name	*Scientific Name*	Common Name	Recorded
	Platycercus elegans	Crimson Rosella	✓
	Psephotus haematonotus	Red-rumped Parrot	
	Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	
	Trichoglossus haematodus	Rainbow Lorikeet	
Psophodidae	*Cinclosoma punctatum*	Spotted Quail-thrush	✓
	Psophodes olivaceus	Eastern Whipbird	✓
Ptilonorhynchidae	*Ptilonorhynchus violaceus*	Satin Bowerbird	
Pycnonotidae	*Pycnonotus jocosus**	Red-whiskered Bulbul	
Rallidae	*Fulica atra*	Eurasian Coot	
	Gallinula tenebrosa	Dusky Moorhen	
	Gallirallus philippensis	Buff-banded Rail	
	Porphyrio porphyrio	Purple Swamphen	
	Pozana fluminea	Australian Spotted Crake	
	Pozana pusilla	Baillon's Crake	
	Pozana tabuensis	Spotless Crake	
	Rallus pectoralis	Lewin's Rail	
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	✓
	Rhipidura rufifrons	Rufous Fantail	✓
Scolopacidae	*Calidris acuminata*	Sharp-tailed Sandpiper (EM)	
	Gallinago hardwickii	Latham's Snipe (EM)	
Strigidae	*Ninox boobook*	Southern Boobook	✓
	Ninox connivens	**Barking Owl (V)**	
	Ninox strenua	**Powerful Owl (V)**	✓
Sturnidae	*Acridotheres tristis**	Common Myna	
	*Sturnus vulgaris**	Common Starling	
Sylviidae	*Acrocephalus australis*	Australian Reed-Warbler	
	Cincloramphus cruralis	Brown Songlark	
	Cincloramphus mathewsi	Rufous Songlark	✓
	Megalurus gramineus	Little Grassbird	
Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill	
	Platalea regia	Royal Spoonbill	
	Threskiornis molucca	Australian White Ibis	
	Threskiornis spinicollis	Straw-necked Ibis	
Turdidae	*Zoothera lunulata*	Bassian Thrush	✓
Turnicidae	*Turnix varia*	Painted Button-quail	
Tytonidae	*Tyto alba*	Barn Owl	
	Tyto novaehollandiae	**Masked Owl (V)**	
	Tyto tenebricosa	**Sooty Owl (V)**	
Zosteropidae	*Zosterops lateralis*	Silvereye	✓

Known and Expected Mammal List

Appendix Key: **1** = Results of ecological investigations conducted within the Study Area
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(EE) = Species listed under the Commonwealth EPBC Act as Endangered
Species indicated in **BOLD** font are those threatened species known from within Lithgow LGA (Atlas of NSW Wildlife)

Data Source: ✓ = Species recorded during this survey

Family Name	*Scientific Name*	Common Name	Recorded
Acrobatidae	*Acrobates pygmaeus*	Feathertail Glider	
Bovidae	*Bos taurus**	European Cattle	
	*Capra hircus**	Goat	
Burramyidae	***Cercartetus nanus***	**Eastern Pygmy-possum (V)**	✓
Canidae	*Canis lupus familiaris**	Dog	
	*Canis lupus**	Dingo, domestic dog	
	*Vulpes vulpes**	Fox	✓
Cervidae	*Cervus sp.**	Unidentified Deer	
Dasyuridae	*Antechinus flavipes*	Yellow-footed Antechinus	
	Antechinus stuartii	Brown Antechinus	✓
	Antechinus swainsonii	Dusky Antechinus	
	Antechinus/Sminthopsis sp.	unidentified 'Marsupial Mouse'	
	Dasyuridae sp.	unidentified dasyurid	
	Dasyurus maculatus	**Spotted-tailed Quoll (V, V*)**	
Emballonuridae	***Saccolaimus flaviventris***	**Yellow-bellied Sheathtail-bat (V)**	✓
Equidae	*Equus caballus**	Horse	
Felidae	*Felis catus**	Cat	✓
Leporidae	*Lepus capensis**	Brown Hare	
	*Oryctolagus cuniculus**	Rabbit	
Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo	✓
	Macropus robustus	Common Wallaroo	
	Macropus rufogriseus	Red-necked Wallaby	✓
	Petrogale penicillata	**Brush-tailed Rock-wallaby (E, V*)**	
	Wallabia bicolor	Swamp Wallaby	✓
Molossidae	*Mormopterus "Species 2"*	Undescribed Freetail Bat	
	Mormopterus norfolkensis	Eastern Freetail-bat (V)	
	Mormopterus planiceps	Little Mastiff-bat	
	Mormopterus sp.	Mastiff-bat	
	Tadarida australis	White-striped Freetail-bat	✓

Family Name	*Scientific Name*	Common Name	Recorded
Muridae	*Hydromys chrysogaster*	Water-rat	
	*Mus musculus**	House Mouse	
	Rattus fuscipes	Bush Rat	✓
	Rattus lutreolus	Swamp Rat	
	*Rattus rattus**	Black Rat	✓
Ornithorhynchidae	*Ornithorhynchus anatinus*	Platypus	
Peramelidae	*Isoodon/Perameles sp.*	unidentified Bandicoot	
Petauridae	***Petaurus australis***	**Yellow-bellied Glider (V)**	
	Petaurus breviceps	Sugar Glider	✓
	Petaurus norfolcensis	**Squirrel Glider (V)**	
Phalangeridae	*Trichosurus caninus*	Short-eared Possum	
	Trichosurus sp.	Brushtail possum	
	Trichosurus vulpecula	Common Brushtail Possum	✓
Phascolarctidae	***Phascolarctos cinereus***	**Koala (V)**	
Potoroidae	*Bettongia gaimardi*	Tasmanian Bettong	
Pseudocheiridae	*Petauroides volans*	Greater Glider	✓
	Pseudocheirus peregrinus	Common Ringtail Possum	✓
Rhinolophidae	*Rhinolophus megaphyllus*	Eastern Horseshoe-bat	
Suidae	*Sus scrofa**	Pig	
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	
Vespertilionidae	***Chalinolobus dwyeri***	**Large-eared Pied Bat (V, V*)**	✓
	Chalinolobus gouldii	Gould's Wattled Bat	✓
	Chalinolobus morio	Chocolate Wattled Bat	✓
	Falsistrellus tasmaniensis	**Eastern False Pipistrelle (V)**	
	Miniopterus australis	**Little Bentwing-bat (V)**	
	Miniopterus schreibersii oceanensis	**Eastern Bentwing-bat (V)**	✓
	Myotis adversus	**Large-footed Myotis (V)**	
	Nyctophilus geoffroyi	Lesser Long-eared Bat	
	Nyctophilus gouldi	Gould's Long-eared Bat	✓
	Nyctophilus sp.	Long-eared bat	
	Scoteanax rueppellii	**Greater Broad-nosed Bat (V)**	
	Scotorepens balstoni	Inland Broad-nosed Bat	
	Scotorepens orion	Eastern Broad-nosed Bat	
	Vespadelus darlingtoni	Large Forest Bat	✓
	Vespadelus pumilus	Eastern Forest Bat	
	Vespadelus regulus	Southern Forest Bat	✓
	Vespadelus vulturnus	Little Forest Bat	✓
Vombatidae	*Vombatus ursinus*	Common Wombat	✓

Known and Expected Reptile List

Appendix Key: **1** = Results of ecological investigations conducted within the Study Area
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(EE) = Species listed under the Commonwealth EPBC Act as Endangered
(EMa) = Species listed under the Commonwealth EPBC Act as Marine
Species indicated in **BOLD** font are those threatened species known from within Lithgow LGA (Atlas of NSW Wildlife)

Data Source: ✓ = Species recorded during this survey

Family Name	*Scientific Name*	Common Name	Recorded
Agamidae	*Amphibolurus muricatus*	Jacky Lizard	✓
	Amphibolurus nobbi	Nobbi	
	Physignathus lesueurii	Eastern Water Dragon	
	Pogona barbata	Bearded Dragon	
	Rankinia diemensis	Mountain Dragon	✓
Chelidae	*Chelodina longicollis*	Eastern Snake-necked Turtle	
Elapidae	*Austrelaps ramsayi*	Highland Copperhead	
	Austrelaps superbus	Lowland Copperhead	
	Cryptophis nigrescens	Eastern Small-eyed Snake	✓
	Drysdalia rhodogaster	Mustard-bellied Snake	
	Furina diadema	Red-naped Snake	
	Hoplocephalus bungaroides	**Broad-headed Snake (E, V*)**	
	Notechis scutatus	Tiger Snake	
	Parasuta dwyeri	Dwyer's Snake	
	Parasuta spectabilis	Mallee Black-headed Snake	
	Pseudechis guttatus	Spotted Black Snake	
	Pseudechis porphyriacus	Red-bellied Black Snake	
	Pseudonaja textilis	Eastern Brown Snake	
	Vermicella annulata	Bandy-bandy	
Gekkonidae	*Diplodactylus vittatus*	Wood Gecko	
	Oedura lesueurii	Lesueur's Velvet Gecko	✓
	Phyllurus platurus	Broad-tailed Gecko	
	Underwoodisaurus milii	Thick-tailed Gecko	
Pygopodidae	*Pygopus lepidopodus*	Common Scaly-foot	✓
Scincidae	*Acritoscincus duperreyi*	Eastern Three-lined Skink	
	Acritoscincus platynota	Red-throated Skink	✓
	Carlia tetradactyla	Southern Rainbow-skink	
	Cryptoblepharus virgatus	Cream-striped Shinning-skink	

Family Name	*Scientific Name*	Common Name	Recorded
	Ctenotus robustus	Robust Ctenotus	
	Ctenotus taeniolatus	Copper-tailed Skink	✓
	Egernia cunninghami	Cunningham's Skink	✓
	Egernia saxatilis	Black Rock Skink	
	Egernia saxatilis intermedia		
	Egernia striolata	Tree Skink	
	Egernia whitii	White's Skink	✓
	Eulamprus heatwolei	Yellow-bellied Water-skink	✓
	Eulamprus leuraensis	**Blue Mountains Water skink (E, E*)**	
	Eulamprus quoyii	Eastern Water-skink	
	Eulamprus tenuis	Barred-sided Skink	
	Eulamprus tympanum	Southern Water-skink	
	Hemiergis decresiensis	Three-toed Earless Skink	
	Lampropholis delicata	Dark-flecked Garden Sunskink	✓
	Lampropholis guichenoti	Pale-flecked Garden Sunskink	
	Lampropholis sp.	unidentified grass skink	
	Lerista bougainvillii	South-eastern Slider	
	Lygisaurus foliorum	Tree-base Litter-skink	
	Morethia boulengeri	South-eastern Morethia Skink	
	Pseudemoia entrecasteauxii	Tussock Cool-skink	
	Pseudemoia pagenstecheri	Tussock Skink	
	Saiphos equalis	Three-toed Skink	
	Saproscincus mustelinus	Weasel Skink	
	Tiliqua nigrolutea	Blotched Blue-tongue	
	Tiliqua scincoides	Eastern Blue-tongue	✓
Typhlopidae	*Ramphotyphlops nigrescens*	Blackish Blind Snake	
Varanidae	***Varanus rosenbergi***	**Rosenberg's Goanna (V)**	
	Varanus sp.	Unidentified Goanna	
	Varanus varius	Lace Monitor	

Known and Expected Frog List

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Data Source: ✓ = Species recorded during this survey

Family Name	*Scientific Name*	Common Name	Recorded
Hylidae	***Litoria booroolongensis***	**Booroolong Frog (E, E*)**	
	Litoria caerulea	Green Tree Frog	
	Litoria citropa	Blue Mountains Tree Frog	✓
	Litoria dentata	Bleating Tree Frog	✓
	Litoria ewingii	Brown Tree Frog	
	Litoria fallax	Eastern Dwarf Tree Frog	
	Litoria latopalmata	Broad-palmed Frog	
	Litoria lesueuri	Lesueur's Frog	
	Litoria peronii	Peron's Tree Frog	✓
	Litoria phyllochroa	Leaf-green Tree Frog	
	Litoria tyleri	Tyler's Tree Frog	✓
	Litoria verreauxii	Verreaux's Frog	✓
	Litoria wilcoxii		
Myobatrachidae	*Crinia parinsignifera*	Eastern Sign-bearing Froglet	
	Crinia signifera	Common Eastern Froglet	✓
	Heleioporus australiacus	**Giant Burrowing Frog (V, V*)**	
	Limnodynastes dumerilii	Eastern Banjo Frog	✓
	Limnodynastes fletcheri	Long-thumbed Frog	
	Limnodynastes ornatus	Ornate Burrowing Frog	
	Limnodynastes peronii	Brown-striped Frog	✓
	Limnodynastes tasmaniensis	Spotted Grass Frog	✓
	Mixophyes balbus	**Stuttering Frog (E, V*)**	
	Neobatrachus sudelli	Sudell's Frog	
	Pseudophryne australis	**Red-crowned Toadlet (V)**	
	Pseudophryne bibronii	Bibron's Toadlet	
	Pseudophryne sp.		
	Uperoleia laevigata	Smooth Toadlet	

Appendix 4

Flora Species List

Family	Scientific Name	Common Name
Trees		
Fabaceae/faboideae/ Mimosoideae	*Acacia floribunda*	White Sally Wattle
Fabaceae/faboideae/ Mimosoideae	*Acacia melanoxylon*	Blackwood
Fabaceae/faboideae/ Mimosoideae	*Acacia parramattensis*	Sydney Green Wattle
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak
Casuarinaceae	*Allocasuarina nana*	Dwarf She-oak
Cupressaceae	*Callitris endlicheri*	Black Cypress Pine
Cupressaceae	*Callitris rhomboidea*	Port Jackson Cypress
Myrtaceae	*Eucalyptus blaxlandii*	Blaxland's Stringybark
Myrtaceae	*Eucalyptus dalrympleana*	Mountain Gum
Myrtaceae	*Eucalyptus dives*	Broad-leaved Peppermint
Myrtaceae	*Eucalyptus fastigata*	Brown Barrel
Myrtaceae	*Eucalyptus gregsoniana*	-
Myrtaceae	*Eucalyptus mannifera* subsp. *mannifera*	Red-spotted Gum
Myrtaceae	*Eucalyptus oreades*	Blue Mountains Ash
Myrtaceae	*Eucalyptus pauciflora*	Snow Gum
Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint
Myrtaceae	*Eucalyptus radiata*	Narrow-leaved Peppermint
Myrtaceae	*Eucalyptus rubida* subsp. *rubida*	Candlebark
Myrtaceae	*Eucalyptus sclerophylla*	Scribbly Gum
Myrtaceae	*Eucalyptus sieberi*	Silvertop Ash
Myrtaceae	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark
Myrtaceae	*Eucalyptus stricta*	Mallee
Myrtaceae	*Eucalyptus viminalis*	Ribbon Gum
Shrubs		
Fabaceae/faboideae/ Mimosoideae	*Acacia asparagoides*	-
Fabaceae/faboideae/ Mimosoideae	*Acacia dorothea*	Dorothy's wattle
Fabaceae/faboideae/ Mimosoideae	*Acacia leucolobia*	-
Fabaceae/faboideae/ Mimosoideae	*Acacia longifolia var. longifolia*	Sydney Golden Wattle
Fabaceae/faboideae/ Mimosoideae	*Acacia obtusifolia*	Blunt-leaf Wattle
Fabaceae/faboideae/ Mimosoideae	*Acacia terminalis*	Sunshine Wattle
Euphorbiaceae	*Amperea xiphoclada* var. *xiphoclada*	Broom Spurge
Epacridaceae	*Astroloma pinifolium*	Pine Heath
Myrtaceae	*Babingtonia densiflora*	-
Myrtaceae	*Baeckea brevifolia*	-
Myrtaceae	*Baeckea diosmifolia*	Fringed Baekea
Myrtaceae	*Baeckea imbricata*	-

Family	Scientific Name	Common Name
Myrtaceae	*Baeckea linifolia*	Weeping Baeckea
Proteaceae	*Banksia ericifolia* var. *ericifolia*	Heath-leaved Banksia
Proteaceae	*Banksia marginata*	Silver Banksia
Proteaceae	*Banksia paludosa*	Swamp Banksia
Proteaceae	*Banksia penicillata*	-
Proteaceae	*Banksia spinulosa*	Hairpin Banksia
Proteaceae	*Banksia spinulosa* var. *collina*	Hairpin Banksia
Proteaceae	*Banksia spinulosa* var. *spinulosa*	Hairpin Banksia
Baueraceae	*Bauera microphylla*	
Rutaceae	*Boronia microphylla*	Small-leaved Boronia
Rutaceae	*Boronia pinnata*	Pinnate Boronia
Fabaceae/faboideae	*Bossiaea obcordata*	Spiny Bossiaea
Epacridaceae	*Brachyloma daphnoides*	Daphne Heath
Myrtaceae	*Calytrix tetragona*	Common Fringe-Myrtle
Asteraceae	*Cassinia aculeata*	Dolly Bush
Proteaceae	*Conospermum ericifolium*	-
Proteaceae	*Conospermum taxifolium*	Coneseed
Fabaceae/faboideae	*Daviesia latifolia*	-
Fabaceae/faboideae	*Daviesia squarrosa*	-
Scrophulariaceae	***Derwentia blakelyi* syn. *Veronica blakelyi***	-
Fabaceae/faboideae	*Dillwynia brunioides*	-
Fabaceae/faboideae	*Dillwynia elegans*	-
Fabaceae/faboideae	*Dillwynia juniperina*	-
Fabaceae/faboideae	*Dillwynia phylicoides*	-
Fabaceae/faboideae	*Dillwynia rudis*	-
Sapindaceae	*Dodonaea multijuga*	-
Epacridaceae	*Epacris breviflora*	-
Epacridaceae	*Epacris microphylla*	Coral Heath
Fabaceae/faboideae	*Gompholobium huegelii*	Pale Wedge Pea
Fabaceae/faboideae	*Gompholobium latifolium*	Broad-leaf Wedge-pea
Fabaceae/faboideae	*Gompholobium uncinatum*	Red Wedge Pea
Proteaceae	*Grevillea acanthifolia* subsp. *acanthifolia*	Bog Grevillea
Proteaceae	*Grevillea laurifolia*	Laurel-leaf Grevillea
Proteaceae	*Hakea dactyloides*	Broad-leaved Hakea
Proteaceae	*Hakea laevipes* subsp. *laevipes*	-
Proteaceae	*Hakea pachyphylla*	-
Proteaceae	*Hakea propinqua*	Warty Needlebush
Dilleniaceae	*Hibbertia serpyllifolia*	Hairy Guinea Flower
Funkiaceae	*Hovea heterophylla*	-
Fabaceae/faboideae	*Hovea linearis*	-
Proteaceae	*Isopogon anemonifolius*	Flat-leaved Drumsticks
Proteaceae	*Isopogon anethifolius*	Round-leaved Drumsticks
Santalaceae	*Leptomeria acida*	Native Currant
Myrtaceae	*Leptospermum arachnoides*	-
Myrtaceae	*Leptospermum continentale*	Tea-tree

Family	Scientific Name	Common Name
Myrtaceae	*Leptospermum grandifolium*	Wooly Tea-tree
Myrtaceae	*Leptospermum juniperinum*	Prickly Tea-tree
Myrtaceae	*Leptospermum morrisonii*	-
Myrtaceae	*Leptospermum myrtifolium*	-
Myrtaceae	*Leptospermum obovatum*	-
Myrtaceae	*Leptospermum parvifolium*	Small-leaved Tea-tree
Myrtaceae	*Leptospermum polyanthum*	-
Myrtaceae	*Leptospermum polygalifolium* subsp. *polygalifolium*	Tantoon
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree
Epacridaceae	*Leucopogon appressus*	-
Epacridaceae	*Leucopogon fletcheri* subsp. *brevisepalus*	-
Epacridaceae	*Leucopogon fraseri*	-
Epacridaceae	*Leucopogon lanceolatus*	Lance-leaf Beard-heath
Epacridaceae	*Leucopogon microphyllus*	Small-leaved Whitebeard
Epacridaceae	*Leucopogon microphyllus* var. *pilibundus*	-
Epacridaceae	*Leucopogon muticus*	Blunt Beard-heath
Proteaceae	*Lomatia silaifolia*	Crinkle Bush
Celastraceae	*Maytenus silvestris*	Orange Bush
Myrtaceae	*Micromyrtus ciliata*	-
Fabaceae/faboideae	*Mirbelia platylobioides*	-
Epacridaceae	*Monotoca scoparia*	Prickly Broom-heath
Myrtaceae	*Ochrosperma oligomerum*	-
Asteraceae	*Olearia erubescens*	Silky Daisy Bush
Asteraceae	*Olearia quercifolia*	-
Santalaceae	*Omphacomeria acerba*	-
Asteraceae	*Ozothamnus diosmifolius*	Ball Everlasting
Proteaceae	*Persoonia chamaepitys*	Mountain Geebung
Proteaceae	***Persoonia hindii***	**-**
Proteaceae	*Persoonia lanceolata*	Lance-leaved Geebung
Proteaceae	*Persoonia laurina*	Laurel Geebung
Proteaceae	*Persoonia levis*	Broad-leaved Geebung
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung
Proteaceae	*Persoonia mollis* subsp. *mollis*	-
Proteaceae	*Persoonia myrtilloides* subsp. *myrtilloides*	-
Proteaceae	*Persoonia recedens*	-
Proteaceae	*Petrophile canescens*	Conesticks
Proteaceae	*Petrophile pulchella*	Conesticks
Proteaceae	*Petrophile sessilis*	Conesticks
Rutaceae	*Phebalium squamulosum* subsp. *squamulosum*	Forest Phebalium
Rutaceae	*Philotheca obovalis*	-
Euphorbiaceae	*Phyllanthus hirtellus*	Thyme Spurge
Fabaceae/faboideae/Faboideae	*Phyllota phylicoides*	Heath Phyllota
Fabaceae/faboideae/Faboideae	*Phyllota squarrosa*	Dense Phyllota

Family	Scientific Name	Common Name
Pittosporaceae	*Rhytidosporum procumbens*	-
Fabaceae/faboideae	*Platylobium formosum*	Handsome Flat-pea
Apiaceae	*Platysace lanceolata*	Lance-leaf Platysace
Apiaceae	*Platysace linearifolia*	Narrow-leafed Platysace
Fabaceae/faboideae	*Podolobium ilicifolium*	Prickly Shaggy Pea
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax
Rhamnaceae	*Pomaderris andromedifolia*	-
Lamiaceae	*Prostanthera granitica*	Granite Mintbush
Lamiaceae	*Prostanthera decussata*	Dense Mintbush
Fabaceae/faboideae	*Pultenaea canescens*	Plumed Bush-Pea
Fabaceae/faboideae	*Pultenaea ferruginea*	-
Fabaceae/faboideae	*Pultenaea tuberculata*	-
Tremandraceae	*Tetratheca rubioides*	-
Tremandraceae	*Tetratheca rupicola*	-
Groundcovers		
Poaceae	*Aristida ramosa*	Purple Wiregrass
Asteraceae	*Arrhenechthites mixta*	Purple Fireweed
Poaceae	*Rytidosperma tenuius*	Wallaby Grass
Poaceae	*Austrostipa pubescens*	Tall Speargrass
Poaceae	*Austrostipa scabra* subsp. *scabra*	Speargrass
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern
Orchidaceae	*Caladenia carnea*	Pink Finger Orchid
Cyperaceae	*Carex inversa*	Knob Sedge
Cyperaceae	*Caustis flexuosa*	Curly Wig
Centrolepidaceae	*Centrolepis fascicularis*	-
Asteraceae	*Coronidium scorpioides*	-
Orchidaceae	*Cryptostylis subulata*	Large Tongue Orchid
Goodeniaceae	*Dampiera stricta*	Blue Dampiera
Poaceae	*Deyeuxia parviseta*	
Phormiaceae	*Dianella caerulea* var. *caerulea*	Flax Lily
Phormiaceae	*Dianella longifolia* var. *longifolia*	Blue Flax Lily
Phormiaceae	*Dianella revoluta* var. *revoluta*	Spreading Flax Lily
Poaceae	*Dichelachne rara*	Rare Plume Grass
Convolvulaceae	*Dichondra repens*	Kidney Weed
Orchidaceae	*Dipodium punctatum*	Hyacinth Orchid
Droseraceae	*Drosera binata*	Forked Sundew
Droseraceae	*Drosera burmanii*	-
Poaceae	*Entolasia stricta*	Wiry Panic
Epacridaceae	*Epacris paludosa*	Swamp Epacris
Cyperaceae	*Gahnia filifolia*	-
Cyperaceae	*Gahnia microstachya*	-
Cyperaceae	*Gahnia sieberiana*	Red-fruited Saw-sedge
Rubiaceae	*Galium leiocarpum*	*Bedstraw*
Gleicheniaceae	*Gleichenia dicarpa*	Pouched Coral Fern
Haloragaceae	*Gonocarpus micranthus* subsp. *micranthus*	Creeping Rasptwort

Family	Scientific Name	Common Name
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort
Haloragaceae	*Gonocarpus teucroides*	Raspwort
Goodeniaceae	*Goodenia bellidifolia*	Daisy-leaved Goodenia
Haemodoraceae	*Haemodorum planifolium*	Bloodroot
Dilleniaceae	*Hibbertia empetrifolia* subsp. *empetrifolia*	-
Dilleniaceae	*Hibbertia monogyna*	-
Dilleniaceae	*Hibbertia obtusifolia*	Grey Guinea Flower
Violaceae	*Hybanthus monopetalus*	Slender Violet
Clusiaceae	*Hypericum gramineum*	Small St Johns Wort
Restionaceae	*Hypolaena fastigiata*	Tassel Rope-rush
Poaceae	*Rytidosperma pallidum*	Silvertop Wallaby Grass
Cyperaceae	*Lepidosperma filiforme*	-
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge
Cyperaceae	*Lepidosperma tortuosum*	-
Restionaceae	*Lepyrodia scariosa*	Scale Rush
Asteraceae	*Leucochrysum graminifolium*	Pagoda Rock Daisy
Lindsaeaceae	*Lindsaea linearis*	Screw Fern
Lomandraceae	*Lomandra confertifolia*	-
Lomandraceae	*Lomandra confertifolia* subsp. *pallida*	-
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*	Wattle Mat-rush
Lomandraceae	*Lomandra glauca*	Pale Mat-rush
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Lomandraceae	*Lomandra multifora*	Many-flowered Mat-rush
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Rice Grass
Orchidaceae	*Microtis parviflora*	Slender Onion Orchid
Loganiaceae	*Mitrasacme polymorpha*	Mitrewort
Loganiaceae	*Mitrasacme serpyllifolia*	-
Poaceae	*Oplismenus imbecillis*	-
Poaceae	*Panicum simile*	Two Colour Panic
Iridaceae	*Patersonia fragilis*	Wild Iris
Iridaceae	*Patersonia glabrata*	Leafy Purple-flag
Iridaceae	*Patersonia longifolia*	Dwarf Purple Flag
Iridaceae	*Patersonia sericea*	Wild Iris
Thymelaeaceae	*Pimelea latifolia*	-
Thymelaeaceae	*Pimelea linifolia* subsp. *linifolia*	Slender Rice Flower
Poaceae	*Poa labillardieri* var. *labillardieri*	Tussock Grass
Poaceae	*Poa sieberiana* var. *sieberiana*	Tussock Grass
Rubiaceae	*Pomax umbellata*	Pomax
Euphorbiaceae	*Poranthera microphylla*	-
Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Cyperaceae	*Ptilothrix deusta*	-
Cyperaceae	*Schoenus moorei*	-
Asteraceae	*Solenogyne bellioides*	-
Anthericaceae	*Sowerbaea juncea*	Vanilla Plant
Caryophyllaceae	*Stellaria pungens*	Prickly Starwort

Family	Scientific Name	Common Name
Gleicheniaceae	*Sticherus flabellatus*	Umbrella Fern
Stylidiaceae	*Stylidium graminifolium*	Grass Trigger Plant
Stylidiaceae	*Stylidium lineare*	Narrow-leaved Trigger Plant
Stylidiaceae	*Stylidium productum*	Trigger Plant
Epacridaceae	*Stypandra glauca*	Nodding Blue Lily
Tremandraceae	*Tetratheca rupicola*	Black-eyed Susan
Phormiaceae	*Thelionema caespitosum*	Tufted Blue Lily
Anthericaceae	*Thysanotus tuberosus* subsp. *tuberosus*	Fringed Lily
Osmundaceae	*Todea barbara*	King Fern
Lentibulariaceae	*Utricularia dichotoma*	-
Violaceae	*Viola betonicifolia*	Native Violet
Violaceae	*Viola hederacea*	Ivy-leaved Violet
Violaceae	*Viola silicestris*	Sandstone Violet
Campanulaceae	*Wahlenbergia littoricola*	Bluebell
Xanthorrhoaceae	*Xanthorrhoea media*	Forest Grass Tree
Apiaceae	*Xanthosia dissecta*	-
Apiaceae	*Xanthosia pilosa*	Woolly Xanthosia
Xyridaceae	*Xyris gracilis*	Slender Yellow-eye
Xyridaceae	*Xyris juncea*	Dwarf Yellow-eye
Xyridaceae	*Xyris usitatus*	-
Climbers		
Pittosporaceae	*Billardiera scandens*	Hairy Appleberry
Pittosporaceae	*Billardiera mutabilis*	Climbing Appleberry
Lauraceae	*Cassytha pubescens*	Common Devil's Twine
Ranunculaceae	*Clematis glycinoides* var. *glycinoides*	Headache Vine
Fabaceae/faboideae	*Hardenbergia violacea*	False Sarsparilla
Water plants		
Cyperaceae	*Baumea rubiginosa*	Twig Rush
Restionaceae	*Empodisma minus*	-
Poaceae	*Paspalum distichum*	Water Couch
Restionaceae	*Baloskion australe*	-
Cyperaceae	*Gymnoschoenus sphaerocephalus*	Button Grass
Juncaceae	*Juncus flavidus*	-
Juncaceae	*Juncus pallidus*	-
Cyperaceae	*Lepidosperma gunnii*	-
Cyperaceae	*Lepidosperma limicola*	-
Cyperaceae	*Schoenus ericetorum*	Heath Bog-rush

Species in **Bold** are listed as Threatened Species within the *TSC Act* (1995) and/or the *EPBC Act* (1999).

V = Listed as a Vulnerable Species within the TSC Act (1995)

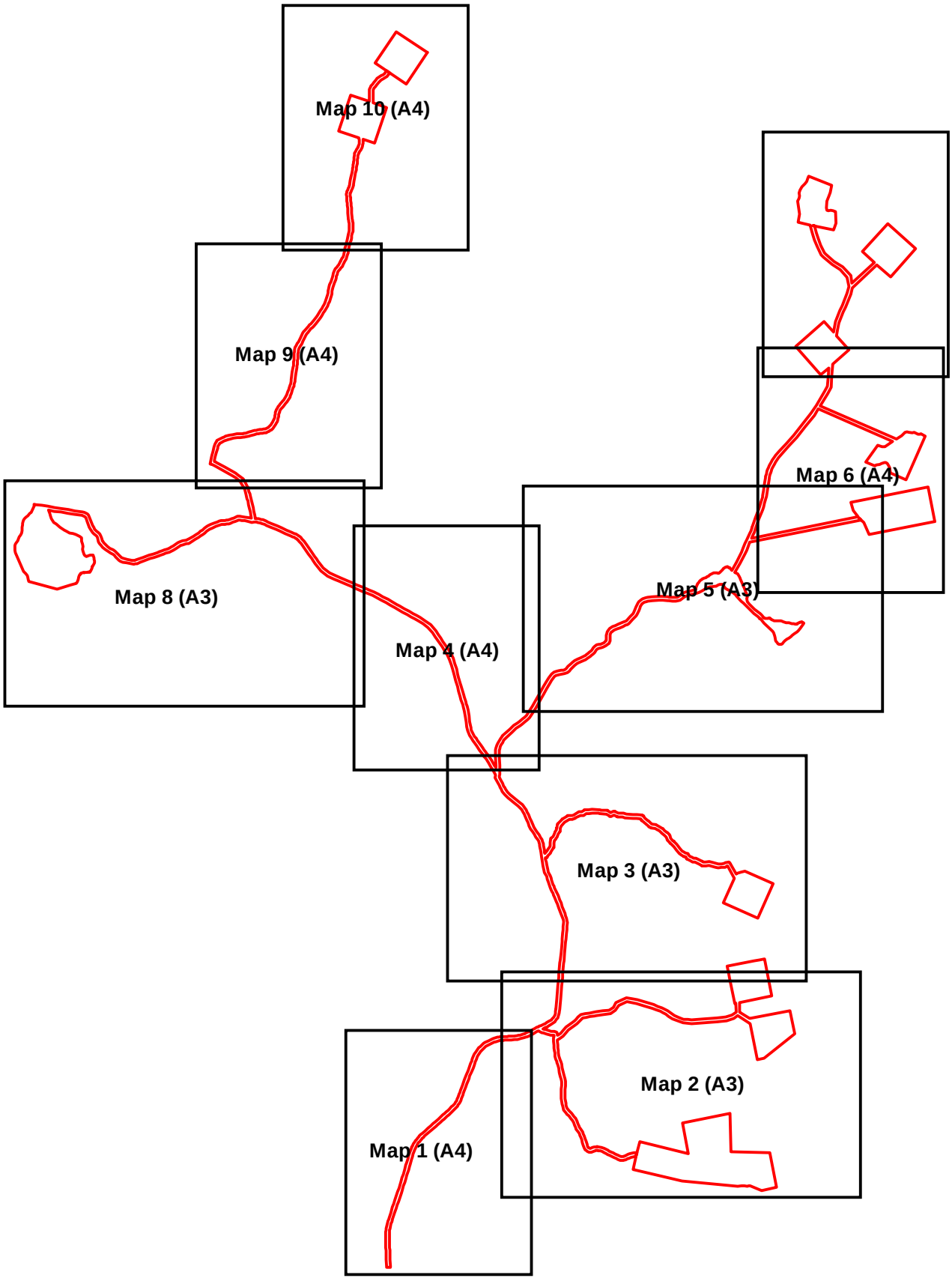
E = Listed as an Endangered Species within the TSC Act (1995)

V* = Listed as a Vulnerable Species within the EPBC Act (1999)

E* = Listed as an Endangered Species within the EPBC Act (1999)

Appendix 5

Avoidance Mapping



0 500 1,000
metres

SCALE: 1:30,000 AT A4

TITLE: ANGUS PLACE AVOIDANCE CONSIDERATIONS
LOCATION: ANGUS PLACE COLLIERY
DATUM: DATUM
PROJECTION: MGA ZONE 56
DATE: 09/02/2014
PURPOSE: CONSTRAINTS ANALYSIS
LAYOUT REF: 110328 Angus Place - Major Extension\10. Drafting\Workspaces\Avoidance Mapping
VERSION (PLAN BY): PH (B-A4)

CLIENT: CENTENNIAL ANGUS PLACE
JOB REF: 110328

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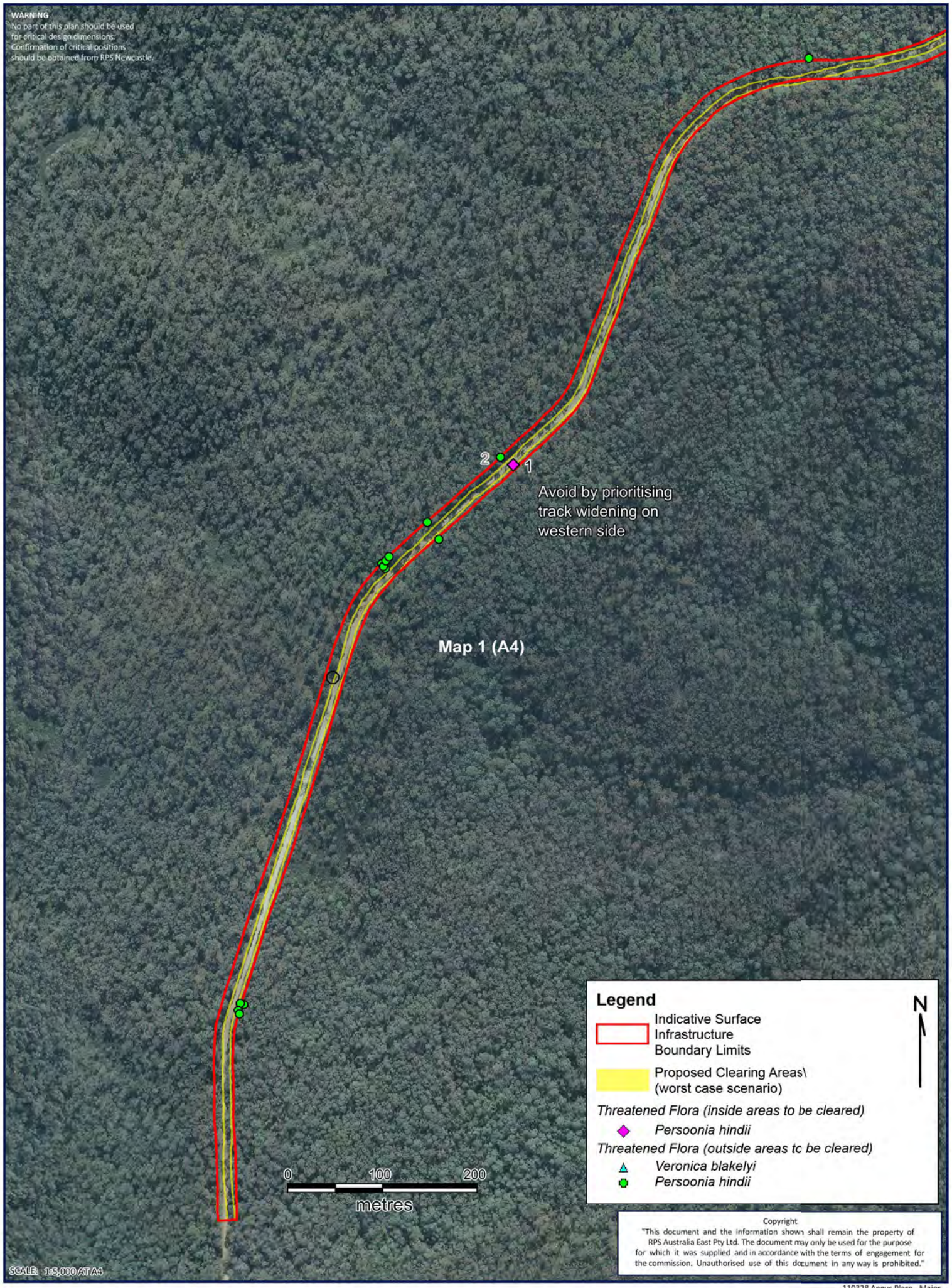

TITLE: MAP 1: ANGUS PLACE AVOIDANCE CONSIDERATIONS
LOCATION: ANGUS PLACE COLLIERY
DATUM: DATUM
PROJECTION: MGA ZONE 56
DATE: 09/02/2014
PURPOSE: CONSTRAINTS ANALYSIS
LAYOUT REF: 110328 Angus Place - Major Extension\10. Drafting\Workspaces\Avoidance Mapping
VERSION (PLAN BY): PH (C-A4)

CLIENT: CENTENNIAL ANGUS PLACE
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WARNING
No part of this map should be used for precise design dimensions. Confirmation of cultural constraints should be obtained from RPS Newcastle.

Alternate Location

2

Avoid by prioritising track widening on western side

Legend

- Indicative Surface Infrastructure Boundary Limits
- Proposed Clearing Areas (worst case scenario)

Threatened Flora (inside areas to be cleared)

- *Persoonia pidii*

Threatened Flora (outside areas to be cleared)

- *Persoonia pidii*

N

Map 2 (A3)

0 200 400

metres

SCALE: 1:5,000 AT A3

TITLE:	MAP 2: ANGUS PLACE AVOIDANCE CONSIDERATIONS	LOCATION:	ANGUS PLACE COLLIERY	DATUM: PROJECTION:	DATUM MGA ZONE 56	DATE: PURPOSE:	09/02/2014 CONSTRAINTS ANALYSIS
LAYOUT REF: VERSION (PLAN BY):	110328 Angus Place - Major Extension\10. Drafting\Workspaces\Avoidance Mapping PH (C-A3)						

CLIENT: CENTENNIAL ANGUS PLACE
JOB REF: 110328

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Legend

- Indicative Proposed Surface Infrastructure Boundary
- Proposed Clearing Areas
- MU51 Newnes Plateau Hanging Swamp (EEC)

N

Alternate access chosen to avoid Hanging Swamp

Map 3 (A3)

Hanging Swamp Avoided

SCALE: 1:5,000 AT A3

TITLE:	MAP 3: ANGUS PLACE AVOIDANCE CONSIDERATIONS	LOCATION:	ANGUS PLACE COLLIERY	DATUM: PROJECTION:	DATUM MGA ZONE 56	DATE: PURPOSE:	02/09/2013 CONSTRAINTS ANALYSIS

LAYOUT REF: 110328 Angus Place - Major Extension\10. Drafting\Workspaces\Avoidance Mapping
VERSION (PLAN BY): PH (D-A3)

CLIENT: CENTENNIAL ANGUS PLACE
JOB REF: 110328

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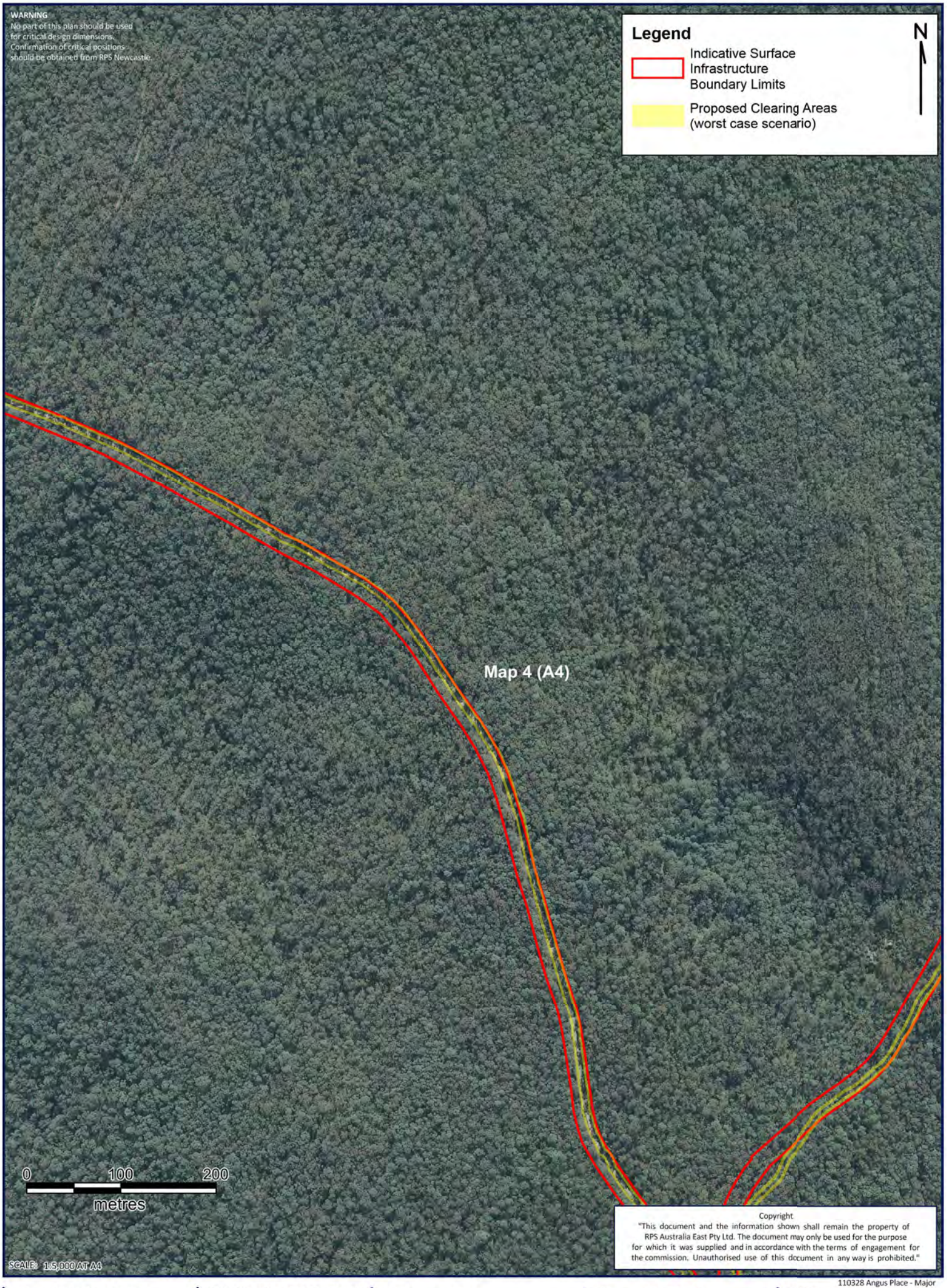

TITLE:	MAP 4: ANGUS PLACE AVOIDANCE CONSIDERATIONS	LOCATION:	ANGUS PLACE COLLIERY	DATUM:	DATUM	DATE:	02/09/2013
				PROJECTION:	MGA ZONE 56	PURPOSE:	CONSTRAINTS ANALYSIS

LAYOUT REF: 110328 Angus Place - Major Extension\10. Drafting\Workspaces\Avoidance Mapping

VERSION (PLAN BY): PH (B-A4)

CLIENT: CENTENNIAL ANGUS PLACE
JOB REF: 110328

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WARNING:
No part of this plan should be used for actual design purposes. Confirmation of cadastral positions should be obtained from RPS Newcastle.

Alternate Location

Map 5 (A3)

0 200 400
metres

SCALE: 1:5,000 AT A3

Legend

- Indicative Surface Infrastructure Boundary Limits
- Proposed Clearing Areas (worst case scenario)

N

TITLE: MAP 5: ANGUS PLACE AVOIDANCE CONSIDERATIONS

LOCATION: ANGUS PLACE COLLIERY

DATUM: DATUM
PROJECTION: MGA ZONE 56

DATE: 02/09/2013
PURPOSE: CONSTRAINTS ANALYSIS

LAYOUT REF: 110328 Angus Place - Major Extension\10. Drafting\Workspaces\Avoidance Mapping
VERSION (PLAN BY): PH (B-A3)

CLIENT: CENTENNIAL ANGUS PLACE
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TITLE:	MAP 6: ANGUS PLACE AVOIDANCE CONSIDERATIONS	LOCATION:	ANGUS PLACE COLLIERY	DATUM: / PROJECTION:	DATUM / MGA ZONE 56	DATE: / PURPOSE:	02/09/2013 / CONSTRAINTS ANALYSIS

LAYOUT REF: 110328 Angus Place - Major Extension\10. Drafting\Workspaces\Avoidance Mapping

VERSION (PLAN BY): PH (B-A4)

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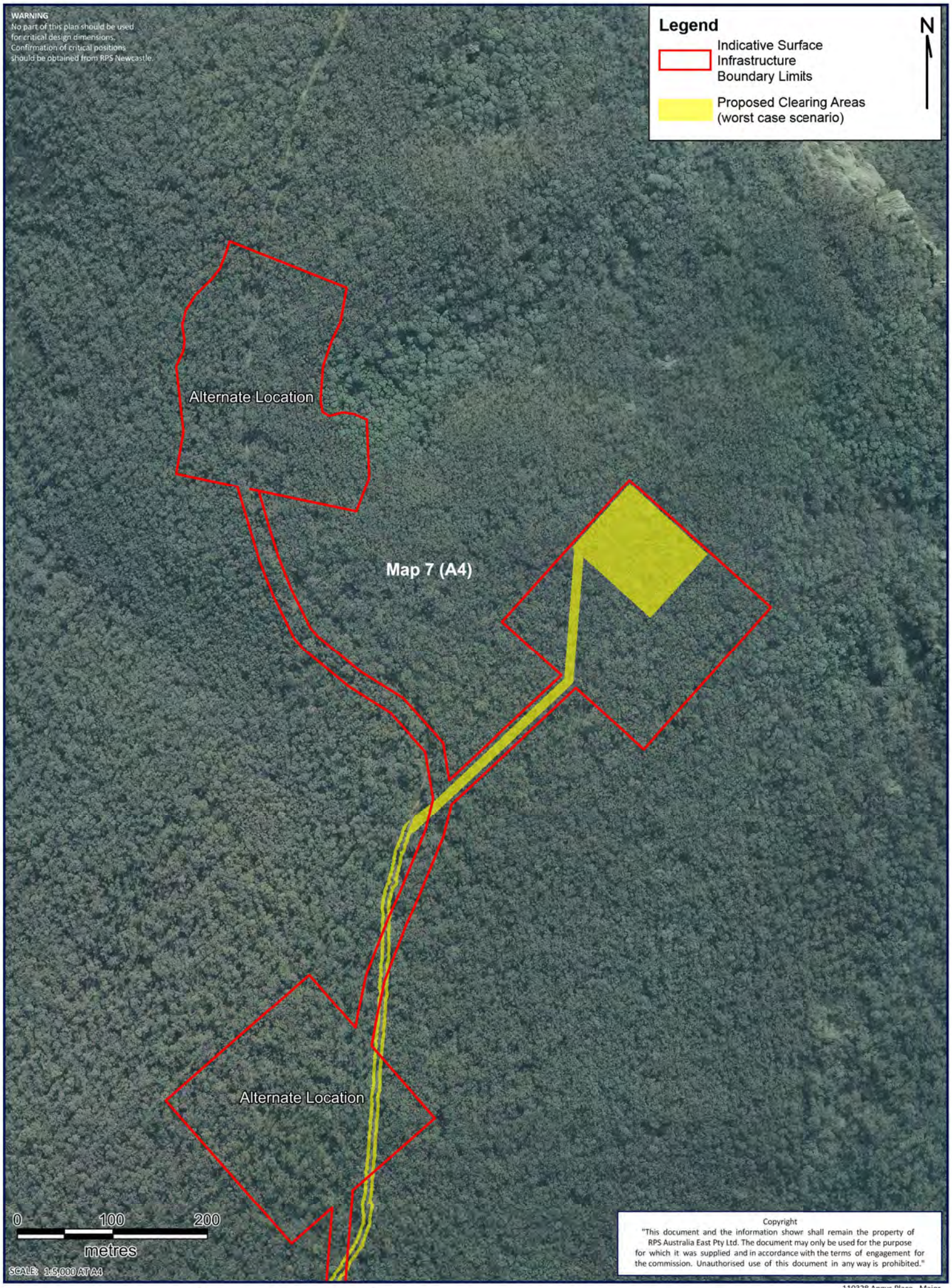

TITLE:	MAP 7: ANGUS PLACE AVOIDANCE CONSIDERATIONS	LOCATION:	ANGUS PLACE COLLIERY	DATUM: / PROJECTION:	DATUM / MGA ZONE 56	DATE: / PURPOSE:	02/09/2013 / CONSTRAINTS ANALYSIS

LAYOUT REF: 110328 Angus Place - Major Extension\10. Drafting\Workspaces\Avoidance Mapping

VERSION (PLAN BY): PH (B-A4)

CLIENT: CENTENNIAL ANGUS PLACE
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WARNING
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Legend

- Indicative Surface Infrastructure Boundary Limits
- Proposed Clearing Areas (worst case scenario)

N

Steep slope. Consider avoiding.

Map 8 (A3)

0 200 400

metres

SCALE: 1:5,000 AT A3

TITLE:	MAP 8: ANGUS PLACE AVOIDANCE CONSIDERATIONS	LOCATION:	ANGUS PLACE COLLIERY	DATUM: PROJECTION:	DATUM MGA ZONE 56	DATE: PURPOSE:	02/09/2013 CONSTRAINTS ANALYSIS
LAYOUT REF: VERSION (PLAN BY):	110328 Angus Place - Major Extension\10. Drafting\Workspaces\Avoidance Mapping PH (B-A3)						

CLIENT: CENTENNIAL ANGUS PLACE
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TITLE: MAP 9: ANGUS PLACE AVOIDANCE CONSIDERATIONS
LOCATION: ANGUS PLACE COLLIERY
DATUM: DATUM
PROJECTION: MGA ZONE 56
DATE: 02/09/2013
PURPOSE: CONSTRAINTS ANALYSIS
LAYOUT REF: 110328 Angus Place - Major Extension\10. Drafting\Workspaces\Avoidance Mapping
VERSION (PLAN BY): PH (B-A4)

CLIENT: CENTENNIAL ANGUS PLACE
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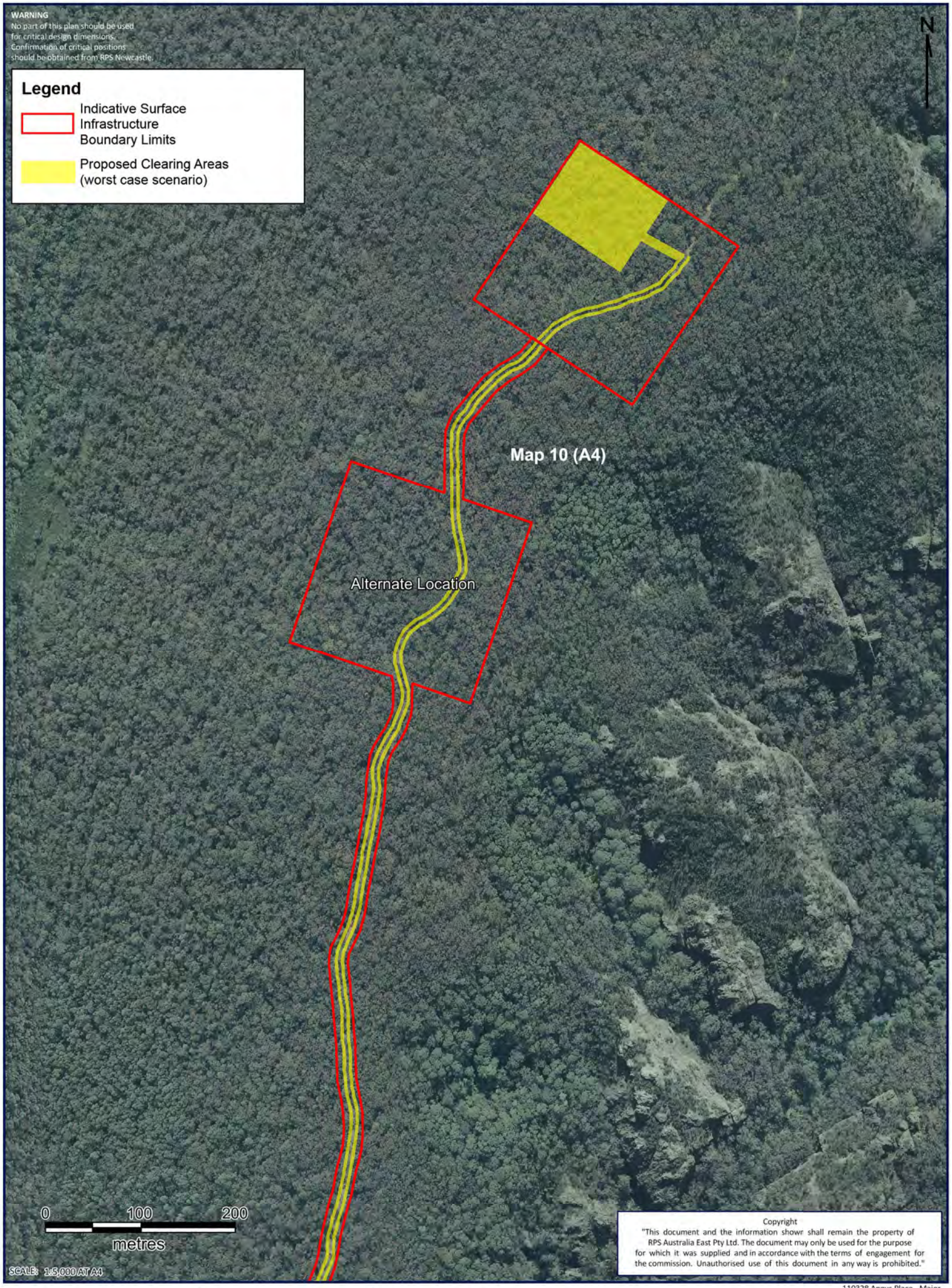

TITLE:	MAP 10: ANGUS PLACE AVOIDANCE CONSIDERATIONS	LOCATION:	ANGUS PLACE COLLIERY	DATUM: PROJECTION:	DATUM MGA ZONE 56	DATE: PURPOSE:	02/09/2013 CONSTRAINTS ANALYSIS

LAYOUT REF: 110328 Angus Place - Major Extension\10. Drafting\Workspaces\Avoidance Mapping
VERSION (PLAN BY): PH (B-A4)

CLIENT: CENTENNIAL ANGUS PLACE
JOB REF: 110328

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Appendix 6

Anabat Report

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ABN: 71 063 148 186

BAT CALL ANALYSIS REPORT
Angus Place, NSW
RPS Australia East Pty Ltd

24 June 2012

Job Reference: A020

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

This report was authored by

Anna McConville
B.Env.Sc.

Table of Contents

1.0 INTRODUCTION

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

2.0 METHODS

The identification of bat echolocation calls recorded during surveys was undertaken using AnalookW (Version 3.8m) software. The identification of calls was undertaken with reference to Pennay and others (2004) and through the comparison of recorded reference calls from north-eastern NSW and the Sydney Basin. Reference calls were obtained from the NSW database and from the authors personal collection.

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

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

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

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

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

Description of the Characteristics Used to Differentiate Species

Chalinolobus gouldii was differentiated from *Mormopterus* species 2 by the presence of mainly curved alternating pulses calls. *Miniopterus schreibersii oceanensis* was identified to a probable level from *Vespadelus regulus* in good call sequences by the presence of uneven consecutive pulses, those with even pulses were assigned to *Vespadelus regulus* at a probable level.

Vespadelus darlingtoni was differentiated from other species at a probable level on the basis of characteristic frequency. *Vespadelus vulturnus* was identified from *Chalinolobus morio* by the absence of a down-sweeping tail.

3.0 RESULTS

A total of 5903 call sequences were recorded, of which 4779 call sequences were able to be analysed (ie were not 'noise' files or bat calls of short length). Of the bat calls, 642 call sequences (13%) were able to be confidently identified (those classified as either definite or probable identifications) to species level (Table 1). Species recorded confidently within the site include:

- *Chalinolobus dwyeri* (Large-eared pied bat)
- *Chalinolobus gouldii* (Gould's wattled bat)
- *Chalinolobus morio* (Chocolate wattled bat)
- *Miniopterus schreibersii oceanensis* (Eastern bentwing bat)
- *Saccolaimus flaviventris* (Yellow-bellied sheathtail bat)
- *Tadarida australis* (White-striped freetail bat)
- *Vespadelus darlingtoni* (Large forest bat)
- *Vespadelus regulus* (Southern forest bat)
- *Vespadelus vulturnus* (Little forest bat)

Additional bat species that are known to exist within the locality of the site, but could not be confidently identified to species (those classified as possible or as a species group), include:

- *Falsistrellus tasmaniensis* (Eastern falsistrelle)
- *Mormopterus* species 2 (Eastern freetail bat)
- *Scoteanax rueppellii* (Greater broad-nosed bat)
- *Scotorepens orion* (Eastern broad-nosed bat)

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

Table 1 below summarises the results of the bat call analysis

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

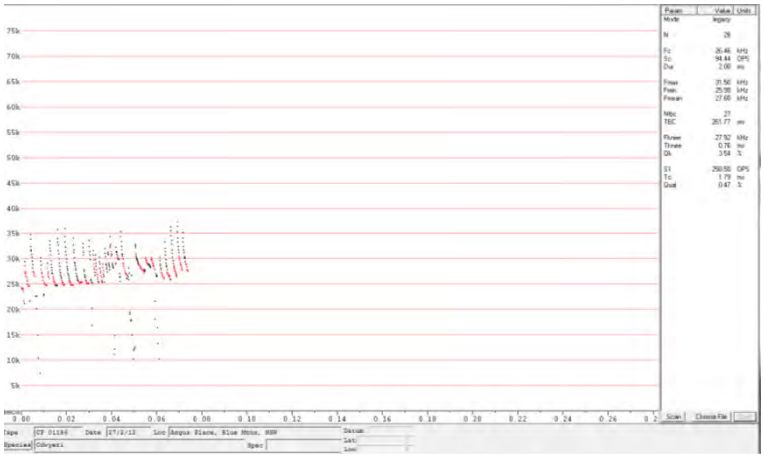
IDENTIFICATION	Anabat 1 20120227 27/02/2012	Anabat 1 20120227 28/02/2012	Anabat 1 20120228 29/02/2012	Anabat 1 20120228 1/03/2012	Anabat 2 20120227 27/02/2012	Anabat 2 20120227 28/02/2012	Anabat 2 20120228 29/02/2012	Anabat 2 20120228 1/03/2012
DEFINITE								
Chalinolobus dwyeri	-	-	-	-	10	22	31	2
Chalinolobus gouldi	-	-	-	-	22	3	15	1
Chalinolobus morio	-	-	-	-	35	6	5	-
Saccolaimus flaviventris	-	-	-	-	1	-	-	-
Tadarida australis	1	1	1	1	14	10	10	13
Vespadelus vulturnus	-	-	-	-	1	1	-	-
PROBABLE								
Chalinolobus dwyeri	-	-	-	-	11	8	18	-
Chalinolobus gouldi	-	-	-	-	11	-	3	-
Chalinolobus morio	2	-	-	-	17	8	6	-
Miniopterus schreibersii oceanensis	-	-	-	-	1	1	-	-
Tadarida australis	1	1	-	1	3	5	2	-
Vespadelus darlingtoni	65	15	1	3	78	41	92	27

IDENTIFICATION	Anabat 1 20120227 27/02/2012	Anabat 1 20120227 28/02/2012	Anabat 1 20120228 29/02/2012	Anabat 1 20120228 1/03/2012	Anabat 2 20120227 27/02/2012	Anabat 2 20120227 28/02/2012	Anabat 2 20120228 29/02/2012	Anabat 2 20120228 1/03/2012
Vespadelus regulus	-	-	-	-	-	1	-	-
Vespadelus vulturnus	-	-	-	-	4	9	-	1
POSSIBLE								
Chalinolobus dwyeri	2	-	-	-	7	10	3	3
Chalinolobus gouldii	-	-	-	-	3	2	-	-
Chalinolobus morio	-	-	-	-	4	3	1	1
Tadarida australis	-	-	-	-	1	-	1	-
Vespadelus darlingtoni	26	19	7	-	7	3	12	3
Vespadelus vulturnus	-	-	-	-	3	2	-	-
SPECIES GROUPS								
Chalinolobus gouldii / Mormopterus species 2	-	-	-	-	65	15	51	16
Chalinolobus morio / Vespadelus vulturnus	11	-	16	-	56	45	17	16
Falsistrellus tasmaniensis / Scotorepens orion	5	2	2	1	27	12	10	8
Falsistrellus tasmaniensis / Scotorepens orion / Scoteanax rueppellii	1	1	1	-	18	8	5	3
Miniopterus schreibersii oceanensis / Vespadelus regulus	32	48	226	59	117	140	53	18

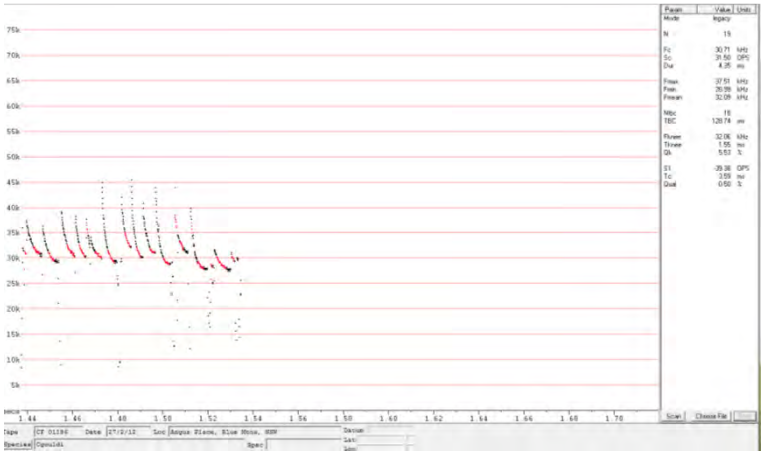
IDENTIFICATION	Anabat 1 20120227 27/02/2012	Anabat 1 20120227 28/02/2012	Anabat 1 20120228 29/02/2012	Anabat 1 20120228 1/03/2012	Anabat 2 20120227 27/02/2012	Anabat 2 20120227 28/02/2012	Anabat 2 20120228 29/02/2012	Anabat 2 20120228 1/03/2012
Vespadelus darlingtoni / Vespadelus regulus	267	407	580	253	251	334	395	422
UNKNOWN								
Unknown	167	211	107	198	121	152	57	42
'Noise' files	4	-	14	-	3	-	42	6
TOTAL	**584**	**705**	**955**	**516**	**891**	**841**	**829**	**582**
Time of calls recorded (does not necessarily translate to survey effort, simply when calls were recorded)	**Entire Night**	**Entire Night**	**Entire Night**	**Entire Night**	**Entire Night**	**Entire Night**	**Entire Night**	**Entire Night**

4.0 SAMPLE CALLS

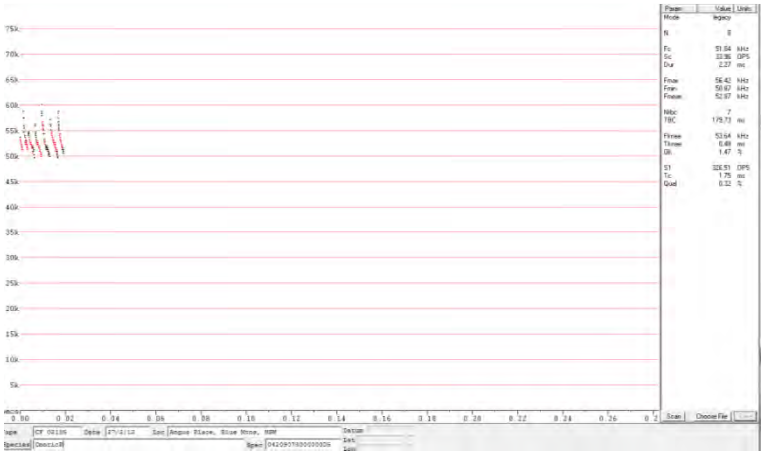
A sample of the calls actually identified from the site for each species is given below.



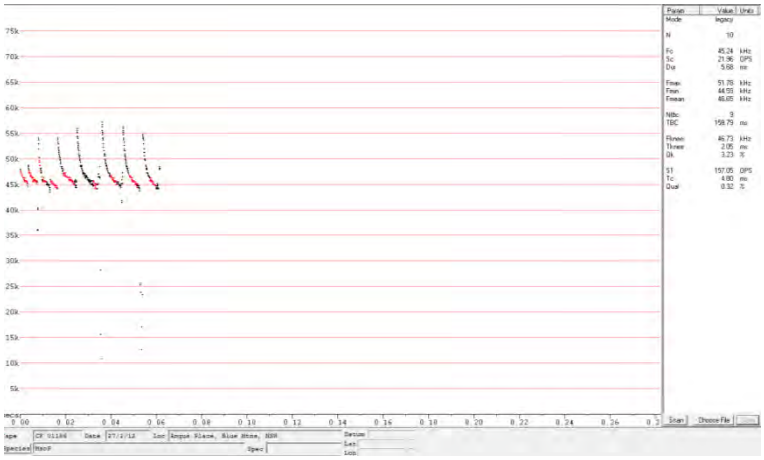
Chalinolobus dwyeri – Definite call



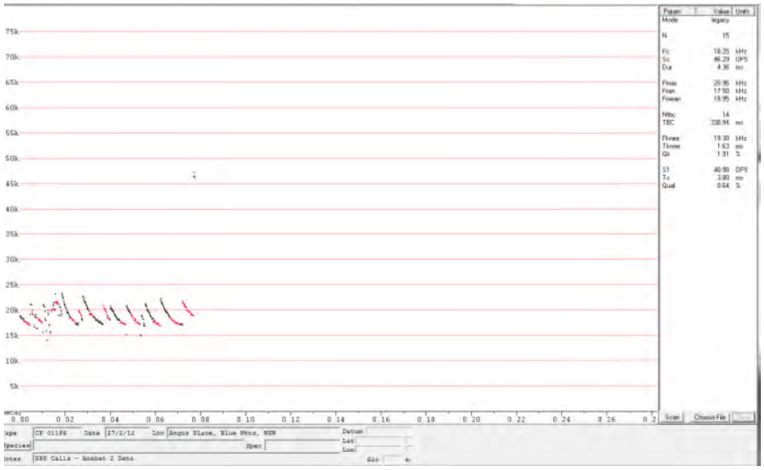
Chalinolobus gouldii – Definite Call



Chalinolobus morio – Probable Call

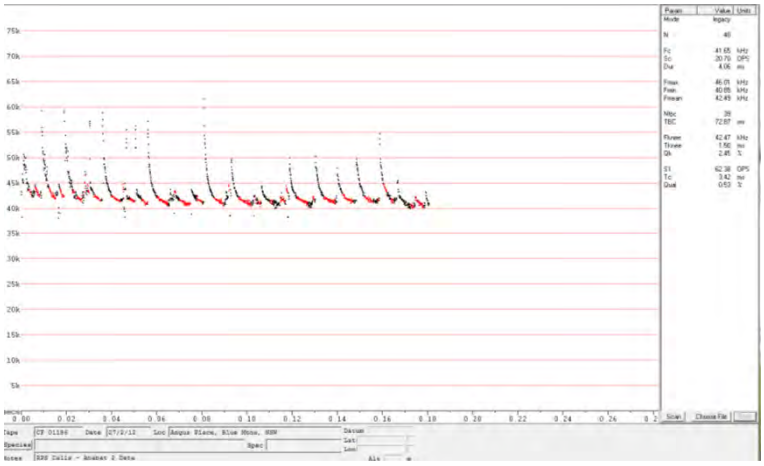


Miniopterus schreibersii oceanensis – Probable call

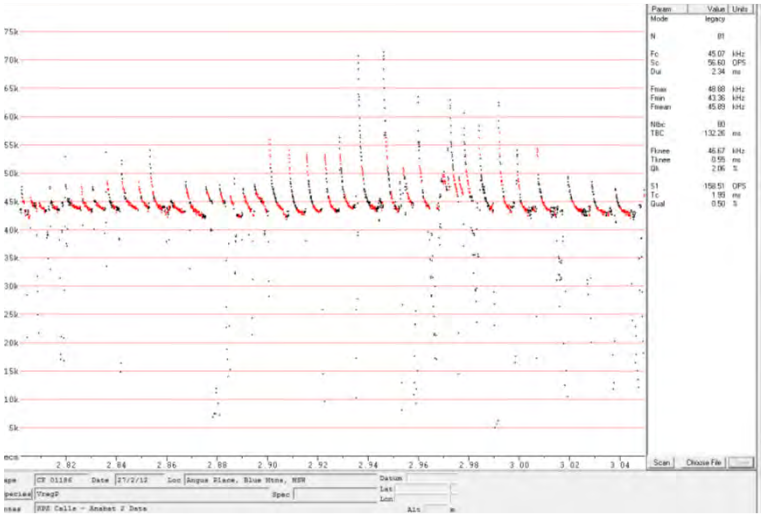


Saccolaimus flaviventris – Definite call

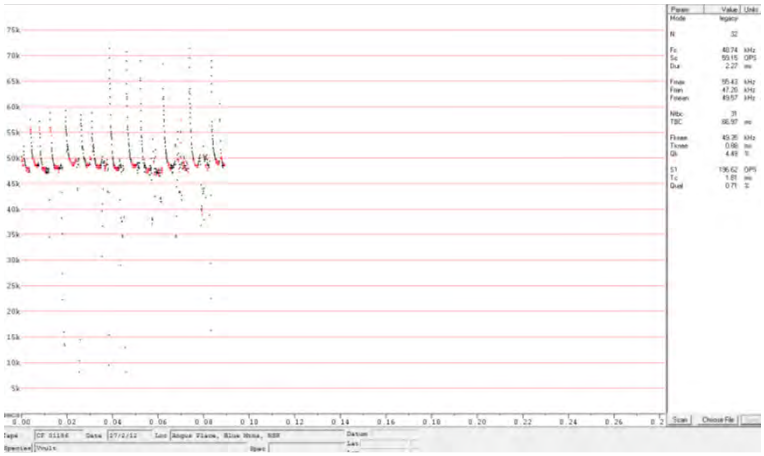
Tadarida australis – Definite Call



Vespadelus darlingtoni – Probable call



Vespadelus regulus – Probable call



Vespadelus vulturnus – Definite call

5.0 REFERENCES

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BAT CALL ANALYSIS REPORT
Angus Place, NSW
RPS Australia East Pty Ltd

6 March 2013

Job Reference: A020

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

This report was authored by

Anna McConville
B.Env.Sc.

Table of Contents

1.0 INTRODUCTION

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

2.0 METHODS

The identification of bat echolocation calls recorded during surveys was undertaken using AnalookW (Version 3.8m) software. The identification of calls was undertaken with reference to Pennay and others (2004) and through the comparison of recorded reference calls from north-eastern NSW and the Sydney Basin. Reference calls were obtained from the NSW database and from the authors personal collection.

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

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

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

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

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

Description of the Characteristics Used to Differentiate Species

Chalinolobus gouldii was differentiated from *Mormopterus* Species 2 by the presence of curved alternating calls. *Nyctophilus* species was able to be differentiated from *Myotis macropus* such as pulse interval less than 75ms or greater than 95 ms, the absence of a central kink and slope between 300-400 OPS.

Calls 40 - 42 kHz were identified as *Vespadelus darlingtoni* at a probable level. *Miniopterus schreibersii oceanensis* was identified from *Vespadelus regulus* by even consecutive pulses with down-sweeping tails. *Chalinolobus morio* was identified from *Vespadelus vulturnus* by the presence of a down-sweeping tail.

3.0 RESULTS

A total of 12,114 call sequences were recorded, of which 5,873 call sequences were able to be analysed (ie were not 'noise' files or bat calls of short length). Of the bat calls, 545 call sequences (9%) were able to be confidently identified (those classified as either definite or probable identifications) to species level (Table 1). Species recorded confidently within the site include:

- *Chalinolobus dwyeri* (Large-eared pied bat)
- *Chalinolobus gouldii* (Gould's wattled bat)
- *Chalinolobus morio* (Chocolate wattled bat)
- *Miniopterus schreibersii oceanensis* (Eastern bentwing bat)
- *Rhinolophus megaphyllus* (Eastern horseshoe bat)
- *Tadarida australis* (White-striped freetail bat)
- *Vespadelus darlingtoni* (Large forest bat)
- *Vespadelus regulus* (Southern forest bat)
- *Vespadelus vulturnus* (Little forest bat)

Additional bat species that are known to exist within the locality of the site, but could not be confidently identified to species (those classified as possible or as a species group), include:

- *Falsistrellus tasmaniensis* (Eastern falsistrelle)
- *Miniopterus schreibersii oceanensis* (Eastern bentwing bat)
- *Mormopterus* species 2 (Eastern freetail bat)
- *Myotis macropus* (Large-footed myotis)
- *Nyctophilus geoffroyi* (Lesser long-eared bat)
- *Nyctophilus gouldi* (Gould's long-eared bat)
- *Scotorepens orion* (Eastern broad-nosed bat)

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

Table 1 below summarises the results of the bat call analysis

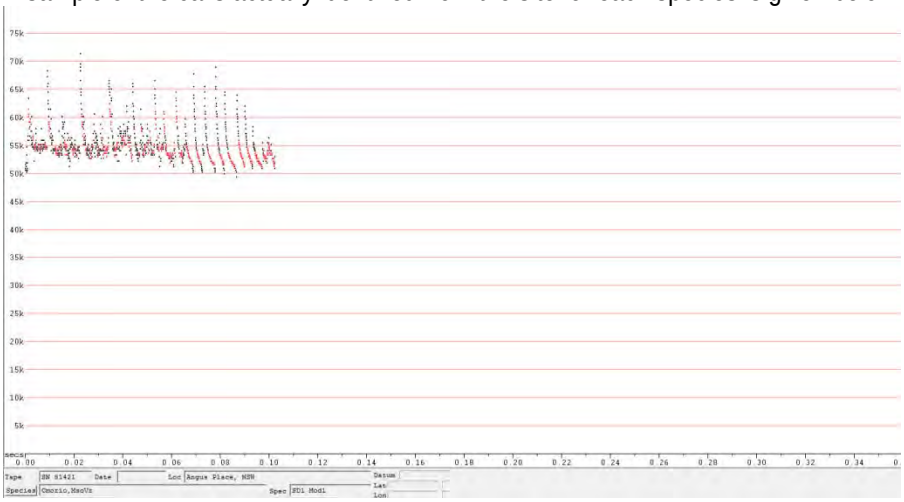
Table 1: Results of bat call analysis (number of passes per site per night)

IDENTIFICATION	Anabat data 071212 LV BS, 3rd location, 20121203, 03/12/2012	Anabat data 071212 LV BS, 3rd location, 20121203, 04/12/2012	Anabat data 071212 LV BS, 3rd location, 20121204, 04/12/2012	Anabat data 071212 LV BS, 3rd location, 20121204, 05/12/2012	Anabat data 071212 LV BS, 3rd location, 20121204, 06/12/2012	Anabat data 071212 LV BS, Anabat 3, 20121203, 03/12/2012	Anabat data 071212 LV BS, Anabat 3, 20121203, 04/12/2012	Anabat data 071212 LV BS, Anabat 3, 20121204, 04/12/2012	Anabat data 071212 LV BS, Anabat 3, 20121204, 05/12/2012	Anabat data 071212 LV BS, Anabat 3, 20121204, 06/12/2012	Anabat data 071212 LV BS, Anabat 4, 20121203, 03/12/2012	Anabat data 071212 LV BS, Anabat 4, 20121203, 04/12/2012	Anabat data 071212 LV BS, Anabat 4, 20121204, 04/12/2012	Anabat data 071212 LV BS, Anabat 4, 20121204, 05/12/2012	Anabat data 071212 LV BS, Anabat 4, 20121204, 06/12/2012	Anabat Data 231112 ce and bs, Anabat Trapline 2, 20121119, 19/11/2012	Anabat Data 231112 ce and bs, Anabat Trapline 2, 20121119, 20/11/2012	Anabat Data 231112 ce and bs, Anabat Trapline 2, 20121120, 20/11/2012	Anabat Data 231112 ce and bs, Anabat Trapline 2, 20121120, 21/11/2012	Anabat Data 231112 ce and bs, Anabat Trapline 2, 20121120, 22/11/2012	Anabat Data 250113 CE BS, Anabat 1, 20130121, 21/01/2013	Anabat Data 250113 CE BS, Anabat 1, 20130121, 22/01/2013	Anabat Data 250113 CE BS, Anabat 1, 20130122, 22/01/2013	Anabat Data 250113 CE BS, Anabat 1, 20130122, 23/01/2013	Anabat Data 250113 CE BS, Anabat 1, 20130123, 23/01/2013	Anabat Data 250113 CE BS, Anabat 1, 20130123, 24/01/2013	Anabat Data 250113 CE BS, Anabat 3, 20130121, 21/01/2013	Anabat Data 250113 CE BS, Anabat 3, 20130122, 22/01/2013	Anabat Data 250113 CE BS, Anabat 3, 20130122, 23/01/2013	Anabat Data 250113 CE BS, Anabat 3, 20130122, 24/01/2013
DEFINITE																															
Chalinolobus dwyeri	-	-	-	1	-	-	-	-	43	-	-	-	-	-	-	64	11	-	20	-	22	18	-	-	-	8	1	12	23	-
Chalinolobus gouldii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Chalinolobus morio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	12	-	9	21	-	36	-	9	3	-	1	-
Miniopterus schreibersii oceanensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Rhinolophus megaphyllus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	-	-	-	-	-	-	-	-	-	-	1	-
Tadarida australis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	4	-	7	5	1	20	2
PROBABLE																														
Chalinolobus dwyeri	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	12	10	1
Chalinolobus gouldii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	6	1	1
Chalinolobus morio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	15	25	-	-	-	3	-	2	4	-
Miniopterus schreibersii oceanensis	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhinolophus megaphyllus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	2	1	-
Tadarida australis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	1	-	-	3	-
Vespadelus darlingtoni	-	-	-	-	-	-	-	-	19	-	-	-	-	-	-	1	4	-	15	-	2	3	-	-	-	2	2	1	2	-
Vespadelus regulus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Vespadelus vulturnus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
POSSIBLE																														
Chalinolobus dwyeri	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1	1	-
Chalinolobus morio	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-
Rhinolophus megaphyllus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-

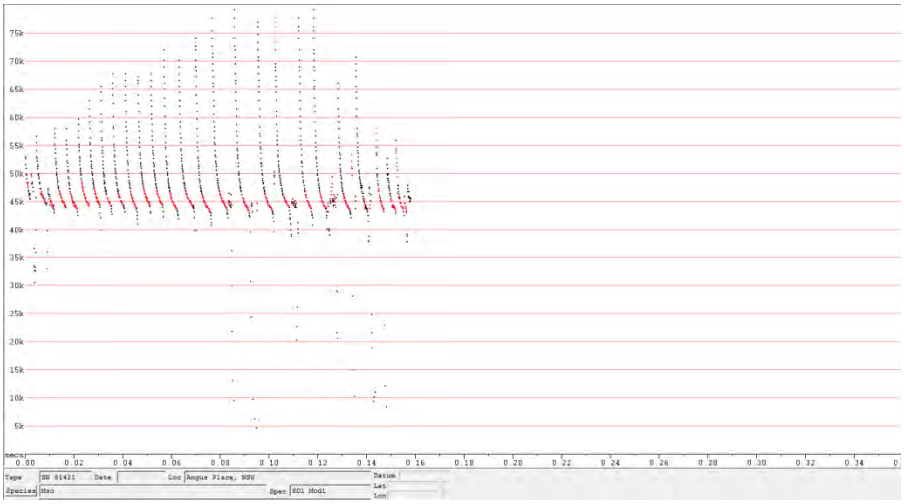
IDENTIFICATION	Anabat data 071212 LV BS, 3rd location, 20121203, 03/12/2012	Anabat data 071212 LV BS, 3rd location, 20121203, 04/12/2012	Anabat data 071212 LV BS, 3rd location, 20121204, 04/12/2012	Anabat data 071212 LV BS, 3rd location, 20121204, 05/12/2012	Anabat data 071212 LV BS, 3rd location, 20121204, 06/12/2012	Anabat data 071212 LV BS, Anabat 3, 20121203, 03/12/2012	Anabat data 071212 LV BS, Anabat 3, 20121203, 04/12/2012	Anabat data 071212 LV BS, Anabat 3, 20121204, 04/12/2012	Anabat data 071212 LV BS, Anabat 3, 20121204, 05/12/2012	Anabat data 071212 LV BS, Anabat 3, 20121204, 06/12/2012	Anabat data 071212 LV BS, Anabat 4, 20121203, 03/12/2012	Anabat data 071212 LV BS, Anabat 4, 20121203, 04/12/2012	Anabat data 071212 LV BS, Anabat 4, 20121204, 04/12/2012	Anabat data 071212 LV BS, Anabat 4, 20121204, 05/12/2012	Anabat data 071212 LV BS, Anabat 4, 20121204, 06/12/2012	Anabat Data 231112 ce and bs, Anabat Trapline 2, 20121119, 19/11/2012	Anabat Data 231112 ce and bs, Anabat Trapline 2, 20121119, 20/11/2012	Anabat Data 231112 ce and bs, Anabat Trapline 2, 20121120, 20/11/2012	Anabat Data 231112 ce and bs, Anabat Trapline 2, 20121120, 21/11/2012	Anabat Data 231112 ce and bs, Anabat Trapline 2, 20121120, 22/11/2012	Anabat Data 250113 CE BS, Anabat 1, 20130121, 21/01/2013	Anabat Data 250113 CE BS, Anabat 1, 20130121, 22/01/2013	Anabat Data 250113 CE BS, Anabat 1, 20130122, 22/01/2013	Anabat Data 250113 CE BS, Anabat 1, 20130122, 23/01/2013	Anabat Data 250113 CE BS, Anabat 1, 20130123, 23/01/2013	Anabat Data 250113 CE BS, Anabat 1, 20130123, 24/01/2013	Anabat Data 250113 CE BS, Anabat 3, 20130121, 21/01/2013	Anabat Data 250113 CE BS, Anabat 3, 20130122, 22/01/2013	Anabat Data 250113 CE BS, Anabat 3, 20130122, 23/01/2013	Anabat Data 250113 CE BS, Anabat 3, 20130122, 24/01/2013
SPECIES COMPLEXES																														
Chalinolobus gouldi / Mormopterus species 2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	6	3	1
Chalinolobus morio / Vespadelus vulturnus	-	-	-	-	-	1	1	-	5	-	2	16	-	1	1	1	19	-	86	-	53	126	-	38	-	61	11	75	71	33
Falsistrellus tasmaniensis / Scotorepens orion	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	5	-	3	12	-	19	-	12	5	28	9	9
Miniopterus schreibersii oceanensis / Vespadelus regulus	3	2	-	2	-	8	32	-	36	-	23	50	-	18	1	394	75	-	364	-	34	61	-	46	-	21	12	155	83	12
Myotis macropus / Nyctophilus geoffroyii / Nyctophilus gouldi	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	5	4	-	51	-	10	1	-	-	-	-	1	1	1	-
Nyctophilus geoffroyii / Nyctophilus gouldi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	-	-	-
Vespadelus darlingtoni / Vespadelus regulus	-	-	-	-	-	1	9	-	275	-	76	48	-	28	2	844	224	-	498	-	243	312	-	3	-	89	65	206	149	17
UNKNOWN																														
'Noise' files	118	69	352	426	65	197	18	51	86	1	713	108	25	6	-	65	45	-	68	-	54	49	-	20	-	43	30	158	103	8
Unknown	4	10	-	2	-	5	43	-	50	-	237	130	-	72	10	17	3	4	369	1	8	101	5	30	11	70	9	529	1582	61
TOTAL	125	81	352	433	65	213	103	51	528	1	1051	352	25	125	15	*1402*	*401*	*4*	*1502*	*1*	*458*	*730*	*5*	*198*	*11*	*326*	*146*	*1195*	*2070*	*145*

4.0 SAMPLE CALLS

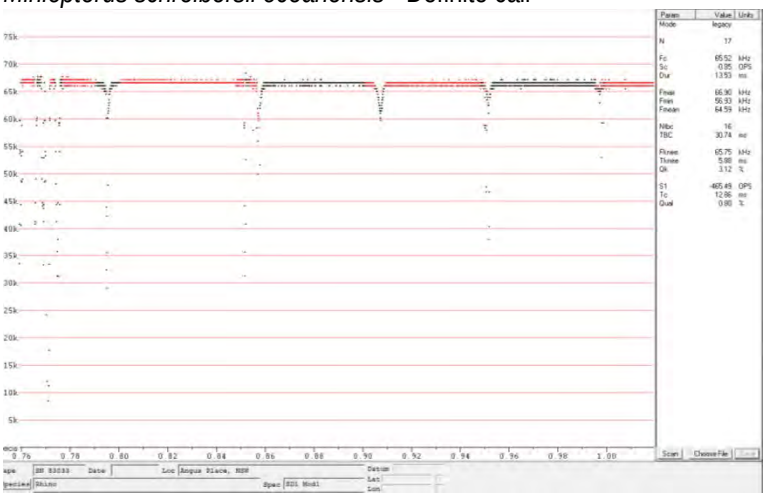
A sample of the calls actually identified from the site for each species is given below.



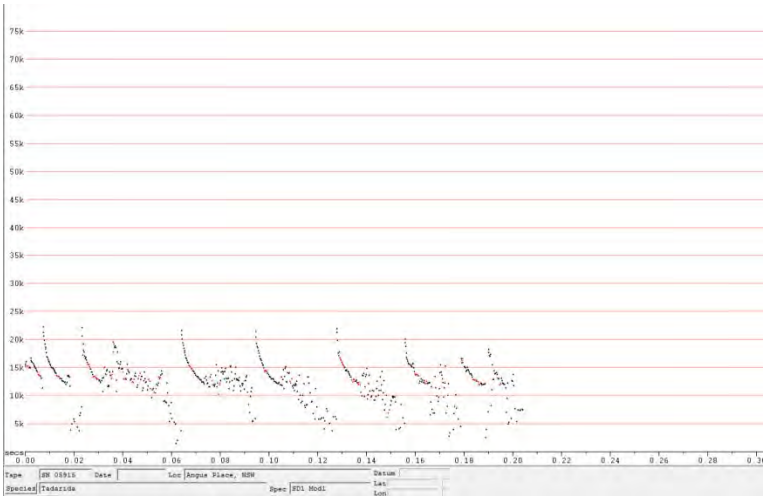
Chalinolobus morio - Definite call



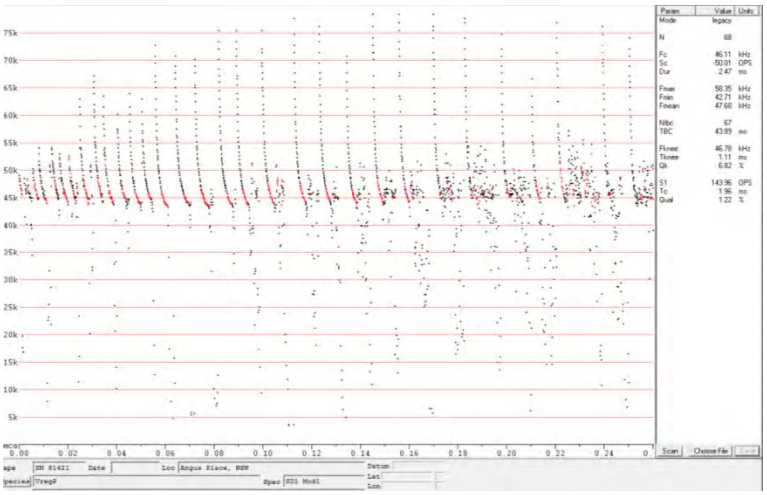
Miniopterus schreibersii oceanensis - Definite call



Rhinolophus megaphyllus - Definite Call



Tadarida australis - Definite call



Vespadelus regulus - Probable call

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