



Angus Place Colliery Development Continuity Modification

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 a Section 75W Modification of Project Approval 06_0021. The approval is being sought to permit the development of the main headings and first workings associated with the first two longwalls (LW1001 and LW1003), forming part of the Angus Place Mine Extension Project. Approval for longwall extraction is not being sought as part of this application.

This assessment aims to examine the likelihood of the proposal to have a significant effect on any threatened species, populations or ecological communities listed under the *Threatened Species Conservation Act 1995* (TSC Act). The 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*. Assessment is also made with regard to those species and communities listed federally under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Project Application Area is located in the Lithgow Local Government Area (LGA), 10 km north of the City of Lithgow. The entirety of the Project Application Area is located within the Newnes State Forest. The Project Application Area incorporates the main headings, first workings, LW1001 and LW1003. The first workings are designed to be long term stable and self-supporting and, therefore, are not expected to result in any measurable subsidence at the surface. Subsidence predictions for the Project, which are detailed within MSEC (2014), extend outside the Project Application Area. The 'subsidence extent' is defined as the surface area that is likely to be affected by the extraction (i.e. both first and second workings) of the proposed LW1001 and LW1003 in the Lithgow Seam. The subsidence extent has been calculated by combining the areas bounded by the following limits:

- the 26.5 degree angle of draw line from the extents of the proposed LW1001 and LW1003; and
- the predicted limit of vertical subsidence, taken as the 20 mm subsidence contour resulting from the extraction of the proposed longwalls.

Where relevant in assessing the potential impacts from subsidence, the 'subsidence extent' is referred to.

Methods

Flora and Fauna surveys were undertaken as part of the *Flora and Fauna Assessment, Angus Place Colliery Ventilation Facility Project for Angus Place Colliery July 2012* (RPS 2012) and the *Angus Place Extension Project, Flora and Fauna Assessment Report* (RPS 2014a). Those surveys for the above-mentioned projects which occurred within or in close proximity to the Project Application Area have been described within this report.

A variety of field survey techniques were employed over the course of fieldwork to record a representative sample of flora species and fauna guilds across the Project Application Area. The surveys included 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 Project Application 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

Fifteen 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 15, two communities are listed as Endangered Ecological Communities (EEC) and occur within 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, occur over the low-lying areas to the west of the Project Application 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 Project Application Area to constitute Groundwater Dependent Ecosystems (GDEs). The vegetation within the Project Application 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 Project Application Area that clearly fall into this category are Map Unit (MU) 50 – Newnes Plateau Shrub Swamp and MU 51 – Newnes Plateau Hanging Swamp.

Two threatened flora species were recorded during the present study, these being *Persoonia hindii* and *Veronica blakelyi*. *V. blakelyi* is listed as Vulnerable under the TSC Act. *P. hindii* is listed as Endangered under the TSC Act.

Two additional threatened flora species, namely *Eucalyptus aggregata* (Black Gum) and *Thesium australe* (Austral Toadflax), have the potential to occur along the water courses of Kangaroo Creek and Coxs River. These watercourses will be influenced by mine water discharge. *E. aggregata* is listed as Vulnerable under the TSC Act and *T. australe* is listed as Vulnerable under the TSC Act and EPBC Act.

Through desktop analysis and habitat assessments, an additional nine threatened flora species have been considered as potentially occurring within the Project Application 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).

Habitats within the Project Application 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, 49 fauna species were identified across the Project Application Area, including five threatened fauna species listed under the TSC and/or EPBC Acts.

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 Project Application 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 Angus Place lease area (BMS 2011b). The

Stuttering Frog has been recorded within the adjacent 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 phoenicea*). An additional four threatened woodland birds have previously been recorded within the Angus Place lease area 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 Project Application Area.

No threatened terrestrial mammal species have been recorded during surveys or monitoring over the Project Application 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. RPS surveys have recorded the presence of Eastern Pygmy Possum (*Cercartetus nanus*) approximately 400 m south of the Project Application Area, with annual monitoring also having recorded Koala (*Phascolarctos cinereus*) (MKES 2008c) and Squirrel Glider (*Petaurus norfolcensis*) (MKES 2006a).

Two threatened microchiropteran bat species were recorded during RPS surveys, namely Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*) and Large-eared Pied Bat (*Chalinolobus dwyeri*). An additional three threatened microchiropteran bat species have been recorded during annual monitoring within the Angus Place lease area, namely Eastern Bentwing Bat (*Miniopterus schreibersii* subsp. *oceanensis*), Eastern Freetail-bat (*Mormopterus norfolkensis*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*).

Impact Assessment

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

- subsidence related impacts from the first workings;
- subsidence related impacts from the longwall extraction; and
- mine water discharge, potentially affecting the quantity and chemistry of surface water.

The first workings are designed to be stable and self-supporting and, therefore, are not expected to result in any measurable subsidence at the surface (i.e. less than 20 mm of vertical subsidence). The predicted tilts, curvatures and strains resulting from the extraction of the first workings are negligible and are not expected to be measurable at the surface using normal ground monitoring techniques (MSEC, 2014 section 4.2).

Longwall extraction is not being sought as part of this project, however subsidence resulting from longwall extraction is presented for completeness. The mining layout has been designed such that the majority of the cliffs and pagoda complexes are located outside the subsidence 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 2013 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 2014b) 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 2013) 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 2014b).

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. No impacts are expected as a result of first workings. Assessment of impacts from longwall extractions 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.

First workings are expected to result in negligible increases in mine water discharge compared to current levels (RPS 2014b). The potential impacts from increased mine water discharge from secondary workings include increases in flow and changes to water quality, particularly increases in salinity. A review of the regional water balance has been undertaken by RPS (2014b). It found that the expected increase in flow is unlikely to impact on geomorphology from increases in streambed velocity.

RPS (2014b) indicates that the worst case salinity impact on Kangaroo Creek would be in the unlikely scenario that the discharge at LDP001 comprised the total flows within Kangaroo Creek. Based on the water quality data for LDP001 the median salinity is 1,010µS/cm and maximum is 1,270µS/cm. These values are comparable to the current median salinity measured at Kangaroo Creek D/S of 770µS/cm and the maximum of 1,130µS/cm. Therefore, even in this unlikely scenario there be little or no change to the salinity of Kangaroo Creek (RPS 2014b).

The salinity levels that may occur within receiving waters of Kangaroo Creek and Cocks River 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 from secondary workings 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.

Water quality in Kangaroo Creek is influenced by mine water discharge at LDP001 and has a pH of 8.3. Water quality in the Cocks River, downstream of the confluence with Kangaroo Creek, also has a median pH of 8.0 (RPS 2014b). This pH level 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 10km of the Project Application 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. The Gardens of Stone National Park is located at a distance of 4.6 kilometres north of LW1003 at their closest point to the proposed longwalls. Subsidence impacts as a result of first workings are considered to be negligible at the surface (<20mm subsidence). In addition, given the distance between proposed longwalls and MNES, it is not expected that secondary workings would result in any adverse impacts on the National Park or the Reserve resulting from the extraction of LW1001 and LW1003.

Conclusion

Potential impacts under the TSC Act and EPBC Act have been assessed with regard to the proposed first workings, with the potential impacts as a result of longwall mining provided for completeness. 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. 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, 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	Commonwealth Department of the Environment
NSW P&I	NSW Planning and Infrastructure
DTIRIS	NSW Department of Trade and Investment, Regional Infrastructure and Services
EEC	Endangered Ecological Community
EPA	NSW Environment Protection Authority (formerly part of OEH)
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
GIS	Geographical 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
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	<i>Threatened Species Conservation Act 1995</i>
SEWPAC	Former 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 a Section 75W Modification of Project Approval 06_0021. The approval is being sought to permit the development of the main headings and first workings associated with the first two longwalls (LW1001 and LW1003) forming part of the Angus Place Mine Extension Project. Approval of longwall extraction regarding panels LW1001 and LW1003 is not being sought under this application. The location of the proposed longwall panels is shown in **Figure 1**.

This assessment aims to examine the likelihood of the proposal to have a significant effect on any threatened species, populations or ecological communities listed under the *Threatened Species Conservation Act 1995* (TSC Act). The 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*. Assessment is also made with regard to those species and communities listed federally under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.1 Project Application Area

The extent of the Project Application Area is provided in **Figure 1**. Where relevant to assessing the predicted impacts of subsidence, this report also considers the 'subsidence extent'. The subsidence extent is defined as the surface area that is likely to be affected by the extraction (i.e. both first and second workings) of the proposed LW1001 and LW1003 in the Lithgow Seam. The subsidence extent has been calculated by combining the areas bounded by the following limits:-

- the 26.5 degree angle of draw line from the extents of the proposed LW1001 and LW1003; and
- the predicted limit of vertical subsidence, taken as the 20 mm subsidence contour resulting from the extraction of the proposed longwalls.

The above limits are described in detail in MSEC (2013) and displayed in **Figure 1**.

Surface features, which could be sensitive to either far field movements or valley related movements have been identified and included in the assessments provided in this report. In this case, features that could be sensitive to far field or valley related movements, within but not limited to 600 metres from the proposed mining, have been assessed.

1.2 Site Particulars

Locality – The Angus Place Colliery pit top is located five kilometres north of the village of Lidsdale, eight kilometres northeast of the township of Wallerawang and 10 kilometres northwest of the city of Lithgow. The proposed workings are below the Newnes State Forest.

Area – The Project Application Area is approximately 395 ha in total.

Boundaries – The Project Application Area is entirely contained within the Newnes State Forest.

Current Land Use – The primary land use is commercial forestry.

Topography – The Newnes State Forest is comprised of 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.

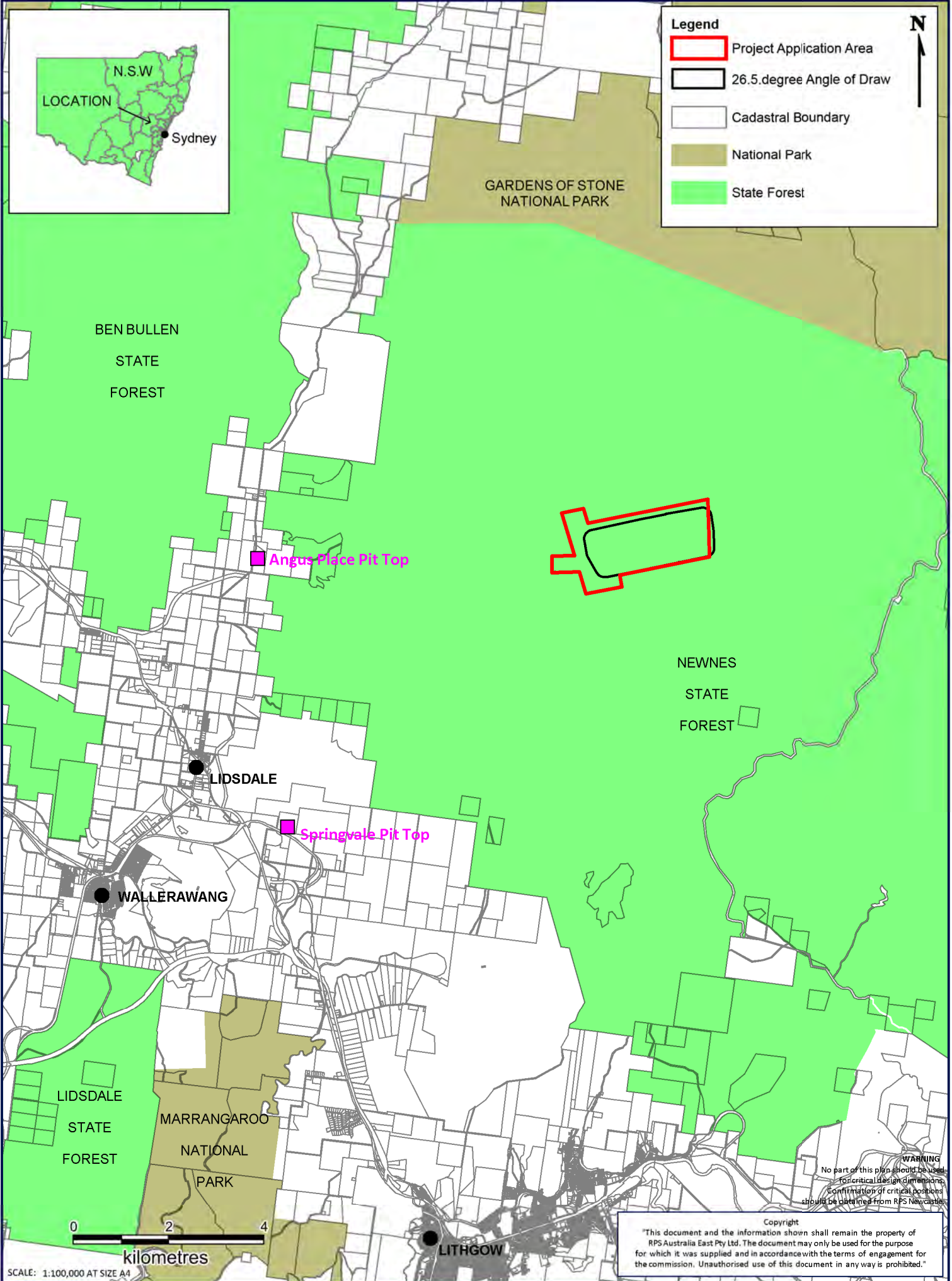
Soils - The Project Application Area is situated over a number of soil landscapes including; Warragamba, Wollongambe, Medlow Bath, Mount Sinai, Newnes Plateau and Deanes Creek. These soil landscapes occur in relation to specific landform elements such as swamps, cliffs, outcrops or terrace plains, and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

Colluvial soil landscapes present in the Project Application Area include the Warragamba soil landscape. Topsoil in this landscape can be either loamy sand, sand, or clayey sand, and can be between 35 and 100 centimetres 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 Wollongambe are associated with the steep to undulating hillslopes; benches; areas of rock outcrop; and generally shallow sandy soils (King 1992). The residual soil landscape of Medlow Bath is 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 centimetres (King 1992). This soil landscape comprises a loose quartz-rich sand A₁ horizon, reddish brown clayey sand A₂ horizon, and earthy sandy clay loam B horizon subsoil (King 1992). Topsoil in this soil landscape, which encompasses both A₁ and A₂ horizon soils, can reach a depth of up to 100 centimetres.

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). The swamp soil landscape present in the Project Application Area includes Deanes Creek. In this soil landscape, topsoil is typically 30 to 40 centimetres 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 Project Application 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.



Legend

- Project Application Area
- 26.5.degree Angle of Draw
- Cadastral Boundary
- National Park
- State Forest

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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TITLE: FIGURE 1: PROJECT APPLICATION AREA	LOCATION: ANGUS PLACE	DATUM: GDA 94 PROJECTION: MGA ZONE 56	DATE: 22/01/2014 PURPOSE: REPORT	LAYOUT REF: 1120986 Angus Place Modification VERSION (PLAN BY): PH (A A4)
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1.3 Scope of the Study

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

- undertake a desktop assessment of relevant ecological assessments and database searches within a 10 km radius of the Project Application Area;
- identify threatened flora and fauna species, populations and ecological communities known or likely to occur;
- identify and map existing vegetation communities;
- undertake 7-part tests under the TSC Act to assess the potential of the proposed first workings to have a significant impact on any threatened species, populations or ecological communities (listed under the TSC Act) known or likely to occur. It should be noted that secondary extraction will be presented for completeness; and
- assess the potential of the proposed first workings to have a significant impact on any threatened species, populations or ecological communities (listed under the EPBC Act) known or likely to occur within the Project Application Area or its immediate vicinity. Impacts from second workings will be presented for completeness.

1.4 Licencing

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 2015);
- 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).

1.5 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
April 2014

2.0 Methodology

Flora and Fauna surveys were undertaken as part of the *Flora and Fauna Assessment, Angus Place Colliery Ventilation Facility Project for Angus Place Colliery July 2012* (RPS 2012) and the *Angus Place Extension Project, Flora and Fauna Assessment Report* (RPS 2014a). Those surveys for the above-mentioned projects, which occurred within or in close proximity to the Project Application Area, have been described within this section.

A variety of field survey techniques were employed over the course of fieldwork to record a representative sample of flora species and fauna guilds across the Project Application Area. The surveys included 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 Project Application Area locality have been used in consideration of adequacy of survey effort and potential for occurrence of threatened species.

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 Project Application Area and locality (i.e. within 10 km of the Project Application Area). Reports prepared for the Project Application Area and nearby sites have been reviewed for the purpose of assessing the likelihood of threatened species or ecological communities to occur within the Project Application Area. Information sources reviewed included:

- Aerial Photograph Interpretation (API) and literature reviews to determine the broad categorisation of vegetation within the Project Application 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 Project Application Area;
- review of fauna and flora records contained in the SEWPAC Protected Matters Search (Accessed January 2014) within a 10 km radius of the Project Application 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;
- RPS (2014a) Angus Place Extension Project - Flora and Fauna Assessment Report. 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 1** below. These results were sourced from a weather station based in Lithgow town centre.

Table 1 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
22 Feb 2009	14.5–23.2	1 mm	06:11-19:14		x	x	x					x
23 Feb 2009	12.0–27.2	0 mm	06:12-19:13		x	x	x					x
24 Feb 2009	12.5–27.4	0.9 mm	06:13-19:12		x	x						x
25 Feb 2009	13.1–27.6	0 mm	06:14-19:11		x	x						x
26 Feb 2009	13.6–21.9	0 mm	06:15-19:10									x
28 Sep 2011	5.7–14.5	0 mm	06:11-18:29			x	x			x	x	x
29 Sep 2011	10.0–12.4	22.4 mm	06:10-18:30			x	x			x	x	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								
15 Feb 2012	10.3–22.1	0.0 mm	06:04-19:23	x								
2 Mar 2012	12.9–13.6	32.0 mm	06:18-19:04			x	x					x
22 Aug 2012	-0.2–17.7	0.0 mm	07:00-18:05	x								
25 Oct 2012	3.4–25.5	0.0 mm	05:37-18:50	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
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
21 Jan 2013	14.3–26.2	0.0 mm	05:41-19:40									x
22 Jan 2013	13.7–29.3	0.0 mm	05:42-19:40		x	x	x			x		x
23 Jan 2013	12.8–23.1	10.4 mm	05:43-19:39		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

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 Project Application 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 (Scale 1:25000) of the Project Application 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 API and ground-truthing surveys.

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 and Quadrat surveys undertaken within the Project Application Area (see **Figure 2**). A total of four full floristic quadrats and 15 RDPs were undertaken within the Project Application Area. Additionally, further flora inspections, vegetation delineation and threatened flora searches were undertaken while conducting diurnal fauna surveys and while otherwise traversing throughout the Project Application Area on foot or within a vehicle.

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

2.3.2 Significant Flora Survey

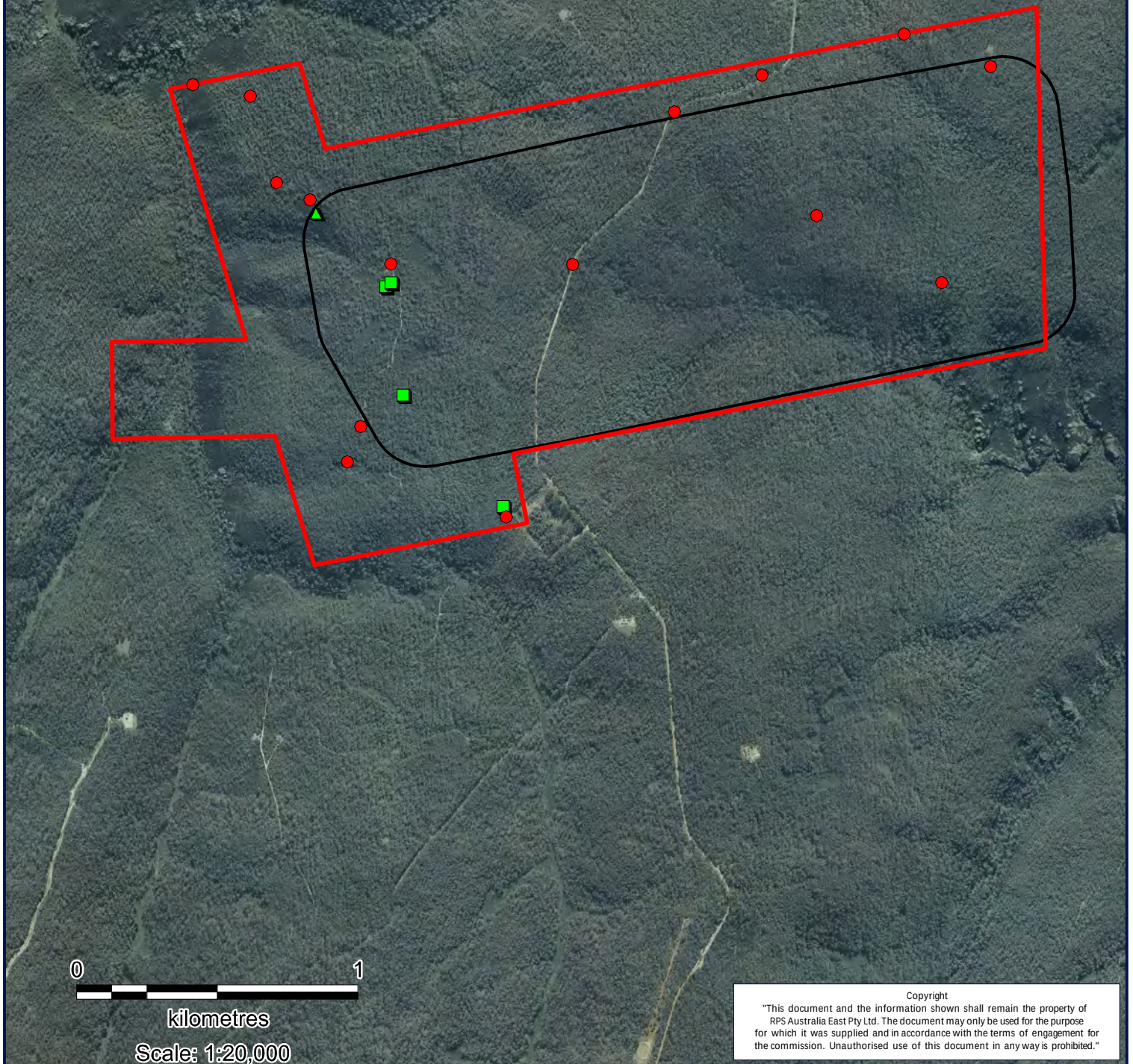
A list of potentially occurring significant flora species from the locality (10 km radius) was compiled, which included threatened species and EECs listed under the TSC Act and/or EPBC Act. Opportunistic and targeted flora surveys were undertaken during all vegetation fieldwork.

The locations of any threatened flora species were recorded using Trimble differential GPS units with sub-metre accuracy.

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

Legend

-  Project Application Area
-  26.5 Degree Angle of Draw
-  Flora Quadrat
-  Rapid Data Point
-  Flora Quadrat
(University of Queensland)



TITLE: FIGURE 2: FLORA SURVEY
METHOD LOCATIONS

LOCATION: ANGUS PLACE

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 22/01/2014
PURPOSE: REPORT

LAYOUT REF: 1120986 Angus Place Modification
10 - Drafting\Mapinfo Workspaces\Eco
VERSION (PLAN BY): PH (A A4)

CLIENT: CENTENNIAL
JOB REF: 120986

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2.4 Habitat Survey

An assessment of the relative value of the habitat present within the Project Application Area was conducted during all survey events. 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 presence of fauna within the Project Application 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.

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 3**.

Two trapping transects were undertaken within the Project Application Area, with a third to the immediate east of the Project Application Area boundary. Each transect contained 25 Elliott A, 25 Elliott B and six cage traps per line. This resulted in 300 Elliott A trap nights, 300 Elliott B trap nights and 72 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. Traps were checked early each morning.

Two trapping transects were undertaken within the Project Application Area, with a third to the immediate east of the Project Application Area boundary. At each transect six Elliott B size arboreal traps were installed, resulting in 72 arboreal trap nights. The location of each trap line is shown in **Figure 3**.

2.5.3 Hair Tubes

Surveys were undertaken using Faunatech Hair Tubes across the Project Application 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. One hair tube transect was undertaken within the Project Application Area, with a second to the immediate east of the Project Application Area boundary. At each site 10 arboreal and 10 terrestrial Hair Tubes were set resulting in 80 arboreal trap nights and 80 terrestrial trap nights. The location of each trap line is shown in **Figure 3**.

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 Project Application Area was undertaken via nocturnal surveys and by opportunistic observations during field surveys. 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. The potential for threatened avifauna to use the Project Application 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 Project Application Area.

2.5.5 Herpetofauna Survey

Opportunistic and targeted herpetofauna searches were conducted during fauna surveys encompassing a diversity of habitats across the Project Application 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 Project Application Area to support such species.

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 six separate sites within the Project Application Area and one site to the immediate east of the Project Application Area. Two sites were surveyed for one night, two sites were surveyed for two nights and two sites were surveyed for four 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 3**.

Anna McConville who is experienced in the analysis of bat echolocation calls undertook bat call analysis. Each call sequence ('pass') was assigned to one of three categories, according to the confidence with which 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 set at three locations across the Project Application Area and at one location to the immediate east of the Project Application Area. Harp Traps are designed to catch microbats, allowing for visual identification of species occurring within the Project Application Area as well as to allow for the identification of species that are not detectable utilising ultrasonic recording devices. Any microbats caught were identified and released on the same night of capture. **Figure 3** shows Harp Trap locations.

2.5.8 Spotlighting

Spotlighting was undertaken across the Project Application 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 Project Application Area, targeting tracks and other areas easily accessible during nighttime periods. A total of 18 person hours of spotlighting was undertaken over four nights within the Project Application Area (**Figure 3**).

2.5.9 Nocturnal Call Playback

Pre-recorded calls of Koala, Owl, and Glider species with the potential to occur within the Project Application 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 1km under still night conditions. Owl species targeted included the Barking Owl (*Ninox connivens*), Powerful Owl (*Ninox strenua*), Masked Owl (*Tyto novaehollandiae*) and Sooty Owl (*Tyto tenebricosa*).

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 four call playback sessions were undertaken within the Project Application Area. The locations of the call playback sites are shown in **Figure 3**.

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 the Glossy Black-cockatoo (*Calyptorhynchus latham*).

2.6 Adequacy of Survey Effort and Limitations

2.6.1 Survey Effort

In addition to the surveys presented within this report, additional fauna surveys were undertaken as part of the *Angus Place Extension Project, Flora and Fauna Assessment Report* (RPS 2014a), as well as 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).

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 Project Application 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 Project Application Area.

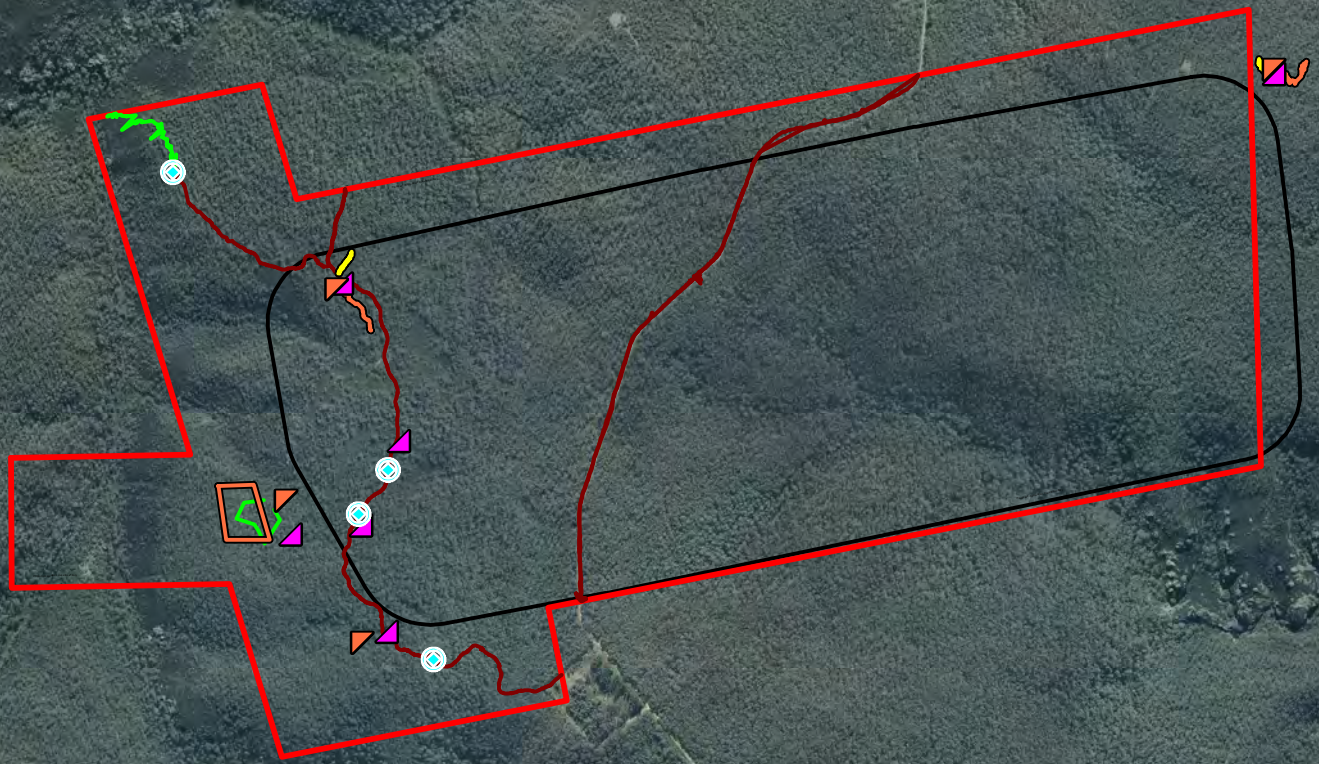
Similarly, EPBC Protected Matters Searches provide a list of threatened species and communities that have been recorded within 10 km of the Project Application Area, or which have suitable habitat within the wider area, and are subject to the same inherent inaccuracy issues as State derived databases.

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 Project Application Area. Consequently, habitat assessment and the results of surveys conducted within the Project Application Area have been used to assess the likelihood of occurrence of threatened species, populations and ecological communities to occur.

WARNING
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for critical design dimensions.
Confirmation of critical positions
should be obtained from RPS Newcastle.

Legend

-  Project Application Area
-  26.5 Degree Angle of Draw
-  Owl Call Playback
-  Harp_Traps
-  Anabat
-  Hair Tube Line
-  Elliot Trap Line
-  Spotlighting (Vehicle)
-  Spotlighting (Foot)



0 1
kilometres

Scale: 1:20,000

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TITLE: FIGURE 3: FAUNA SURVEY
LOCATIONS

LOCATION: ANGUS PLACE

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 22/01/2014
PURPOSE: REPORT

LAYOUT REF: 1120986 Angus Place Modification
10 - Drafting\MapInfo Workspaces\Eco
VERSION (PLAN BY): PH (A A4)

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3.0 Results

3.1 Desktop Assessment

3.1.1 Literature Review

A review of *Angus Place Extension Project, Flora and Fauna Assessment Report* (RPS 2014a) and fauna monitoring reports conducted within the Project Application Area has been undertaken. Monitoring reports undertaken for the neighbouring Springvale and Clarence mines have also been reviewed. **Table 2** provides a list of any threatened species recorded, including the location and report from which it has been derived.

Table 2 Threatened Species Recorded by Previous Ecological Surveys.

Species	TSC Act	EPBC Act	Location and Source		
			Angus Place	Springvale	Clarence
Amphibians					
<i>Heleioporus australiacus</i> Giant Burrowing Frog	V	V	BMS (2011b)	-	-
<i>Mixophyes balbus</i> Stuttering Frog	E	V	-	MKES (2004b)	-
Reptiles					
<i>Eulamprus leuraensis</i> Blue Mountains Water Skink	E	E	-	BMS (2011d)	BMS (2009d)
Birds					
<i>Callocephalon fimbriatum</i> Gang-gang Cockatoo	V	-	MKES (2004a, 2006a, 2007, 2008c) and BMS (2009c, 2010c, 2011b, 2012b, 2012c, 2012d, 2012e), RPS (2014a)	MKES (2004b, 2006b, 2006c, 2008a) and BMS (2009a, 2010a, 2011a, 2011c, 2011d, 2012a, 2012f, 2012g, 2012h)	MKES (2008b) and BMS (2009b, 2009d, 2010b)
<i>Calyptorhynchus lathami</i> Glossy Black-Cockatoo	V	-	MKES (2006a, 2007) and BMS (2009c)	MKES (2008a)	BMS (2009d)
<i>Climacteris picumnus victoriae</i> 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)
<i>Daphoenositta chrysoptera</i> Varied Sittella	V	-	MKES (2008c) and BMS (2009c, 2012d) , RPS (2014a)	BMS (2009a, 2011a, 2011c, 2011d, 2012a, 2012g)	BMS (2009d)
<i>Hieraaetus morphnoides</i> Little Eagle	V	-	MKES (2006a, 2007) and BMS (2011b)	-	-
<i>Melanodryas cucullata cucullata</i> 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
<i>Melithreptus gularis gularis</i> Black-chinned Honeyeater (eastern subsp.)	V	-	MKES (2004a)	MKES (2004b)	-
<i>Ninox strenua</i> Powerful Owl	V	-	MKES (2006a, 2007, 2008c), BMS (2009c, 2010c, 2011b, 2012c) and RPS (2014a)	MKES (2004b, 2006b, 2006c) and BMS (2011a, 2012a)	MKES (2008b) and BMS (2009d, 2010d)
<i>Ninox connivens</i> Barking Owl	V	-	MKES (2006a)	-	-
<i>Petroica boodang</i> Scarlet Robin	V	-	MKES (2006a, 2007, 2008c) and BMS (2009c, 2010c, 2011b, 2012b, 2012c, 2012d, 2012e) MKES (2004a, 2006a, 2007, 2008c), BMS (2010c, 2011b, 2012c, 2012d) and RPS (2014a)	MKES (2004b, 2006c, 2008a) and BMS (2009a, 2010a, 2011a, 2011c, 2011d, 2012a, 2012f, 2012g, 2012h)	MKES (2008b0 and BMS (2009b, 2010b, 2010d)
<i>Petroica phoenicea</i> Flame Robin	V	-	RPS (2014a)	MKES (2006b, 2006c, 2008a) and BMS (2010a, 2011a, 2011c, 2011d, 2012a, 2012f, 2012g, 2012h)	MKES (2008b) and BMS (2010d)
<i>Pomatostomus temporalis</i> Grey-crowned Babbler	V	-	-	MKES (2006c)	-
<i>Pyrrholaemus sagittatus</i> Speckled Warbler	V	-	MKES (2006a) and BMS (2009c)	-	-
<i>Tyto novaehollandiae</i> Masked Owl	V	-	-	-	BMS (2009d)
<i>Tyto tenebricosa</i> Sooty Owl	V	-	BMS (2010c)	BMS (2011a)	-
Mammals					
<i>Cercartetus nanus</i> Eastern Pygmy Possum	V	-	RPS (2014a)	MKES (2004b, 2006c) and BMS (2010a, 2011c, 2011d, 2012g, 2012h)	-
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	V	V	MKES (2007), BMS (2010c, 2011b, 2012d) and RPS (2014a)	BMS (2010a, 2011a)	MKES (2008b)
<i>Chalinolobus picatus</i> Little Pied Bat	V	-	-	-	BMS (2009d)
<i>Falsistrellus tasmaniensis</i> Eastern False Pipistrelle	V	-	-	MKES (2006b, 2006c, 2008a) and BMS (2009a, 2010a, 2011a, 2012a, 2012h)	MKES (2008b) and BMS (2009b, 2010d)

Species	TSC Act	EPBC Act	Location and Source		
			Angus Place	Springvale	Clarence
<i>Miniopterus schreibersii oceanensis</i> Eastern Bentwing-bat	V	-	MKES (2004a, 2007), BMS (2009c, 2010c, 2011b, 2012d) and RPS (2014a)	MKES (2004b, 2006c, 2008a) and BMS (2009a, 2010a, 2011a, 2012a, 2012h)	MKES (2008b) and BMS (2009b, 2009d, 2010b)
<i>Mormopterus norfolkensis</i> Eastern Freetail-bat	V	-	MKES (2007, 2008c)	-	-
<i>Petaurus norfolcensis</i> Squirrel Glider	V	-	MKES (2006a)	MKES (2004b, 2006c 2008a)	BMS (2010b)
<i>Phascolarctos cinereus</i> Koala	V	V	MKES (2008c)	BMS (2011c)	-
<i>Saccolaimus flaviventris</i> Yellow-bellied Sheath-tail-bat	V	-	RPS (2014a)	-	-
<i>Scoteanax rueppellii</i> 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 Project Application Area. These species are listed in **Table 3** below.

Table 3 Occurring and potentially occurring Threatened Flora, Fauna and Ecological Communities within a 10 km radius of the Project Application Area

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

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

Scientific Name	Common Name	TSC Act	EPBC Act	No. of Records
<i>Ninox connivens</i>	Barking Owl	V	-	6
<i>Ninox strenua</i>	Powerful Owl	V	-	44
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	1
<i>Tyto tenebricosa</i>	Sooty Owl	V	-	7
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subsp.)	V	-	87
<i>Chthonicola sagittata</i>	Speckled Warbler	V	-	11
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E,M	2
<i>Grantiella picta</i>	Painted Honeyeater	V		1
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subsp.)	V	-	3
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subsp.)	V	-	2
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	32
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern subsp.)	V	-	9
<i>Petroica boodang</i>	Scarlet Robin	V	-	210
<i>Petroica phoenicea</i>	Flame Robin	V		197
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	6
Mammals				
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll (SE mainland subsp.)	V	E	6
<i>Isodon obesulus obesulus</i>	Southern Brown Bandicoot	E	E	-
<i>Phascolarctos cinereus</i>	Koala (Qld, NSW, Vic and ACT Populations)	V	V	16
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	-	13
<i>Petaurus australis</i>	Yellow-bellied Glider	V	-	5
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	11
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (mainland subsp.)	V	V	-
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	1
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	-
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail Bat	V	-	-
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V	-	2
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	28
<i>Chalinolobus picatus</i>	Little Pied Bat	V	-	-
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	38
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	-	21
<i>Nyctophilus corbeni</i>	South-eastern Long-eared Bat	V	V	-
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	6
<i>Vespadelus troungtoni</i>	Eastern Cave Bat	V	-	2
<i>Pseudomys fumeus</i>	Smoky Mouse		E	-
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	1
Fish				
<i>Maccullochella peelii</i>	Murray Cod	-	V	-

Scientific Name	Common Name	TSC Act	EPBC Act	No. of Records
<i>Macquaria australasica</i>	Macquarie Perch	-	E	-
<i>Prototroctes maraena</i>	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 which lists potential migratory species. **Table 4** lists the potentially occurring migratory species within a 10 km radius of the Project Application Area.

Table 4 Potentially Occurring Migratory Species within a 10 km radius of the Project Application Area

Scientific Name	Common name	EPBC Act Status
<i>Anthochaera phrygia</i>	Regent Honeyeater	E,M
<i>Apus pacificus</i>	Fork-tailed Swift	M
<i>Ardea alba</i>	Great Egret	M
<i>Ardea ibis</i>	Cattle Egret	M
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	M
<i>Hirundapus caudacutus</i>	White-throated Needletail	M
<i>Gallinago hardwickii</i>	Latham's Snipe	M
<i>Merops ornatus</i>	Rainbow Bee-eater	M
<i>Monarcha melanopsis</i>	Black-faced Monarch	M
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	M
<i>Rhipidura rufifrons</i>	Rufous Fantail	M
<i>Rostratula benghalensis</i>	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=Hawkesbury/Nepean) resulted in the return of three species (excluding marine species) as shown below:

▪ <i>Austrocordulia leonardi</i>	Sydney hawk dragonfly	Endangered
▪ <i>Archaeophya adamsi</i>	Adam's emerald dragonfly	Endangered
▪ <i>Macquaria australasica</i>	Macquarie perch	Endangered

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:

▪ <i>Maccullochella peelii</i>	Murray Cod	Vulnerable to Extinction
▪ <i>Prototroctes maraena</i>	Australian Grayling	Vulnerable to Extinction
▪ <i>Macquaria australasica</i>	Macquarie Perch	Endangered

None of the above species are likely to occur within the Project Application 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. 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 the above fish species if they were present in the lower Hawkesbury-Nepean Catchment. Therefore, the presence of these above species is considered unlikely.

3.2 Flora Survey

3.2.1 Vegetation Community Mapping

Flora surveys, including ground-truthing of vegetation communities were undertaken within the Project Application Area. Those areas within the Project Application 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 5** below lists the vegetation communities within Project Application Area. The locations of each vegetation community are provided in **Figure 4**.

Table 5 Vegetation Communities within the Project Application Area

Map Unit (DEC 2006)	Area (ha)
07 Newnes Plateau Narrow-leaved Peppermint - Mountain Gum - Brown Stringybark Layered Forest	36.01
08 Newnes Sheltered Peppermint - Brown Barrel Shrubby Forest	8.30
14 Tableland Mountain Gum - Snow Gum - Daviesia Montane Open Forest	28.45
26 Newnes Plateau Narrow-leaved Peppermint - Silvertop Ash Layered Open Forest	182.67
26a Newnes Plateau Gum Hollows variant: Brittle Gum - Mountain Gum, Scribbly Gum - Snow Gum Shrubby Open Forest	74.00
28 Sandstone Plateau and Ridge Scribbly Gum - Silvertop Ash Shrubby Woodland	23.69
29 Sandstone Slopes Sydney Peppermint Shrubby Forest	16.23
30 Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	1.96
43 Pagoda Rock Sparse Shrubland	0.24
44 Sandstone Plateau Tea Tree - Dwark Sheoak - Banksia Rocky Heath	7.33
45 Newnes Plateau Tea Tree - Banksia - Mallee Heath	6.84
46 Newnes Plateau Dwarf Sheoak - Banksia Heath	6.52
50 Newnes Plateau Shrub Swamp	0.22
51 Newnes Plateau Hanging Swamp	2.26
59 Non Native Vegetation Plantation	0.27
Total	394.72

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 Project Application Area.

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 Project Application Area.
Canopy Layer:	22 – 36 m tall with 30 - 60% Percentage Foliage Cover (PFC). Dominant species included <i>Eucalyptus radiata</i> (Narrow-leaved Peppermint), <i>Eucalyptus blaxlandii</i> (Blaxland's Stringybark) and <i>Eucalyptus sieberi</i> (Silvertop Ash).
Shrub Layer:	1 – 2 m tall with approximately 60% PFC. Dominant shrub species included <i>Leucopogon lanceolata</i> (Lance-leaf Beard-heath), <i>Monotoca scoparia</i> , <i>Hakea dactyloides</i> (Broad-leaved Hakea), <i>Banksia spinulosa</i> var. <i>spinulosa</i> (Hairpin Banksia), <i>Leucopogon fletcheri</i> subsp. <i>brevisepalus</i> , and <i>Lomatia silaifolia</i> (Crinkle Bush).
Ground Layer:	0 - 1 m tall with 15 - 45% PFC. Dominant species included <i>Rytidosperma pallidum</i> (Silvertop Wallaby Grass), <i>Dianella revoluta</i> var. <i>revoluta</i> (Blue Flax-lily), <i>Lomandra longifolia</i> (Spiny-headed Mat-rush) <i>Patersonia longifolia</i> (Dwarf Purple Flag) and <i>Pteridium esculentum</i> (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 Project Application 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 Project Application 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 Project Application 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 Project Application 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 Project Application 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 Project Application 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 <i>Eucalyptus dives</i> (Broad-leaved Peppermint), <i>Eucalyptus blaxlandii</i> (Blaxland's Stringybark), <i>Eucalyptus sieberi</i> (Silver-top Ash), <i>Eucalyptus rubida</i> (Candlebark), <i>Eucalyptus oreades</i> (Mountain Ash) and <i>Eucalyptus piperita</i> (Sydney Peppermint).
Shrub Layer:	1.5 – 4.0 m tall with 3 – 70% PFC. Dominant shrub species included <i>Daviesia latifolia</i> (Hop Bitter-pea), <i>Hakea dactyloides</i> (Broad-leaved Hakea), <i>Acacia obtusifolia</i> (Blunt-leaved Wattle), <i>Phebalium squamulosum</i> subsp. <i>squamulosum</i> (Forest Phebalium) and <i>Monotoca scoparia</i> .
Ground Layer:	0 – 1 m tall with 10 – 70% PFC. Dominant species included <i>Pteridium esculentum</i> (Bracken), <i>Dianella revoluta</i> var. <i>revoluta</i> (Blueberry Lily), <i>Lomandra glauca</i> (Pale Mat-rush), <i>Lomandra longifolia</i> (Spiky-headed Mat-rush), <i>Poa sieberiana</i> (Snowgrass) and <i>Patersonia sericea</i> (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 <i>Eucalyptus mannifera</i> . 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 <i>Eucalyptus mannifera</i> (Brittle Gum), <i>Eucalyptus dives</i> (Broad-leaved Peppermint), <i>Eucalyptus radiata</i> (Narrow-leaved Peppermint), and <i>Eucalyptus sclerophylla</i> (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 <i>Hakea dactyloides</i> (Broad-leaved Hakea), <i>Phyllota squarrosa</i> (Dense Phyllota), <i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i> (Tantoon), <i>Hakea laevipes</i> and <i>Banksia spinulosa</i> var. <i>spinulosa</i> (Hairpin Banksia).
Ground Layer:	0 – 1 m tall with 10 – 70% PFC. The most common species was <i>Poa sieberiana</i> (Snowgrass), with <i>Lepyrodia scariosa</i> (Scale Rush), <i>Rytidosperma pallidum</i> (Silvertop Wallaby Grass), <i>Rytidosperma tenuius</i> (Wallaby Grass), and <i>Lomandra glauca</i> (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 Project Application 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.

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 Project Application 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 to 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 Project Application Area.
Canopy Layer:	11 – 28 m tall with 2 – 50% PFC. Dominant species included; <i>Eucalyptus sieberi</i> (Silvertop Ash), <i>Eucalyptus piperita</i> (Sydney Peppermint) and <i>Eucalyptus sclerophylla</i> (Hard-leaved Scribbly Gum).
Shrub Layer:	0.5 – 4 m tall with 50% PFC. Dominant shrub species included; <i>Acacia terminalis</i> (Sunshine Wattle), <i>Hakea dactyloides</i> (Broad-leaved Geebung), <i>Leptospermum trinervium</i> (Flaky-barked Tea-tree), <i>Monotoca scoparia</i> and <i>Platysace linearifolia</i> .
Ground Layer:	Approximately 0.5 m tall with 5 – 25% PFC. <i>Lomandra glauca</i> (Pale Mat-rush), <i>Caustis flexuosa</i> (Curly Wig), <i>Amperea xiphoclada</i> , <i>Dampiera stricta</i> (Blue Dampiera) and <i>Patersonia glabrata</i> (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 Project Application 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 phyllicoides*, *Hibbertia empetrifolia*, *Leptospermum trinervium* (Slender Tea-tree) and *Hakea dactyloides* (Broad-leaf Geebung).
- Ground Layer:** 0m to 0.5m – 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 Project Application 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 Project Application 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 to 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 to 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 Project Application 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 to 8 m – 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 to 2.5 m – 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 to 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 are sometimes more affected by weed invasion due to previous or repeated disturbance.
Canopy Layer:	Generally absent, but occasionally regrowth 3 to 5 m – 0 to 10% PFC. Typical species include whichever species are naturally occurring adjacent to the cleared area.
Shrub Layer:	Highly variable 0.5 to 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 to 1.5 m – 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

Two EECs were recorded within the Project Application Area. These EECs were:

- Temperate Highland Peat Swamps on Sandstone; and
- Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion (Newnes Plateau Shrub Swamp).

Temperate Highland Peat Swamps on Sandstone is listed as an EEC under the EPBC Act. Vegetation communities recorded within the Project Application Area that correspond to this EEC are MU 50 - Newnes Plateau Shrub Swamp and MU 51 - Newnes Plateau Hanging Swamp within DEC (2006).

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

The locations of these EECs are provided in **Figure 5**.

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.

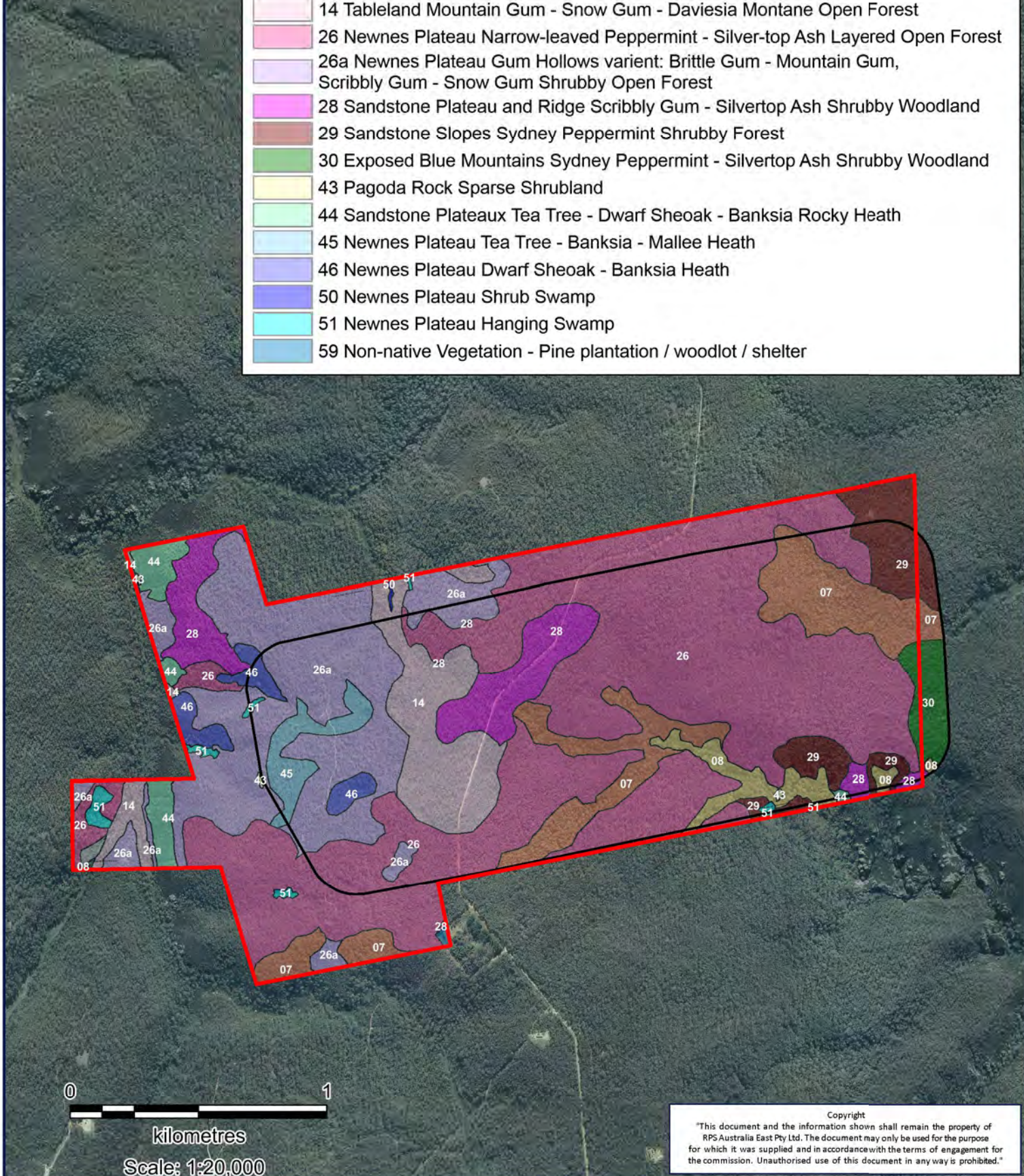
Caution should therefore be exercised when using this data for purposes requiring high levels of accuracy. Furthermore, no account for intergrading areas between delineated vegetation communities has been made.

Legend

- Project Application Area
- 26.5 Degree Angle of Draw

Vegetation Communities

- 07 Newnes Plateau Narrow - Leaved Peppermint - Mountain Gum - Brown Stringybark Layered Forest
- 08 Newnes Sheltered Peppermint - Brown Barrel Shrubby Forest
- 14 Tableland Mountain Gum - Snow Gum - Daviesia Montane Open Forest
- 26 Newnes Plateau Narrow-leaved Peppermint - Silver-top Ash Layered Open Forest
- 26a Newnes Plateau Gum Hollows variant: 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
- 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
- 50 Newnes Plateau Shrub Swamp
- 51 Newnes Plateau Hanging Swamp
- 59 Non-native Vegetation - Pine plantation / woodlot / shelter



TITLE: FIGURE 4: VEGETATION COMMUNITIES

LOCATION: ANGUS PLACE

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 27/02/2014
PURPOSE: REPORT

LAYOUT REF: 1120985 Angus Place Modification
10 - Drafting\MapInfo Workspace\Eco
VERSION (PLAN BY): PH (A A4)

CLIENT: CENTENNIAL
JOB REF: 120986

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
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RPS

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 Project Application 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 Project Application Area that fall into this category are:

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

The potential impacts of the proposed Project on these GDEs have been assessed in **Section 5.1.2** of this report.

3.2.5 Significant Flora

Two threatened flora species were observed within the Project Application Area during flora surveys. These species were:

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

The locations of these threatened flora species are shown in **Figure 5**.

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 inherent difficulty in recording individuals. Therefore this Flora and Fauna Assessment does not attempt to estimate individuals, instead number of stems are recorded.

Records made for this species are predominately along Sunnyside Ridge Road, which runs north to south through the centre of the Project Application Area. Records have also been made off the track in the southwest and north east of the Project Application Area. A total of 141 stems have been recorded within the Project Application Area.

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.

Two individual plants have been recorded within the Project Application Area. One plant has been recorded along Sunnyside Ridge Road and a second plant has been recorded in the west of the Project Application Area.

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.

Legend

- Project Application Area
- 26.5 deg Angle of Draw
- Water Course

Threatened Flora

- *Persoonia hindii*
- ▲ *Veronica blakelyi*

Endangered Ecological Communities

(Temperate Highland Peat Swamps On Sandstone (EPBC Act EEC))

- 50 Newnes Plateau Shrub Swamp (TSC Act I)
- 51 Newnes Plateau Hanging Swamp

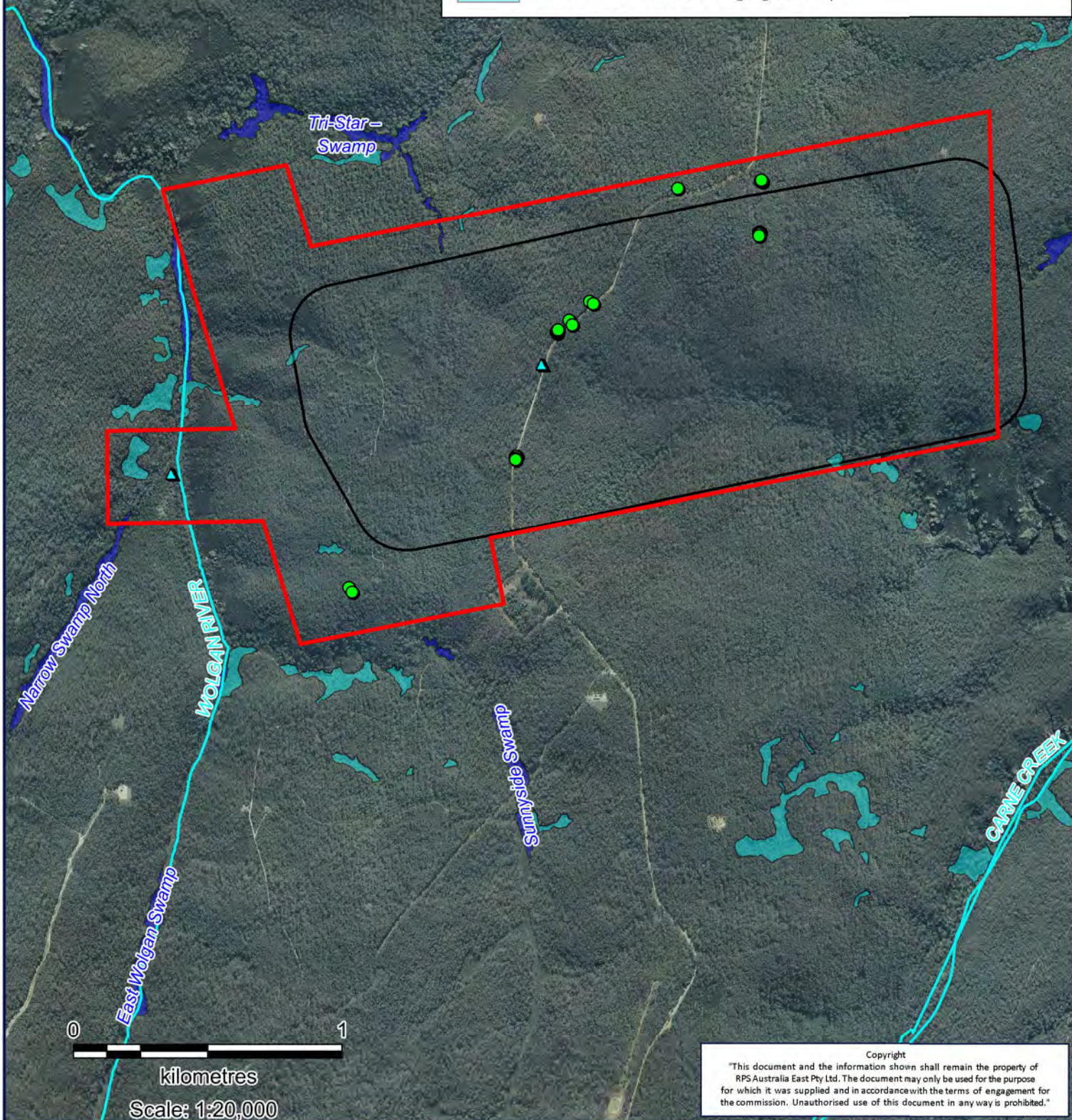


FIGURE 5: LOCATION OF
THREATENED FLORA
SPECIES AND ENDANGERED
ECOLOGICAL COMMUNITIES

LOCATION: ANGUS PLACE

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 22/01/2014
PURPOSE: REPORT

LAYOUT REF: J:\083\Centennial\All Jobs
1120986\Angus Place Modification\10 - Drafting\MapInfo Workspace\Eco
VERSION (PLAN BY): PH (A A4)

CLIENT: CENTENNIAL
JOB REF: 120986

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
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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 Project Application Area. Those species observed within the Project Application Area are discussed further below. Threatened fauna species locations are shown in **Figure 6**. A full list of fauna species recorded within the Project Application 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 Project Application Area 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. The Greater Glider (*Petauroides volans*) and Common Ringtail Possum (*Pseudocheirus peregrinus*) were recorded during spotlighting. Although not observed during surveys, there is suitable habitat within the Project Application Area for smaller gliders such as the Sugar Glider and Squirrel Glider. In addition, one Eastern Pygmy Possum (*Cercartetus nanus*), a species listed as vulnerable under the TSC Act 1995, has been captured approximately 400 m south of the Project Application Area boundary. This species is known to occur throughout the Newnes Plateau.

3.3.3 Bats

Four species of microchiropteran bat were positively identified from Anabat echolocation call recordings, namely:

- Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Chocolate Wattled Bat (*Chalinolobus morio*); and
- Southern Forest Bat (*Vespadelus regulus*).

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

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Gould's Wattled Bat (*Chalinolobus gouldii*);
- Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*);
- Eastern Freetail Bat (*Mormopterus* Species 2); and
- Large Forest Bat (*Vespadelus darlingtoni*).

Yellow-bellied Sheath-tail Bat, Eastern Bentwing Bat and Eastern False Pipistrelle are listed as Vulnerable under the TSC Act. Large-eared Pied Bat is listed as Vulnerable under the TSC Act and EPBC Act.

3.3.4 Avifauna Survey

A moderate diversity of common open forest birds including those characterising elevated habitats were observed across the Project Application Area. Avian species groups encountered, included, but were not limited to, Honeyeaters, Flycatchers, Fairy-wrens, Thornbills, Magpie / Butcherbirds / Currawongs, Parrots / Cockatoos, Quail-thrush, Whistlers, birds of prey and Frogmouths. High country birds such as Grey Currawongs and Red-browed Treecreepers were present as well as a number of threatened bird species including the Scarlet Robin, Flame Robin and Gang-Gang Cockatoo.

There are no Allocasuarina tree species within the Project Application Area that are suited to the foraging requirements of the Glossy Black-Cockatoo (*Calyptrorhynchus lathamii*) and few hollows of sufficient size to provide breeding opportunities for this species.

Although no forest owl species were observed during targeted surveys it is likely that the Project Application Area represents a portion of the local foraging range of both the Masked and Powerful Owls, due to the presence or likely presence of small terrestrial mammals and arboreal mammals, which are the respective prey of these owl species. A limiting factor on the presence of forest owl species may be a generally low density of the large hollows that these species require for breeding, and in the case of the Masked Owl, hollows for roosting purposes.

Habitat within the Project Application Area was considered to provide generally limited opportunities for the Sooty Owl, although a small area of tall gully forest habitat occurs at the eastern end of the Project Application Area, which may represent habitat for locally occurring individuals.

3.3.5 Herpetofauna

Targeted and opportunistic searches for the Blue Mountains Water Skink (*Eulamprus leuraensis*) were undertaken, however only a number of common skink species were recorded, including two species related to the Blue Mountains Water Skink, *E. leuraensis*, namely the Yellow-bellied Water Skink (*E. heatwolei*) and the Eastern Water Skink (*E. quoyii*).

3.4 Secondary and Incidental Observations

During fauna surveys macropod and wombat scats were evident, in addition some scratches on tree trunks were observed. The tree trunk scratches were most likely attributable to Greater Gliders, Ringtail Possums or Lace Monitors (*Varanus varius*). No other secondary indications or incidental observations of note occurred.

3.5 Habitat Survey

Habitats within the Project Application 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 Project Application 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 consisted 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 like 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 Project Application 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 Project Application 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 decorticated bark and small hollows and/or logs for roosting purposes.

Diverse guilds of woodland bird species detected over the Project Application 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 for this threatened species within the Project Application 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.

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 Project Application 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 Project Application Area is located within the Newnes State Forest. The Project Application Area and surrounds, for a distance of greater than 2km in any direction, contain native vegetation, which 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 Project Application Area is connected to the Gardens of Stone National Park to the North, Ben Bullen State Forest to the 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 Project Application Area, the habitat linkages throughout the Project Application 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 Project Application 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 Project Application Area. No assessment under SEPP 44 is required.

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**.

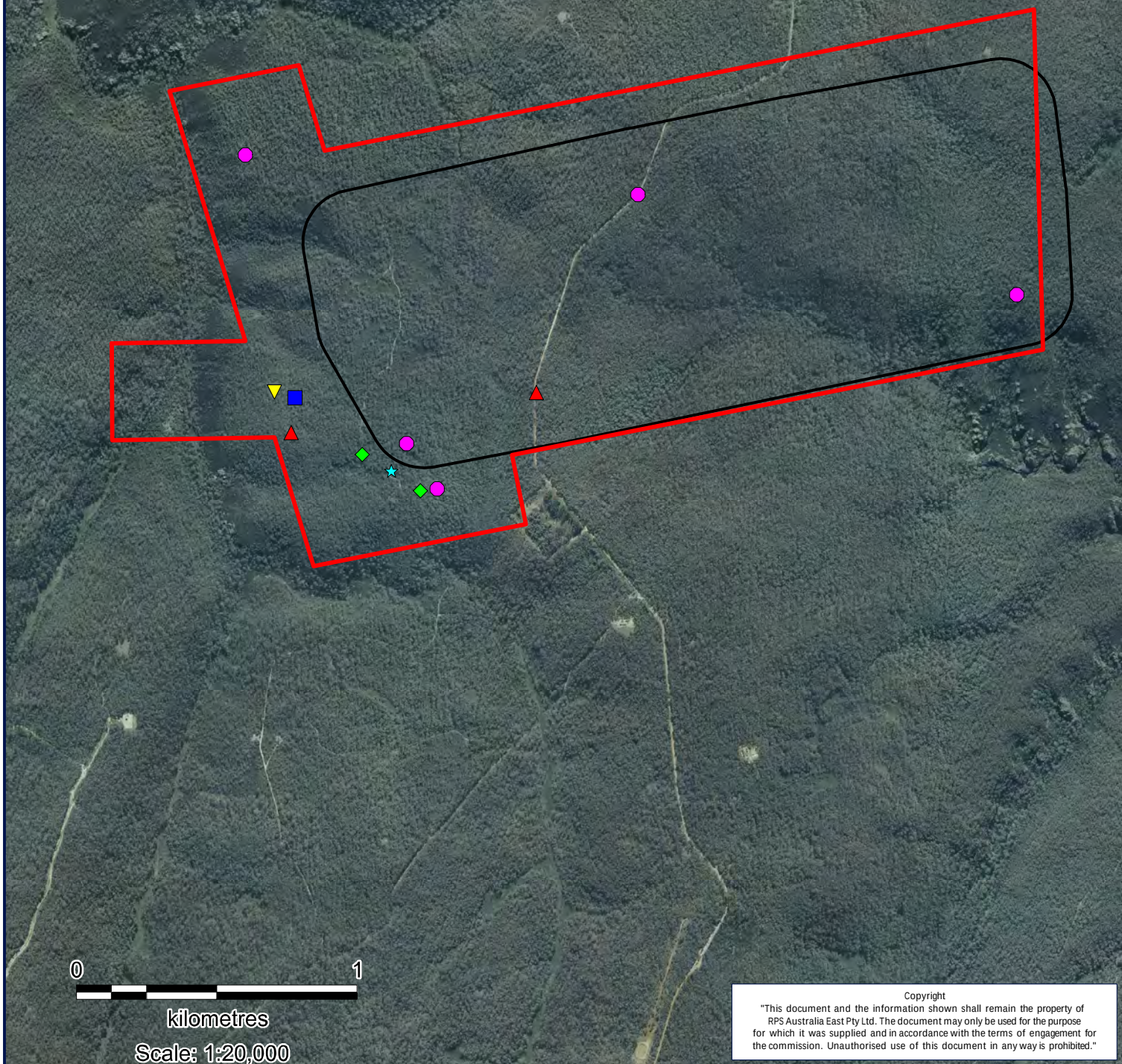
WARNING
No part of this plan should be used
for critical design dimensions.
Confirmation of critical positions
should be obtained from RPS Newcastle.

Legend

- Project Application Area
- 26.5 Degree Angle of Draw

Threatened Fauna

- ▲ Flame robin
- ◆ Gang-gang Cockatoo
- Large-eared Pied Bat
- Scarlet Robin
- ▼ Varied Sitella
- ★ Yellow-bellied Sheatail Bat



TITLE: FIGURE 6: LOCATIONS OF THREATENED FAUNA SPECIES | LOCATION: ANGUS PLACE

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 27/02/2014
PURPOSE: REPORT

LAYOUT REF: 1120986 Angus Place Modification
10 - Drafting\Mapinfo Workspaces\Eco
VERSION (PLAN BY): PH (A A4)

CLIENT: CENTENNIAL
JOB REF: 120986

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RPS

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 Project Application 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 Project Application 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 are 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 Project Application Area in terms of the aforementioned habitat description and taking 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 (including LW1001 and LW1003 extraction, as well as first workings) 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:

- subsidence related impacts (for the area of predicted subsidence, which is referred to in **Table 6**, see MSEC (2013); 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 5**, **Appendix 1** and **Appendix 2** where relevant.

Table 6 Chance of Occurrence and Likely Level of Impact

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
Flora			
<i>Caesia parviflora</i> var. <i>minor</i> (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 <i>C. parviflora</i> have been described and are more common and widespread. A small or stunted <i>C. parviflora</i> of another variety may potentially be mistaken for <i>C. parviflora</i> var. <i>minor</i> . One OEH Atlas of NSW Wildlife record exists within 10 km of the Project Application Area. The location description for this record identifies the plant as occurring at the northern end of Sunnyside Ridge. This record therefore lies approximately 2km to the north of the Project Application 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 Project Application 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. 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 .
<i>Lastreopsis hispida</i> 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 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 <i>Lastreopsis</i> species and its distribution may therefore extend further. Potentially suitable wet forest habitats occur within sheltered gullies of the Project Application Area. This species could potentially occur.	Potential 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 .
<i>Pultenaea glabra</i> 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 <i>et al.</i> , 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 Project Application Area. This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Pultenaea</i> sp. <i>Genowlan Point</i> (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 northwest 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 Project Application Area and therefore unlikely to be impacted.
<i>Acacia bynoeana</i> 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 <i>et al.</i> , 1999).	This species was not recorded by desktop assessments, however records are known from the Blue Mountains. Suitable sandy habitats occur within the Project Application Area. This species could potentially occur.	Potential 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 Assessment of Significance (AoS) (EPBC Act) in Appendix 2 .
<i>Acacia flocktoniae</i> 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 500-1000m above sea level in areas of high rainfall.	The Project Application Area is outside the known distribution of <i>Acacia flocktoniae</i> . This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i> 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 10km radius of the Project Application 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 Project Application Area. This species could potentially occur.	Potential 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
<i>Eucalyptus aggregata</i> 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 <i>Eucalyptus rubida</i> (Candlebark) and <i>E. viminalis</i> (Ribbon Gum) with which it readily hybridises (Field 2008), along with <i>E. pauciflora</i> (Snow Gum) and <i>Poa labillardieri</i> (River Tussock) as an understorey grass.	This species has not been recorded within the Project Application Area, however has been recorded as part of the Angus Place Extension Project. This species occurs along the water courses that may be affected by mine water discharge.	No areas of occupied or potential habitat of this species occur within the areas of predicted subsidence. 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
<i>Eucalyptus cannonii</i> 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 <i>Eucalyptus cannonii</i> is from about 460 to 1040 m. Within the range, the species appears to tolerate most situations except the valley floors.	This species has not been recorded on the Newnes Plateau, with its closest occurrence to the west along the talus slopes off the plateau itself. This species is unlikely to occur.	No areas of occupied or potential habitat of this species occur within the areas of predicted subsidence or mine water discharge. This species is unlikely to be impacted upon.
<i>Eucalyptus pulverulenta</i> 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 occur 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 (<i>Eucalyptus mannifera</i>), Red Stringybark (<i>E. macrorhyncha</i>), Broad-leafed Peppermint (<i>E. dives</i>), Silvertop Ash (<i>E. sieberi</i>) and Apple Box (<i>E. bridgesiana</i>). The nearest population is near Bowenfels, approximately 13 km south of the Project Application Area.	As this species can occur on steep terrain, potential habitat does exist within the Project Application Area, however due to access difficulties these areas could not be traversed to assess potential occurrence. This species could potentially occur.	Potential 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 .
<i>Eucalyptus robertsonii</i> subsp. <i>hemispherica</i> (V, V*)	Tree to 30m high. Known only from the central tablelands of NSW, from north of Orange to Burruga. It is locally common in grassy or dry sclerophyll woodland or forest. It occurs in close association with other Eucalypts including <i>Eucalyptus piperita</i> , <i>Eucalyptus goniocalyx</i> , <i>E. dalrympleana</i> , <i>E. dives</i> , <i>E. mannifera</i> and <i>E. rossi</i> . Habitats include ridges and upper slopes.	The Project Application Area is outside the known distribution of this species and it is therefore unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Melaleuca biconvexa</i> 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 Project Application 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 Project Application Area and therefore unlikely to be impacted.
<i>Cryptostylis hunteriana</i> Leafless Tongue-orchid (E, V*)	Occupies swamp heath, but also in sclerophyll forest and woodland, often on sandy soils. Typically found in communities containing <i>Eucalyptus haemastoma</i> , <i>E. capitellata</i> and <i>Corymbia gummifera</i> . Its distribution in NSW is primarily coastal.	The Project Application Area is outside its known distribution of <i>Cryptostylis hunteriana</i> . This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Genoplesium superbum</i> (E)	<i>Genoplesium superbum</i> 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. <i>Genoplesium superbum</i> 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 Project Application 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. 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 .
<i>Prasophyllum fuscum</i> Tawny Leek Orchid (CE, V*)	<i>Prasophyllum fuscum</i> 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. 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 .
<i>Prasophyllum</i> sp. <i>Wybong</i> (<i>C.Phelps</i> 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 Project Application Area is outside of the known distribution of this species. It is considered unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
<i>Grevillea evansiana</i> (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 Project Application Area. This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Grevillea obtusiflora</i> (E, E*)	Two subspecies of <i>Grevillea obtusiflora</i> exist, with subspecies <i>obtusiflora</i> occurring within Clandulla State Forest near Rylstone and subspecies <i>fecunda</i> occurring in the Capertee Valley and Gardens of Stone National Park, northwest of Lithgow. Subspecies <i>fecunda</i> 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 metres. It grown in association with <i>Eucalyptus tenella</i> , <i>E. fibrosa</i> , <i>E. macrorhyncha</i> , <i>E. punctata</i> , <i>Callitris endlicheri</i> , <i>Acacia buxifolia</i> , <i>Leptospermum continentale</i> , <i>Monotoca elliptica</i> , <i>Persoonia linearis</i> , <i>Indigofera</i> sp. and <i>Pomax umbellata</i> .	The associated habitat features of this species are not present within the Project Application Area. This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Persoonia acerosa</i> 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 Project Application Area. This species could potentially occur.	Potential 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 .
<i>Persoonia hindii</i> (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 Project Application 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 .
<i>Persoonia marginata</i> 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 wildlife atlas data for this species shows that most records do occur in association with the Shoalhaven Group Sediments. Wildlife atlas records also occur over areas mapped as Illawarra Coal Measures. The Project Application Area lies entirely over the Narrabeen Group sediments. This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Asterolasia elegans</i> (E, E*)	This species is endemic to the Maroota district of northern Sydney, with a. current known distribution of less than 37km 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 <i>et al</i> 1999).	The Project Application Area is outside its known distribution of <i>Asterolasia elegans</i> . This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Boronia deanei</i> 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 Project Application Area. However, potentially suitable habitat occurs in the form of swamps and damp riparian habitats. This species could potentially occur.	As this species has the potential to occur within the Project Application 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 .
<i>Pomaderris brunnea</i> 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 <i>et al.</i> , 1999).	The Project Application Area is outside of the known distribution of <i>Pomaderris brunnea</i> . This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Thesium australe</i> Austral Toadflax (V, V*)	This species occurs in grassland or grassy woodland and is often found in damp sites in association with kangaroo grass (<i>Themeda australis</i>). 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 Project Application Area.	This species has not been recorded within the Project Application Area, however this species may potentially occur along the watercourses that may be affected by mine water discharge.	No areas of occupied or potential habitat of this species occur within the areas of predicted subsidence. This species is may occur downstream of proposed discharge points, which has potential indirect impacts. 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 .
<i>Veronica blakelyi</i> (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 Project Application 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 .
<i>Euphrasia arguta</i> (CE, CE*)	This species is known from Nundle State Forest and adjacent private land in NSW in an area estimated to be 26km ² (NSW DPI 2008).	This species is extremely rare and potentially locally extinct, historic records indicate a habitat that is not represented within the Project	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
	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.	Application Area. This species is unlikely to occur.	
<i>Haloragis exalata</i> subsp. <i>exalata</i> (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 Project Application Area is outside of the known distribution of <i>Haloragis exalata</i> subsp. <i>exalata</i> . The species is therefore unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Haloragodendron lucasii</i> (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 Project Application Area is outside of the known distribution of <i>Haloragodendron lucasii</i> . The species is therefore unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Pelargonium</i> sp. <i>Striatellum</i> (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 Project Application Area. This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Philotheca ericifolia</i> (V*)	This species inhabits the northwestern 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 Project Application Area is to the southwest of the known distribution of <i>Philotheca ericifolia</i> . The species is therefore unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Wollemia nobilis</i> 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 Project Application Area and therefore unlikely to be impacted.
Invertebrates			
<i>Paralucia spinifera</i> 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 <i>Bursaria spinosa</i> subsp. <i>lasiophylla</i> (Blackthorn) which is used as the larval food plant. Found above 850m, 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).	No areas of suitable habitats occur within the Project Application Area. This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Petalura gigantea</i> Giant Dragonfly (E)	<i>Petalura gigantea</i> 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.	Potential swamp habitats occur within the Project Application Area and therefore this species potentially occurs. Additional areas of suitable swamp habitat also within other parts of the Project Application Area.	Potential 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 .
Amphibians			
<i>Heleioporus australiacus</i> Giant Burrowing Frog (V, V*)	Confined to the eastern slopes of the Great Divide in southeast 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 within the Angus Place lease area by call recognition (BMS 2011b). The location description provided was the 'Kangaroo Creek road crossing'. This species is likely to occur.	Potential 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 .
<i>Mixophyes balbus</i> 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 to 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 Project Application Area. This species is likely to occur.	Potential 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 .
<i>Pseudophryne australis</i> 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 Project Application Area. This species could potentially occur.	Potential 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
<i>Litoria booroolongensis</i> 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 Project Application Area, a lack of perennial rocky stream habitat limits the potential for the species to inhabit the Project Application Area. This species is therefore considered unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Litoria littlejohni</i> 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 Project Application 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 Project Application Area, this species could potentially occur.	Potential 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 as an AoS (EPBC Act) in Appendix 2 .
Reptiles			
<i>Aprasia parapulchella</i> 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 <i>et al.</i> , 2009).	This species has a more western distribution than the Project Application 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 Project Application Area and therefore unlikely to be impacted.
<i>Eulamprus leuraensis</i> 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 occurs within the Project Application 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 as an AoS (EPBC Act) in Appendix 2 .
<i>Varanus rosenbergi</i> 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. NSW Wildlife Atlas (2014) records exist for the species within the sites' locality in Gardens of Stone and Wollemi NPs.	The sandstone habitats required for this species occur within the Project Application 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. 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 .
<i>Hoplocephalus bungaroides</i> 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 <i>et al.</i> , 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. Five records for this species exist within a 10 km radius of the Project Application Area (NSW Wildlife Atlas Data 2014).	Targeted searches did not detect this species within the Project Application Area however suitable habitat in the form of sandstone outcrops with adjacent forest vegetation does occur within the Project Application Area. This species could potentially occur.	Potential 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 as an AoS (EPBC Act) in Appendix 2 .
Birds			
<i>Botaurus poiciloptilus</i> 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 Project Application 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 Project Application Area and therefore unlikely to be impacted.
<i>Heiraaetus morphnoides</i> 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 Project Application 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 Project Application Area, most likely traversing the site en route to more favourable habitats.	Whilst this species has been recorded, areas of predicted subsidence provide little if any areas 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
<i>Lophoictinia isura</i> 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 known record within the locality of the site is situated within Wolgan Valley to the north (NSW Wildlife Atlas data 2014).	The various habitats of the Project Application 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 Project Application Area and therefore unlikely to be impacted.
<i>Rostratula australis</i> 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 <i>et al.</i> , 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 Project Application 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 Project Application Area and therefore unlikely to be impacted.
<i>Callocephalon fimbriatum</i> 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.	This species has been recorded within the Project Application 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 .
<i>Calyptorhynchus lathamii</i> 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 <i>A. littoralis</i> , <i>A. torulosa</i> and at time <i>A. distyla</i> (NSW Scientific Committee 2008b). Requires large Eucalypt tree hollows for nesting.	This species has been recorded within the Angus Place lease area in previous surveys (MKES 2006a, 2007 and BMS 2009c). This species is likely to occur.	Potential 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 .
<i>Glossopsitta pusilla</i> 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 (<i>Eucalyptus meliodora</i>) and White Box (<i>E. albens</i>) 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 Project Application Area (NSW Atlas Data 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.	Potential 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 .
<i>Lathamus discolor</i> 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 Project Application Area and therefore unlikely to be impacted.
<i>Neophema pulchella</i> 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 Project Application 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 Project Application Area and therefore unlikely to be impacted.
<i>Ninox connivens</i> 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 <i>Melaleuca</i> species (NPWS 2003). Roosts in dense foliage in large trees including rainforest species of streamside gallery forests.	This species has been recorded within the Angus Place lease area in previous surveys (MKES 2006a). This species is likely to occur.	Potential 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 .
<i>Ninox strenua</i> 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 Angus Place lease area during previous surveys (RPS 2013). This species is likely to occur.	Potential 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
<i>Tyto novaehollandiae</i> 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 Project Application Area.	Potential 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 .
<i>Tyto tenebricosa</i> 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 <i>et al.</i> , 2000).	This species has been recorded within the Angus Place lease area in previous surveys (BMS 2010c). This species is likely to occur.	Potential 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 .
<i>Climacteris picumnus victoriae</i> 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 Angus Place lease area in previous surveys (MKES 2004a, 2006a, 2008c and BMS 2009c, 2010c, 2011b). This species is likely to occur.	Potential 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 .
<i>Chthonicola sagittata</i> 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 <i>et al.</i> 2000).	This species has been recorded within the Angus Place lease area in previous surveys (MKES 2006a and BMS 2009c). This species is likely to occur.	Potential 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 .
<i>Anthochaera phrygia</i> 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 <i>et al.</i> , 2000). Seasonal movements appear to be dictated by the flowering of various <i>Eucalyptus</i> 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 <i>Eucalyptus</i> 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. 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 .
<i>Grantiella picta</i> Painted Honeyeater (V)	This species occurs in scattered locations through eastern and mid NSW north to QLD and south to central Victoria (Higgins <i>et al.</i> 2001). In NSW this species is widespread on and west of the Great Dividing Range from Tenterfield, Glen Alice, Canberra and Kosciusko NP (Higgins <i>et al.</i> 2001). Generally occurs on dry open woodlands and forest that are strongly associated with mistletoes (Higgins <i>et al.</i> 2001). Woodlands including species such as Red Ironbark, Mugga, Yellow Box, Broad-leaved Peppermint with drooping <i>Amyema pendulum</i> and <i>A. miquelii</i> mistletoes preferred (Higgins <i>et al.</i> 2001).	This species was not detected within the Project Application Area with only one record existing within a 10km radius of the Project Application Area (NSW Atlas Data 2013). There is an abundance of mistletoe within the Project Application Area amongst suitable habitat for this species. This species could potentially occur.	Potential 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 .
<i>Melithreptus gularis gularis</i> 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 <i>et al.</i> , 2000). Habitat species include Mugga Ironbark (<i>E. sideroxylon</i>), White Box (<i>E. albens</i>), Inland Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>), Blakely's Red Gum (<i>E. blakelyi</i>) and Forest Red Gum (<i>E. tereticornis</i>).	This species has been recorded within the Angus Place lease area in previous surveys (MKES 2004a). This species is likely to occur.	Potential 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 .
<i>Pomatostomus temporalis temporalis</i> 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 <i>et al.</i> 2000; Higgins and Peter 2002). Occupies open forests and woodlands especially on inland plains, and also live in acacia shrublands and adjoining farmland (Garnett <i>et al.</i> , 2000; Higgins and Peter 2002). Requires an open shrub layer with sparse ground cover and fallen timber and leaf-litter.	This species has been recorded within the Springvale lease in previous surveys (MKES 2006c). Available habitat for the species exists within the Project Application Area. This species is likely to occur.	Potential 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
<i>Daphoenositta chrysoptera</i> 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 Angus Place lease area during previous surveys (RPS 2013). This species is likely to occur.	Potential 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 .
<i>Melanodryas cucullata cucullata</i> Hooded Robin (south-eastern subsp.) (V)	<i>Melanodryas cucullata cucullata</i> occur widely across south-eastern Australia aside from driest deserts and wetter coastal areas. (Garnett <i>et al.</i> , 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 Angus Place lease area in previous surveys (MKES 2004a, 2006a). This species is likely to occur.	Potential 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 .
<i>Petroica boodang</i> Scarlet Robin (V)	Scarlet Robins are located in south-eastern Australia and south-west western Australia. 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 Project Application 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 .
<i>Petroica phoenicea</i> Flame Robin (V)	Flame Robins are found in south-eastern Australia from the QLD border to Tasmania (Garnett <i>et al.</i> , 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 <i>et al.</i> , 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 Project Application 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 .
<i>Stagonopleura guttata</i> 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 <i>et al.</i> , 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 <i>et al.</i> , 2000).	The grassy eucalypt-dominated habitats typically associated with this species are not present. This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
Mammals			
<i>Dasyurus maculatus maculatus</i> Spotted-tailed Quoll (SE mainland subsp.) (V, E*)	In NSW, this species is largely confined to within 200km 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 600mm/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).	Suitable habitat for this species does occur within the Project Application Area. This species could potentially occur.	Potential 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 .
<i>Isodon obesulus obesulus</i> 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, sedge land and woodland, preferring a dense understorey 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 Project Application Area. However, this species is known to occur within the Blue Mountains National Park. Suitable habitat for this species does occur within the Project Application Area. This species could potentially occur.	Potential 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 .
<i>Phascolarctos cinereus</i> 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	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). This species is likely to occur.	Potential 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

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
	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 <i>Eucalyptus tereticornis</i> , <i>E. camaldulensis</i> , <i>E. robusta</i> , <i>E. punctata</i> and <i>E. parramattensis</i> (Phillips <i>et al.</i> , 2000; Strahan 1995). They have also been known to frequent isolated paddock trees and roadside remnant vegetation. Populations in NSW now exist in fragmented and isolated habitats, and scattered records exist for the areas in the Blue Mountains including within the Gardens of Stone NP and along the Glow Worm Tunnel track (NSW Wildlife Atlas data 2014).		Appendix 2
<i>Cercartetus nanus</i> 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 Angus Place lease area during previous surveys (RPS 2013). This species is likely to occur.	Potential 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 .
<i>Petaurus australis</i> 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 Project Application Area during fieldwork. Five records exist for this species within a 10 km radius of the Project Application 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. 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 .
<i>Petaurus norfolcensis</i> 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 Angus Place lease area in previous surveys (MKES 2006a). This species is likely to 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 .
<i>Potorous tridactylus tridactylus</i> Long-nosed Potoroo (mainland subsp.) (V, V*)	Long-nosed Potoroo has a patchy distribution throughout southeastern Australia and Tasmania with an isolated population occurring in southwest 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 Project Application Area exist. Potential habitat within the Project Application 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 Project Application Area and therefore unlikely to be impacted.
<i>Petrogale penicillata</i> 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 Project Application Area (NSW Atlas Data 2013). Steep rocky areas do occur within the Project Application Area, offering potential habitat for this species. This species could potentially occur.	Potential 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 .
<i>Pteropus poliocephalus</i> 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 Project Application Area exist. This species is unlikely to inhabit areas of high altitudes such as those within the Project Application Area. This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.

Species / Community	Habitat Description	Likelihood of Occurrence	Potential Impact
<i>Saccolaimus flaviventris</i> 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 Project Application Area.	Potential 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 .
<i>Mormopterus norfolkensis</i> 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 Angus Place lease area in previous surveys (MKES 2007, 2008c). This species is likely to occur.	Potential 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 .
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat (V, V*)	Distributed from southeast 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 (<i>Hirundo ariel</i>) 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, <i>Callitris</i> 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 Project Application 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 as well an AoS (EPBC Act) in Appendix 2 .
<i>Chalinolobus picatus</i> 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 <i>et al.</i> , 1999).	This species was not identified during desktop assessments or recorded on site 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 Project Application Area.	Potential 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 .
<i>Falsistrellus tasmaniensis</i> Eastern False Pipistrelle (V)	This species is distributed from southeast 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 Project Application 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 .
<i>Miniopterus schreibersii oceanensis</i> 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 Angus Place lease area during previous field surveys (RPS 2013). This species is likely to 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 .
<i>Nyctophilus corbeni</i> South-eastern Long-eared Bat (V, V*)	A recently described species, this species is the southeastern form of the Greater Long-eared Bat (<i>Nyctophilus timoriensis</i>) that is restricted around the Murray-Darling Basin in southeastern Australia. It is distributed throughout inland NSW except in the northwest area which 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 Project Application Area exist. This species is typically a more western species. This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Scoteanax rueppellii</i> 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 <i>et al.</i> , 2000).	This species has been recorded within the Angus Place lease area in previous surveys (BMS 2009c, 2010c). This species is likely to 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 .
<i>Vespadelus troughtoni</i> 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 (Churchill 2009). It has been found roosting in small groups in relatively	This species was not recorded during field surveys and only two records for this species exist within a 10 km radius of the Project Application Area (NSW Atlas Data 2013). Potential foraging habitat for this species is widespread across the Project Application Area, as are rock crevices and caves which offer roosting habitat for this species. This species could	Potential 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
	well-lit sandstone overhangs, in mine tunnels and occasionally in buildings (Strahan 1995).	potentially occur.	
<i>Pseudomys fumeus</i> Smoky Mouse (CE, E*)	Distributed over Victoria, NSW and ACT but with small fragmented populations; in NSW it is confined to the southeastern 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 southeast corner of the state. This species is unlikely to occur.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Pseudomys novaehollandiae</i> New Holland Mouse (V*)	Distributed across Tasmania, Victoria, NSW and QLD, predominantly in coastal locations (Strahan 1995), however some records exist up to 100km 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 Project Application 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 Project Application Area. This species could potentially occur.	Potential habitat for this species occurs within the areas of predicted subsidence. Therefore, it has the potential to be impacted. An AoS (EPBC Act) has been applied to this species in Appendix 2 .
Fish			
<i>Maccullochella peelii</i> Murray Cod (V*)	The largest freshwater fish in Australia found extensively throughout the Murray Darling Basin in the southeast 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 Project Application Area.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Macquarie australasica</i> 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 Project Application Area.	This species is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.
<i>Prototroctes maraena</i> Australian Grayling (E*)	The species is diadromous, migrating between rivers, their estuaries and coastal seas across the southeast of the continent including southern NSW, Victoria and Tasmania. The adults are known to occur up to 100km 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 <i>et al.</i> , 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 Project Application Area.	This species is unlikely to occur within the Project Application Area and 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 watercourses 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.	This community has been recorded within the Project Application 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*)	Temperate Highland Peat Swamps on Sandstone is comprised of 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) (Environment Australia 2000) regions in New South Wales.	This community has been recorded within the Project Application 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
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 comprise 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 <i>Sphagnum</i> spp., the hummock peat-forming mosses. Small trees may be present as scattered emergents or absent.	This species has not been recorded within the Project Application Area and is unlikely to occur.	This community was mapped by DEC (2006) far from the areas of predicted subsidence. 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: <i>Eucalyptus albens</i> (White Box), <i>E. melliodora</i> (Yellow Box) and <i>E. blakelyi</i> (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 species has not been recorded within the Project Application Area and is unlikely to occur.	This community is unlikely to occur within the Project Application Area and 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 open-forest, woodland or open woodland. This community may also occur as secondary grassland where the trees have been removed, but the groundlayer remains. The the main tree species are <i>Eucalyptus pauciflora</i> (Snow Gum), <i>E. rubida</i> (Candlebark), <i>E. stellulata</i> (Back Sallee) and <i>E. viminalis</i> (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 species has not been recorded within the Project Application Area. However, this community has been mapped by DEC (2006) as occurring along the watercourses that may be influenced by mine water discharge.	This community was mapped by DEC (2006) far from the areas of predicted subsidence and ESAs. However, this community has been mapped by DEC (2006) within along watercourses that may be influenced by mine water discharge. 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 .
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). Dominant eucalypt sp include <i>E. fastigata</i> (Brown Barrel), <i>E. viminalis</i> (Ribbon Gum) and <i>E. radiata subsp. radiata</i> (Narrow-leaved Peppermint). <i>E. oreades</i> (Blue Mountains Ash) and <i>E. blaxlandii</i> (Blaxland's stringybark) are prevalent in the Blue Mountains forms.	No suitable basalt derived habitats exist within the Project Application Area. This community is unlikely to occur.	This community is unlikely to occur within the Project Application Area and therefore unlikely to be impacted.

Key:

- V

Vulnerable Species under the TSC Act
- E

Endangered Species under the TSC Act
- CE

Critically Endangered under the TSC Act
- V*

Vulnerable Species under the EPBC Act
- E*

Endangered Species under the EPBC Act
- CE*

Critically Endangered under the EPBC Act

5.0 Potential Impacts

5.1 Subsidence

5.1.1 Predicted Subsidence

It is to be noted that approval for this project is limited to first workings only. However, the potential impacts resulting from longwall extraction (secondary workings) are provided below for completeness.

The first workings are designed to be stable and self-supporting and, therefore, are not expected to result in any measurable subsidence at the surface (i.e. less than 20 mm of vertical subsidence). The predicted tilts, curvatures and strains resulting from the extraction of the first workings are negligible and are not expected to be measurable at the surface using normal ground monitoring techniques (MSEC, 2014 section 4.2).

The maximum predicted subsidence, tilt and curvature due to second workings is also discussed in MSEC (2014 section 4.3). The maximum predicted total conventional subsidence during extraction is 1,050mm and 1,350mm after the completion of all the two longwalls. 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 (subsidence extents) is provided in **Table 7** below.

Longwall mining has been undertaken at 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 would 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 2013 section 3.7.). There is therefore a high level of accuracy between pre-mining modelled subsidence predictions and post-mining measured subsidence.

Table 7 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	31.12
08 Newnes Sheltered Peppermint - Brown Barrel Shrubby Forest	7.50
14 Tableland Mountain Gum - Snow Gum - Daviesia Montane Open Forest	21.99
26 Newnes Plateau Narrow-leaved Peppermint - Silvertop Ash Layered Open Forest	131.63
26a Newnes Plateau Gum Hollows variant: Brittle Gum - Mountain Gum, Scribbly Gum - Snow Gum Shrubby Open Forest	34.58
28 Sandstone Plateau and Ridge Scribbly Gum - Silvertop Ash Shrubby Woodland	14.65
29 Sandstone Slopes Sydney Peppermint Shrubby Forest	13.16
30 Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	6.82
43 Pagoda Rock Sparse Shrubland	0.10
44 Sandstone Plateaux Tea Tree - Dwarf Sheoak - Banksia Rocky Heath	0.16
45 Newnes Plateau Tea Tree - Banksia - Mallee Heath	6.60
46 Newnes Plateau Dwarf Sheoak - Banksia Heath	2.98
51 Newnes Plateau Hanging Swamp	0.32
Total	271.61

5.1.2 Potential Impacts to Groundwater Dependent Ecosystems (GDEs)

The first workings are not expected to result in any measurable surface subsidence and only negligible tilts, curvatures and strains are expected (MSEC 2014 section 4.2). In addition, no measurable impacts to groundwater drawdown or base flows are considered likely as a result of first workings (RPS 2014 section 9.2). Therefore, no impacts to any GDEs are expected to occur as a result of the first workings.

Approval for longwall extraction (secondary workings) is not being sought as part of this project, however the potential impacts of longwall extraction on GDEs are herewith provided for completeness. One vegetation types has been identified as Groundwater Dependent Ecosystems (GDE's) within the predicted subsidence extent of the secondary workings, namely MU 51 - Newnes Plateau Hanging Swamp. Whilst not mapped within the subsidence extent, one additional GDE occurs within the Project Application Area, namely MU 50 - Newnes Plateau Shrub Swamp. The closest shrub swamps located at distances of 190 metres, 225 metres and 550 metres from these longwalls.

This section provides a summary of the potential impacts to GDE's, 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 ground water 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 an average thickness of 22 metres. This unit has been found to act as an aquitard.

5.1.2.1 Newnes Plateau Shrub Swamps

The first workings are not expected to result in any measurable surface subsidence and only negligible tilts, curvatures and strains are expected (MSEC 2014 section 4.2). In addition, no measurable impacts to groundwater drawdown or base flows are considered likely as a result of first workings (RPS 2014 section 9.2). Therefore, no impacts to any shrub swamps are expected to occur as a result of the first workings.

Approval for longwall extraction (secondary workings) is not being sought as part of this project, however the potential impacts of longwall extraction on shrub swamps are provided for completeness. There are no shrub swamps located directly above the proposed longwalls. Tri Star Swamp is located at a minimum distance of 225 metres north of the proposed LW1003. Sunnyside Swamp is located at a minimum distance of 550 metres south of the proposed LW1001. A shrub swamp along a tributary to Carne Creek is also located at a minimum distance of 190 metres east of the proposed LW1003. Summaries of the maximum predicted subsidence, tilts and curvatures for the shrub swamps and the hanging swamps located in the vicinity of the predicted subsidence extents is provided in MSEC (2014 section 5.12.2).

Mining can potentially affect surface water flows through swamps, if the mining induced tilts of longwall extractions are much greater than the natural gradients, potentially resulting in increased levels of ponding or scouring, or affecting the distribution of the captured water within swamps. The predicted post mining grades are similar to the natural grades along these typical drainage lines. It is not expected, therefore, that there would be any adverse changes in ponding or scouring within the swamps resulting from the predicted mine subsidence movements. It is also not 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).

It is possible that some minor and isolated fracturing could occur in the bedrock beneath the swamps located outside the extents of the proposed longwalls, however, it is not expected to result in any adverse impacts on these swamps. The dilated strata beneath the drainage lines, upstream of the swamps, could result in the diversion of some surface water flows beneath parts of the shrub swamps. The shrub swamps comprise significant quantities of sediment and, therefore, fracturing of shallow bedrock beneath these swamps are likely to be filled with soil during subsequent flow events along the drainage lines (MSEC 2014 section 5.12.5).

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 (MSEC 2014 section 5.12.5).

An assessment of possible changes to base flows in swamps has been undertaken by RPS (2014 section 8.2). The impacts of surface water infiltrating underground are limited, localised and temporary since any cracks and fractures tend to be sealed by sediments in the long term. The base flow contribution for the recharge of the swamps will most likely increase due to increased horizontal permeability of the upper most layers. Furthermore there is no evidence of past underground mining affecting the flows and levels of the swamps. The risk of a fracture occurring exactly at the location of one of the swamps and affecting the water flows and levels exist but it is very unlikely.

Studies of peat swamps akin to those found on the Newnes Plateau showed that these swamps exhibit resilience to changes in base flows and water levels as a result of the capillary action of the underlying peat layer (Gough 2010; Hose *et al.*, 2004). In addition, 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 of mining to date at Angus Place. As a result, any small reductions in the water levels are unlikely to result in drying of the peat layer to the extent that the integrity of the shrub swamps is compromised.

5.1.2.2 Newnes Plateau Hanging Swamps

The first workings are not expected to result in any measurable surface subsidence and only negligible tilts, curvatures and strains are expected (MSEC 2014, section 4.2). In addition, no measurable impacts to groundwater drawdown or base flows are considered likely as a result of first workings (RPS 2014 section 9.2). Therefore, no impacts to any hanging swamps are expected to occur as a result of the first workings.

Approval for longwall extraction (secondary workings) is not being sought as part of this project, however the potential impacts of longwall extraction on shrub swamps are provided for completeness. There is one hanging swamp located directly above the western end of the proposed LW1001 and a further five hanging swamps which are located outside the proposed longwalls but within the Project Application Area.

The hanging swamps are located on the sides of the valleys and, therefore, are not expected to experience significant valley related upsidence movements or compressive strains due to closure movements (associated with the secondary workings), which occur near the bases of the valleys. The hanging swamps, which are located directly above or immediately adjacent to the proposed longwalls, could experience tensile strains greater than 0.5 mm/m. It is expected, therefore, that fracturing would occur in the top most bedrock beneath these swamps.

The maximum predicted tilts at the hanging swamps are up to 6mm/m, are considerably less than the natural gradients, which vary from 25 to 300mm/m. On this basis adverse impacts regarding ponding or scouring and significant changes to the distribution of stored surface water within the swamps are considered unlikely (RPS 2014 section 8.2.1).

Hanging swamps present within the Project Application 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.

There have been no reported impacts on hanging swamps at Angus Place or Springvale Collieries. In addition to this, there have been no reported impacts on headwater swamps on the Woronora Plateau, which develop along valley sides, similar to the hanging swamps of the Newnes Plateau. It is also expected, therefore, that there would be no adverse impacts on the hanging swamps resulting from the extraction of LW1001 and LW1003.

5.1.3 Potential Impacts to Riparian Habitats

Riparian habitats identified within or in the vicinity of the Project Application Area include the Wolgan River, Carne Creek and minor drainage lines that feed into these watercourses. These may provide habitat for those threatened frog species that have potential to occur within the Project Application Area. Potential subsidence related impacts upon riparian habitats might include surface cracking, ponding or erosion due to changes of gradient. MSEC (2014 section 5) provides a detailed description of the subsidence parameters for these features.

The subsidence resulting from the first workings is predicted to be negligible (i.e. not measurable at the surface) (MSEC 2014, section 4.2). It is not expected, therefore, that riparian habitats would experience any adverse impacts due to the development of the first workings. Approval for longwall extraction (secondary workings) is not being sought as part of this project, however the potential impacts of longwall extraction on riparian habitats are provided for completeness.

Carne Creek is located 900 metres southeast of LW1001, at its closest point to the proposed longwalls. At this distance, it is not expected that the creek would experience any measurable conventional subsidence or valley related movements resulting from the extraction of the proposed longwalls. It is expected, therefore, that Carne Creek would not experience any adverse impacts (MSEC 2014 section 5.3).

Predicted post-mining grades are similar to the natural grades along the Wolgan River and 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, flooding or scouring along the Wolgan River or drainage lines resulting from the proposed mining. It is possible that there could be very localised areas along the drainage lines, which could experience small increases in the levels of ponding, where the natural gradients are low, immediately upstream of the chain pillar or panel edges. The predicted changes in grade are small, typically less than 10 mm/m (i.e. 1 %), however, any localised changes in ponding are expected to be minor and not result in adverse impacts on the drainage lines (MSEC 2014 section 5.4.4.).

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 and the draining of pooled water within the alignments. It is not expected that there would be any net loss of water from the catchment. The depth of dilation and fracturing is expected to be less than 10 metres to 15 metres and, therefore, any diverted surface water is likely to re-emerge into the catchment further downstream (MSEC 2014 section 5.4.4.).

The cracking incidences, as observed in Kangaroo Creek, indicate that longwall extractions during secondary workings have the potential to cause minor changes to flows within riparian habitats. These changes have been found not 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.

The proposed longwalls are located at a distance of 560 metres from the centreline of the Wolgan River, at their closest point. Historical observations indicate that, at these distances, mining induced fracturing is not expected to occur in the bed of the river. If any fracturing were to occur in the bed of the Wolgan River, resulting from the extraction of the proposed longwalls, it would be isolated and minor in nature. The fractures are expected to be shallow and discontinuous and, therefore, are not expected to result in any diversion of surface water flows into subterranean flows (MSEC 2014 section 5.4.3.).

5.1.4 Potential Impacts to Caves and Rocky Habitats

The subsidence resulting from the first workings is predicted to be negligible (i.e. not measurable at the surface). It is not expected, therefore, that the cliffs, minor cliffs or pagodas would experience any adverse impacts due to the development of the first workings (MSEC 2014 section 5.7.3). Approval for longwall extraction (secondary workings) is not being sought as part of this project, however the potential impacts of longwall extraction on riparian habitats are provided for completeness.

It is expected that the cliffs and pagoda complexes would not experience any adverse impacts resulting from the extraction of the proposed longwalls. The isolated pagodas which are located directly above the proposed longwalls are also likely to experience some fracturing and, where the rock is marginally stable, could then result in spalling of the exposed rockfaces. The isolated pagodas are discontinuous and, therefore, are less susceptible to impacts when compared with cliffs and minor cliffs.

It is unlikely that the cliffs and pagoda complexes would experience any significant adverse impacts resulting from the extraction of the proposed longwalls. 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.

5.1.5 Potential Impacts to Wooded Habitats

No significant impacts to the dry woodland and forest habitats are predicted as a result of subsidence during either the first workings or the longwall extractions during secondary workings. 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.

5.2 Mine Water Discharge

The increase in Mine Water Discharge (MWD) as a result of the first workings is predicted to increase by up to 0.73ML/day. However, this level is considered insignificant given the current Angus Place dewatering results in a discharge of 13ML/day. As a result, the additional discharge of first workings can be accommodated within the existing discharge licences and infrastructure (MSEC 2014, section 9.1), and no impacts as a result of the small increase in flows are expected as a result of first workings.

Approval for longwall extraction (secondary workings) is not being sought as part of this project, however the potential changes to MWD as a result of longwall extractions and their associated impacts are provided for completeness. A description of the 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 Kangaroo Creek and then the Coxs River. The potential impacts from increased mine water discharge as a result of secondary workings 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 6** 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.

This section considers the cumulative effects of the proposed mine water discharge upon the biodiversity values of the receiving watercourses.

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 (RPS 2014b). This will comprise upgrade of Angus Place's portion of the SDWTS by Angus Place Mine as well as 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.

Increased dewatering requirements will be managed through transfer to Springvale's SDWTS, which will be upgraded from its current capacity of 30ML/d to 50ML/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 since there is excess demand for this water resource in this catchment (RPS 2014b).

RPS (2014b) indicates that the worst case salinity impact on Kangaroo Creek would be in the unlikely scenario that the discharge at LDP001 comprised the total flows within Kangaroo Creek. Based on the water quality data for LDP001 the median salinity is 1,010µS/cm and maximum is 1,270µS/cm. These values are comparable to the current median salinity measured at Kangaroo Creek D/S of 770µS/cm and the maximum of 1,130µS/cm. Therefore, even in this unlikely scenario there be little or no change to the salinity of Kangaroo Creek (RPS 2014b).

Hart et. al. (1991) provides 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. This species should therefore tolerate the predicted maximum salinity of the discharged mine water. Hart et. al. (1991) also provides 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 1,010µS/cm is therefore 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.

Water quality in Kangaroo Creek is influenced by mine water discharge at LDP001 and has a pH of 8.3. Water quality in the Coxs River, downstream of the confluence with Kangaroo Creek, also has a median pH of 8.0 (RPS 2014b). This pH level is not expected to affect habitats for *E. aggregata*, *T. australe* and Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland.

5.3 Key Threatening Processes

Key Threatening Processes (KTPs) are listed under Schedule 3 of the TSC Act. Approval for this project is restricted to the first workings, and therefore KTPs have only been considered in relation to predicted impacts of first workings. There is one KTP that may be relevant to this Project, namely 'Anthropogenic climate change'.

"Anthropogenic Climate Change"

The linkages between emissions of CO₂ from an individual project, resulting global CO₂ concentrations and climate warming 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.

5.4 Cumulative Impacts

There are three underground mining operation 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.

5.4.1 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.

5.4.2 Mine Water Discharge

The cumulative effects of MWD were previously considered in **Section 5.2** above. This assessment has found that the increases in MWD are unlikely to impact upon threatened species or EECs.

5.5 Matters of National Environmental Significance

An EPBC Act Protected Matters Search was undertaken within the SEWPAC on-line database (accessed January 2014) to generate a list of those Matters of National Environmental Significance (MNES) from within 10km of the Project Application 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.

5.5.1 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 4** 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.

5.5.2 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 Project Application Area.

5.5.3 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.

5.5.4 World Heritage Properties and National Heritage Places

The Gardens of Stone National Park is part of the Greater Blue Mountains Area (GBMA). 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.

An assessment of the potential impacts upon the GBMA as a result of subsidence is provided in MSEC (2014 section 5.15). The Gardens of Stone National Park is located at a distance of 4.6 kilometres north of LW1003 at their closest point to the proposed longwalls. At these distances, it is not expected that there would be any adverse impacts on the National Park or the Reserve resulting from the extraction of LW1001 and LW1003.

Based on the available far-field monitoring data from the NSW Coalfields, it is expected that there would be no measurable far-field horizontal movements within the National Park resulting from the extraction of LW1001 and LW1003. It is expected, therefore, that there will be no adverse impacts within the National Park resulting from the extraction of the proposed LW1001 and LW1003 (MSEC 2014 section 5.15).

5.5.5 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.

5.5.6 Nuclear Actions

No type of nuclear activity is proposed for the Project Application Area.

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

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

6.0 Mitigation Measures

It is to be noted that approval for this project is limited to first workings only. No direct or indirect impacts are expected as a result of the first workings (see **Section 5** above). As a result, no mitigation measures are proposed that are directly related to first workings, however details of general mine design and monitoring procedures for the Project are provided below. Mitigation measures of any predicted impacts as a result of longwall extractions are provided in RPS (2014b).

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.

The mine plan and design has been selected to minimise environmental effects of the Project.

6.1 Monitoring and Management

The mine plan for 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. When a trigger is reached, appropriate responses will be in place, as a contingency, in the unlikely event that worst case scenarios occur. 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 that 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 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 that 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.

7.0 Conclusion

RPS has been engaged by Centennial Angus Place Pty Limited (the Applicant) to prepare a Flora and Fauna Assessment for a Section 75W Modification of Project Approval 06_0021. The modification seeks to permit the development of the main headings and first workings associated with the first two longwalls (LW1001 and LW1003) forming part of the Angus Place Colliery Mine Extension Project.

A total of fifteen 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 15, two communities are listed as Endangered Ecological Communities (EEC) and occur within 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, occur over the low-lying areas to the west of the Project Application Area. This community has been mapped along the watercourses, which may be influenced by mine water discharge.

Two threatened flora species were recorded during the present study, these being *Persoonia hindii* and *Veronica blakelyi*. Two additional threatened flora species, *Eucalyptus aggregata* (Black Gum) and *Thesium australe* (Austral Toadflax), might to occur along the water courses, which may be influenced by mine water discharge. Through desktop analysis and habitat assessments, an additional nine threatened flora species have been considered as potentially occurring within woodland, forest and/or heath habitats, which may be impacted upon by subsidence.

A total of 40 threatened fauna species listed under the TSC and/or EPBC Acts have the potential to occur within the Project Application Area based on existing site habitats and habitat preferences of the threatened species. Of these 40 species, five were recorded within the Project Application Area by RPS.

The Project Application Area occurs within the Newnes State Forest and is surrounded by extensive vegetated habitats, including areas of protected habitat, which provide additional habitat for those threatened flora and fauna species known or having potential to occur. Consideration of potential impacts under the TSC Act and EPBC Act has been considered with regard to the proposed subsidence. As a consequence of the available surrounding habitat and the minor predicted impacts from subsidence, the project is unlikely to have a significant impact on threatened species or EECs.

Approval for this Project is limited to first workings only; the extraction of longwalls LW1001 and LW1003 are secondary workings that do not require approval as part of this application. The first workings are not expected to result in any measurable surface subsidence and only negligible tilts, curvatures and strains are expected (MSEC 2014 section 4.2). In addition, no measurable impacts to groundwater drawdown or baseflows are considered likely as a result of first workings (RPS 2014 section 9.2). Despite approval not being sought for secondary workings, the potential impacts associated with longwall extraction are provided below for completeness.

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 would 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 2013 section 3.7.). There is therefore a high level of accuracy between pre-mining modelled subsidence predictions and post-mining measured subsidence.

Angus Place has invested considerable time and money in monitoring and specialist studies in relation to their mining activities. 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. The Project has maintained those similarities with regard to mine design, with the addition of those avoidance and mitigation measures. 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 THPSS.

The consequence of increased mine water discharge to the Coxs River, either at Angus Place|LDP001 or through Springvale|LDP009, is not significant since there is excess demand for this water resource in this catchment (RPS 2014b). Predicted salinity changes are unlikely to significantly alter habitats for *E. aggregata*, *T. australe* and Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland. PH is also not expected to affect habitats for *E. aggregata*, *T. australe* and Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland.

Water quality in Kangaroo Creek is influenced by mine water discharge at LDP001 and has a pH of 8.3. Water quality in the Coxs River, downstream of the confluence with Kangaroo Creek, also has a median pH of 8.0 (RPS 2014b). This pH level 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 10km of the Project Application 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. The Gardens of Stone National Park is located at a distance of 4.6 kilometres north of LW1003 at their closest point to the proposed longwalls. At these distances, it is not expected that there would be any adverse impacts on the National Park or the Reserve resulting from the extraction of LW1001 and LW1003.

Potential impacts under the TSC Act and EPBC Act have been assessed with regard to the proposed first workings and longwall mining. 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. 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, Project is unlikely to have a significant impact upon threatened species, EECs or other MNES.

8.0 References

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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 have been assessed for those threatened species and EECs, which have been recorded in the Project Application Area or likely to occur and are likely to utilise habitats that may be potentially impacted by the proposed activities (see **Table 6**). The following communities and species have been considered:

Flora

- *Caesia parviflora* var. *minor*
- *Lastreopsis hispida* (Bristly Shield Fern)
- *Acacia bynoeana* (Bynoe's Wattle)
- *Prostanthera cryptandroides* subsp. *cryptandroides* (Wollemi Mintbush)
- *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*
- *Boronia deanei* (Deane's Boronia)
- *Thesium australe* (Austral Toadflax)
- *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 lathamii*)
- 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 phoenicea*)
- 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 Sheath-tail 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*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)

Threatened Ecological Communities

- Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion
- 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

It is to be noted that approval for this project is limited to first workings only. The first workings are not expected to result in any measurable surface subsidence (<20mm) and only negligible tilts, curvatures and strains are expected (MSEC 2014 section 4.2). In addition, no measurable impacts to groundwater drawdown or baseflows are considered likely as a result of first workings (RPS 2014 section 9.2). Therefore, no impacts to any of the threatened species or ecological communities listed above are expected to occur as a result of the first workings. However, potential impacts of secondary workings (i.e. longwall extractions) are provided below for all identified threatened species and ecological communities for completeness.

- (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 wildlife atlas record of this species occurs within 10km of the Project Application Area. The location description for this record identifies the plant as occurring at the northern end of Sunnyside Ridge. This record therefore lies approximately 2km north of the Project Application 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. 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 have 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 predicted subsidence, such that a local population of the species is likely to be placed at risk of extinction.

- *Lastreopsis hispidus* (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 Project Application Area. As this species occurs within closed moist forest with humus rich substrates, subsidence impacts are unlikely to affect the habitat for this species. Consequently, the Project is unlikely to affect the lifecycle of *L. hispidus* as a result of 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. 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. It is therefore expected that the Project will not affect the lifecycle of *A. bynoeana*, *P. hindii*, *P. acerosa* and *P. cryptandroides* subsp. *cryptandroides* such that a local population of these species are 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 Project Application Area it occurs as a component of MU 15 - Tableland Hollows Black Gum - Black Sally Open Forest.

This species is likely to occur along drainage lines and waterways that would be affected by mine water discharge. As discussed in **Section 5.2**, 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 13km south of the Project Application 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. Therefore, the Project is unlikely to affect the lifecycle of *E. pulverulenta* as a result of 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 Project Application 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 Project Application Area therefore have potential to support this species. The woodland 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 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 Project Application Area. *P. fuscum* has not been recorded within the Project Application Area, and is largely restricted to 500-700m above sea level, which is lower than that found on the Newnes Plateau, however the species has potentially suitable habitat along swamp margins.

As discussed in **Section 5.1.2**, negative long-term changes to baseflow and water levels within shrub swamps are unlikely. In addition, the capillary forces in the peat layer enable saturation of the peat above the water table, thus maintaining the suitability of habitats for these threatened flora species. Given that any impacts to groundwater levels are unlikely to significantly impact upon *Boronia deanei*, if present within the

Project Application Area and any populations of *Prasophyllum fuscum* that may exist within the Project Application Area, it is 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 Project Application Area.

This species was not detected during current or previous surveys within the Project Application Area however, it 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*.

Two individual *V. blakelyi* plants have been recorded within the project Application Area, however additional plants may occur therein. *V. blakelyi* is often recorded at the edge of shrub swamps and hanging swamps. As discussed in **Section 5.1.2**, 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. Additionally, subsidence within drier woodland habitats that may support this species are predicted to be minor. Consequently, the Project is unlikely to affect the lifecycle of *V. blakelyi* as a result of 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). Potential habitat, in the form of shrub swamps and hanging swamps, occur within the Project Application Area.

As discussed in **Section 5.1.2**, 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.

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 75cm (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 Angus Place lease 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 Project Application 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 Project Application 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 lease 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 Project Application 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 Project Application Area. Potential breeding habitat may occur within the more permanently water fed shrub swamps.

Fauna surveys carried out across the Project Application 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 20km southeast of the Project Application 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. Therefore, 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 Project Application 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).

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 5.1.3**). Similar events may occur as a result of the Project, however these would also be isolated and often short term. 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 Project Application 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 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 Project Application Area. 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 Project Application Area may constitute several 'local populations' of the species.

As discussed in **Section 5.1.2**, 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. It is therefore 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.

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 Angus Place. 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. 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 lathamii*)
- 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 Project Application Area for foraging, and many species may also nest within the Project Application Area.

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 it is 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 mostly mammalian prey. These species nest in large hollows (preferably Eucalypt trees). Roosting can also occur in dense canopy vegetation.

Barking Owls, Powerful Owls, Masked Owls and Sooty Owls have all been recorded during previous surveys within the Angus Place lease 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 Project Application Area. The Forest Owl species are likely to forage in the Project Application Area periodically throughout the year, and the Project Application Area may form part of the territory of several individuals of different 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 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.

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 (*Isodon 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 Project Application Area.

The predicted subsidence levels and surface cracking is 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 Angus Place lease area during previous surveys (MKES 2008c). Mostly secondary feed tree species occur within the Project Application Area. 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 significantly 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*)
- Yellow-bellied Glider (*Petaurus australis*)
- Squirrel Glider (*Petaurus norfolcensis*)

Eastern Pygmy Possums have been recorded close to the Project Application Area, with suitable habitat therein. Squirrel Gliders have been recorded within the Angus Place lease 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. Yellow-bellied Gliders have not been recorded within the Project Application 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.

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 arboreal mammal 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 arboreal mammal species, such that it 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 Project Application 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 Project Application Area.

The proposed longwalls and subsidence extent are away from rocky escarpments and would therefore not impact upon potential Brush-tailed Rock-wallaby habitat. 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 has been recorded foraging in the Project Application Area during survey. The Eastern Bentwing Bat has been recorded within the Angus Place lease area (RPS 2013) and the Little Pied Bat has been recorded once within the Clarence lease area (BMS 2009d). Eastern Cave Bats have potential to occur in the Project Application 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 Project Application Area, and fissures and caves suitable for roosting are likely to be present in the rocky escarpments and cliff edges. Low levels of subsidence will occur throughout the Project Application Area, however the cliff edges and rocky escarpments are outside the area of extraction of proposed longwalls and unlikely to experience effects from subsidence that might damage habitat features vital for roosting. Thus, the Project 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 Sheath-tail Bat (*Saccolaimus flaviventris*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)

These hollow-roosting Bat species have potential to occur within the Project Application Area, with Yellow-bellied Sheath-tail Bat having been recorded. 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 Project Application 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

Impact assessments of subsidence (MSEC 2014) and groundwater impact assessments (RPS 2014b) 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 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

The Project will not undermine 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 5.2**, 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,**

The first workings are designed to be stable and self-supporting and, therefore, are not expected to result in any measurable subsidence at the surface (i.e. less than 20 mm of vertical subsidence). The predicted tilts, curvatures and strains resulting from the extraction of the first workings are negligible and are not expected to be measurable at the surface using normal ground monitoring techniques (MSEC 2014 section 4.2).

The predicted 26.5 degree angle of draw for LW1001 and LW1003 covers an area of 271.6 ha. Within this area minor surface cracking, heaving, buckling, humping and stepping at the surface may occur. The exact areas of habitats that may be modified as a result of subsidence can not be predicted. However, any modifications to habitats are not expected to make these habitats unsuitable for the threatened species or EECs known or predicted to occur.

- (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**

No areas of potential or known habitat are likely to become fragmented or isolated from other areas of habitat as a result of the Project.

- (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**

No areas of habitat, important or otherwise, are expected to be removed, modified, fragmented or isolated such that it may affect the long-term survival of the threatened species or EECs known or predicted to occur.

(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 Project Application 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.

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

The Large Forest Owls – Final Recovery Plan drafted by the Department of Environment and Conservation (NSW) and approved by the NSW OEH applies to the Sooty Owl. The objectives of this Recovery Plan are listed below.

- (i) Assess the distribution and amount of high quality habitat for each owl species across public and private lands to get an estimate of the number and proportion of occupied territories of each species that are, and are not, protected
- (ii) To monitor trends in population parameters (numbers, distribution, territory fidelity and breeding success) across the range of the three species and across different land tenures and disturbance histories
- (iii) To assess the implementation and effectiveness of forest management prescriptions designed to mitigate the impact of timber-harvesting operations on the three owl species and, (if necessary), to use this information to refine the prescriptions so that forestry activities on state forests are not resulting in adverse changes in species abundance and breeding success
- (iv) Ensure the impacts on large forest owls and their habitats are adequately assessed during planning and environmental assessment processes
- (v) Minimise further loss and fragmentation of habitat by protection and more informed management of significant owl habitat (including protection of individual nest sites)
- (vi) To improve the recovery and management of the three large forest owls based on an improved understanding of key areas of their biology and ecology
- (vii) To raise awareness of the conservation requirements of the three large forest owls amongst the broader community, to involve the community in owl conservation efforts and in so doing increase the information base about owl habitats and biology
- (viii) To coordinate the implementation of the recovery plan and continually seek to integrate actions in this plan with actions in other recovery plans or conservation initiatives

The project does not contravene any of the above recovery objectives.

- 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 Project Application Area. The Project does not contravene and 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 Project Application Area. The Project does not contravene and of the above objectives.

- 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, terms of subsidence, the Project is not regarded as intervening with the recovery objectives of this species.

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

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.

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

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

Key Threatening Processes (KTPs) are listed under Schedule 3 of the TSC Act 1995. Approval for this project is restricted to the first workings, and therefore KTPs have only been considered in relation to predicted impacts of first workings. There is one KTP that may be relevant to this Project, being Anthropogenic climate change. This KTP has been previously addressed in **Section 5.3**.

Appendix 2

EPBC Act: Assessments of Significance

Table 6 identified the following nationally listed threatened species and EEC as having potential to be impacted upon by the Project. These species/EEC are:

These species 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* subsp. *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 (*Isodon 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 novaehollandica*), 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 Project Application 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.

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 Project Application 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.

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

The heath and woodland areas, where this species has potential to occur, are unlikely to be affected by predicted levels of cracking, such that these habitats would become unsuitable. Therefore, the Project is unlikely to 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;**

The predicted subsidence is unlikely to reduce the area of occupancy for this species.

(c) **Fragment an existing important population into two or more populations;**

The Project will not fragment a potential existing population into two or more populations.

(d) **Adversely affect habitat critical to the survival of a species;**

No areas of critical habitat have been identified within the Project Application Area.

(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 *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;**

The minor predicted modification to potential habitats from subsidence would not decrease the availability or quality of habitat to the extent that *A. bynoeana*, if present, 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 result in the establishment of invasive 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.**

This species has not been recorded within the Project Application Area. The limited effects of subsidence upon the potential 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. This 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 Project Application Area is considered to be Newnes Plateau Shrub Swamp.

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 Project Application Area can be considered a '*population that is near the limit of the species range*', as the location is at its northern limit. Any *B. deanei* that may occur within the Project Application Area are considered to be part of an important population and is further assessed using the significant impact criteria below.

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

As discussed in **Section 5.1.2**, negative longterm changes to baseflow and water levels within shrub swamps are unlikely. In addition, the capillary forces in the peat layer enable saturation of the peat above the water tabel, thus maintaing the suitability of habitats for these threatened flora species. 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 Project Application Area. However, if present, the predicted impacts from subsidence are 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 Project Application Area. The nearest population is near Bowenfels, approximately 13 km south of the Project Application 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 Project Application Area. However, as these areas could not be accessed due the dangerous terrain, it could not be verified whether the species occurred or not.

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 Project Application 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.

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

Surface cracking of soils is expected to be similar to those observed above the previously extracted longwalls at Angus Place and Springvale Collieries. 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. Therefore, the Project is unlikely to 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;**

The predicted subsidence is unlikely to reduce the area of occupancy for this species.

(c) **Fragment an existing important population into two or more populations;**

The Project will not fragment a potential existing population into two or more populations.

(d) **Adversely affect habitat critical to the survival of a species;**

No areas of critical habitat have been identified within the Project Application Area.

(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 *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;**

The minor predicted modification to potential habitats from subsidence would not decrease the availability or quality of habitat to the extent that *E. pulverulenta*, if present, 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 result in the establishment of invasive 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.**

This species has not been recorded within the Project Application Area. The limited effects of subsidence upon the potential 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 Project Application 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 Project Application 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.

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 Project Application 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.

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

Surface cracking of soils is expected to be similar to those observed above the previously extracted longwalls at Angus Place and Springvale Collieries. 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. Therefore, the Project is unlikely to 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;**

The predicted subsidence is unlikely to reduce the area of occupancy for this species.

- (c) **Fragment an existing important population into two or more populations;**

The Project will not fragment a potential existing population into two or more populations.

- (d) **Adversely affect habitat critical to the survival of a species;**

No areas of critical habitat have been identified within the Project Application Area.

- (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 *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;**

The minor predicted modification to potential habitats from subsidence would not decrease the availability or quality of habitat to the extent that *P. acerosa*, if present, 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 result in the establishment of invasive 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.**

This species has not been recorded within the Project Application Area. The limited effects of subsidence upon the potential 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 Project Application 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 doesn't necessarily flower each year. As suitable swamp habitat for this species occurs, there is potential for this species to occur within the Project Application Area and be impacted.

This species 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.

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 Project Application 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.

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

As discussed in **Section 5.1.2**, negative longterm changes to baseflow within shrub swamps are unlikely. In addition, the capillary forces in the peat layer enable saturation of the peat above the water tabel, thus maintaing the suitability of habitats for this species. Any impacts to swamp edge habitats for this species are therefore, unlikely to lead to a long-term decrease in the size of a potentially occurring population of *P. fuscum*.

- (b) **Reduce the area of occupancy of the species;**

This species has not been recorded within the Project Application Area. 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;**

No areas of critical habitat have been identified within the Project Application Area.

(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 *P. fuscum*.

Prostanthera cryptandroides* subsp. *cryptandroides

Wollemi Mintbush

Prostanthera cryptandroides subsp. *cryptandroides* (Wollemi Mintbush) is listed as Vulnerable under the EPBC Act. This species was not detected during current or previous surveys within the Project Application Area. *Prostanthera cryptandroides* subsp. *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* subsp. *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.

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* subsp. *cryptandroides* was to occur within the Project Application 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.

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

Surface cracking of soils is expected to be similar to those observed above the previously extracted longwalls at Angus Place and Springvale Collieries. 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. Therefore, the Project is unlikely to result in a long-term decrease in the size of a potentially occurring population of *P. cryptandroides* subsp. *cryptandroides*.

(b) **Reduce the area of occupancy of the species;**

The predicted subsidence is unlikely to reduce the area of occupancy for this species.

(c) **Fragment an existing important population into two or more populations;**

The Project will not fragment a potential existing population into two or more populations.

(d) **Adversely affect habitat critical to the survival of a species;**

No areas of critical habitat have been identified within the Project Application Area.

(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 *P. cryptandroides* subsp. *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;**

The minor predicted modification to potential habitats from subsidence would not decrease the availability or quality of habitat to the extent that *P. cryptandroides* subsp. *cryptandroides*, if present, 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 result in the establishment of invasive 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.**

This species has not been recorded within the Project Application Area. The limited effects of subsidence upon the potential habitats are unlikely to interfere with the recovery of *P. cryptandroides* subsp. *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 Project Application Area however, grassy woodland habitat with *T. australis* is present along water courses that will receive mine water discharge and where this species may also potentially occur.

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 Project Application 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.

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

No likely habitat for *T. australe* occurs within the 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;**

No areas of critical habitat have been identified for this species.

(e) **Disrupt the breeding cycle of a population;**

The minor predicted modification to potential habitats from mine water discharge 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 mine water discharge 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 contribute to an increase of weeds.

(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.

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.

(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 Project Application Area. The remainder of the Project Application 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.

Localised subsidence or surface cracking is unlikely to affect any potential breeding habitat. No areas of non-breeding habitat (forests, woodlands and heaths) are likely to be impacted to an extent that they would be unsuitable for this species. The Project Application Area is also surrounded by significantly large areas of commensurate breeding and non-breeding habitat. 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 Project Application 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).

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.

(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 Project Application Area. The remainder of the Project Application Area could potentially be utilised as non-breeding habitat.

Given the large amounts of available habitat within the Project Application Area, localised subsidence or surface cracking is unlikely to affect any potential breeding habitat. No areas of non-breeding habitat (wet forests) are likely to be impacted to an extent that they would be unsuitable for this species. 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.

(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 Project Application 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 Project Application 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 within the Newnes Plateau.

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.

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.

- (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 Project Application Area, localised subsidence or surface cracking is unlikely to affect any potential breeding or non-breeding habitat. 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.

- (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 Project Application 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 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 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 Project Application Area.

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

As discussed in **Section 5.1.2**, 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. 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

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 Project Application 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.

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 Project Application 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.

(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. 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.

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. Predicted minor alterations to potential habitats from subsidence will not lead to a long-term decrease in a Broad-headed Snake population.

(b) **Reduce the area of occupancy of the species;**

The habitats in which the Broad-headed Snake 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 Broad-headed Snake.

(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 Project Application 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 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 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 however 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.

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

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 Angus Place or 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. 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 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).

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 Project Application 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.

(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. 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 project is unlikely to 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;**

The abundance of potential habitat within the Newnes State Forest and neighbouring National Parks suggests that the habitats within the Project Application 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.

(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 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 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).

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 the Large-eared Pied Bat within the Project Application Area could be considered a '*population that is near the limit of the species range*' as the location is at its western limit. As such, this species is further assessed using the significant impact criteria below.

(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 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). The Project is unlikely to have any adverse impacts on the cliffs or pagoda complexes. Therefore, no impacts would be expected to possible critical habitat, such as cave roosting sites or critical foraging habitat.

(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 would not disrupt the breeding cycle of a population of the Large-eared Pied Bat.

- (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 Project Application 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.

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

The expected subsidence levels are 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 project will not reduce the area of occupancy of this species.

- (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 Project Application 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.

(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 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 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 31km to the south of the Project Application Area. Both records are derived from hair analysis in fox scats dated from 1986 (DECCW 2011).

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

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 project will not reduce the area of occupancy of this species.

(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 Project Application 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.

(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 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 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 Project Application Area in the form of rock pagodas and escarpments, however 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 Project Application Area, however has not been recorded.

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 Project Application 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.

(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. Due to the abundance of similar foraging habitat adjacent to potential cliff line and pagoda habitats, these minor impacts are 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 project will not reduce the area of occupancy of this species.

(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 Project Application 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 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 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.

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 Project Application Area. Therefore, the population may be '*necessary for maintaining genetic diversity*'. As such, this species is further assessed using the significant impact criteria below.

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

The predicted 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 project will not reduce the area of occupancy of this species.

(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;**

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.

One vegetation community is likely to contain secondary food tree species comprise at least 50% of the overstorey trees, namely MU14 Tableland Mountain Gum - Snow Gum - Daviesia Montane Open Forest. Approximately 22 ha of this community occurs within the subsidence extents. However, the predicted subsidence levels are not expected to adversely affect this vegetation community, such that it would become unsuitable for Koalas. Therefore, the Project is unlikely to adversely affect habitat critical to the survival the Koala.

(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 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).

(a) Reduce the extent of an ecological community

Impact assessments of subsidence (MSEC 2014) and groundwater impact assessments (RPS 2014b) 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 Temperate Highland Peat Swamps on Sandstone. The Project is therefore, unlikely to have an adverse effect on the extent of the ecological community.

(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 adversely 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 Project is 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 Project Application 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 Project Application Area during this investigation.

* - Indicates an introduced species

Known and Expected Bird List

Appendix Key: 1 = Results of ecological investigations conducted within the Project Application 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	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	
	<i>Acanthiza lineata</i>	Striated Thornbill	✓
	<i>Acanthiza nana</i>	Yellow Thornbill	
	<i>Acanthiza pusilla</i>	Brown Thornbill	✓
	<i>Acanthiza reguloides</i>	Buff-rumped Thornbill	✓
	<i>Aphelocephala leucopsis</i>	Southern Whiteface	
	<i>Calamanthus pyrrhopygius</i>	Chestnut-rumped Heathwren	
	<i>Gerygone fusca</i>	Western Gerygone	
	<i>Gerygone mouki</i>	Brown Gerygone	
	<i>Gerygone olivacea</i>	White-throated Gerygone	
	<i>Origma solitaria</i>	Rockwarbler	
	<i>Pycnoptilus floccosus</i>	Pilotbird	
	<i>Pyrrholaemus sagittatus</i>	Speckled Warbler (V)	
	<i>Sericornis citreogularis</i>	Yellow-throated Scrubwren	
	<i>Sericornis frontalis</i>	White-browed Scrubwren	✓
	<i>Sericornis magnirostris</i>	Large-billed Scrubwren	
	<i>Smicronis brevirostris</i>	Weebill	
Accipitridae	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	
	<i>Accipiter fasciatus</i>	Brown Goshawk	✓
	<i>Accipiter novaehollandiae</i>	Grey Goshawk	
	<i>Aquila audax</i>	Wedge-tailed Eagle	
	<i>Elanus axillaris</i>	Black-shouldered Kite	
	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	
	<i>Haliastur sphenurus</i>	Whistling Kite	
	<i>Hieraaetus morphnoides</i>	Little Eagle	
	<i>Lophoictinia isura</i>	Square-tailed Kite (V)	
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	✓

Family Name	Scientific Name	Common Name	Recorded
Alaudidae	<i>Alauda arvensis</i> *	Eurasian Skylark	
	<i>Mirafra javanica</i>	Horsfield's Bushlark	
Alcedinidae	<i>Alcedo azurea</i>	Azure Kingfisher	
	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	✓
	<i>Todiramphus sanctus</i>	Sacred Kingfisher	✓
Anatidae	<i>Anas gracilis</i>	Grey Teal	
	<i>Anas rhynchotis</i>	Australasian Shoveler	
	<i>Anas superciliosa</i>	Pacific Black Duck	
	<i>Aythya australis</i>	Hardhead	
	<i>Biziura lobata</i>	Musk Duck	
	<i>Chenonetta jubata</i>	Australian Wood Duck	
	<i>Cygnus atratus</i>	Black Swan	
	<i>Malacorhynchus membranaceus</i>	Pink-eared Duck	
	<i>Oxyura australis</i>	Blue-billed Duck (V)	
Apodidae	<i>Hirundapus caudacutus</i>	White-throated Needletail (EM)	✓
Ardeidae	<i>Ardea pacifica</i>	White-necked Heron	
	<i>Egretta novaehollandiae</i>	White-faced Heron	
	<i>Nycticorax caledonicus</i>	Nankeen Night Heron	
Artamidae	<i>Artamus cinereus</i>	Black-faced Woodswallow	
	<i>Artamus cyanopterus</i>	Dusky Woodswallow	
	<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	
	<i>Artamus superciliosus</i>	White-browed Woodswallow	
	<i>Cracticus nigrogularis</i>	Pied Butcherbird	✓
	<i>Cracticus torquatus</i>	Grey Butcherbird	✓
	<i>Gymnorhina tibicen</i>	Australian Magpie	✓
	<i>Strepera graculina</i>	Pied Currawong	✓
	<i>Strepera versicolor</i>	Grey Currawong	✓
Cacatuidae	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	
	<i>Cacatua sanguinea</i>	Little Corella	
	<i>Callocephalon fimbriatum</i>	Gang-Gang Cockatoo (V)	✓
	<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo	
	<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo (V)	
	<i>Eolophus roseicapillus</i>	Galah	
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	✓
	<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike	
	<i>Coracina tenuirostris</i>	Cicadabird	
	<i>Lalage tricolor</i>	White-winged Triller	
Caprimulgidae	<i>Eurostopodus mystacalis</i>	White-throated Nightjar	
Charadriidae	<i>Elseya melanops</i>	Black-fronted Dotterel	
	<i>Vanellus miles</i>	Masked Lapwing	
Cisticolidae	<i>Cisticola exilis</i>	Golden-headed Cisticola	

Family Name	Scientific Name	Common Name	Recorded
Climacteridae	<i>Climacteris erythrops</i>	Red-browed Treecreeper	
	<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies) (V)	
	<i>Cormobates leucophaea</i>	White-throated Treecreeper	✓
Columbidae	<i>Geopelia cuneata</i>	Diamond Dove	
	<i>Geopelia humeralis</i>	Bar-shouldered Dove	
	<i>Geopelia placida</i>	Peaceful Dove	
	<i>Leucosarcia melanoleuca</i>	Wonga Pigeon	
	<i>Macropygia amboinensis</i>	Brown Cuckoo-Dove	
	<i>Ocyphaps lophotes</i>	Crested Pigeon	
	<i>Phaps chalcoptera</i>	Common Bronzewing	
	<i>Phaps elegans</i>	Brush Bronzewing	
Coraciidae	<i>Eurystomus orientalis</i>	Dollarbird	
Corcoracidae	<i>Corcorax melanorhamphos</i>	White-winged Chough	✓
Corvidae	<i>Corvus coronoides</i>	Australian Raven	✓
	<i>Corvus mellori</i>	Little Raven	
Cuculidae	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	✓
	<i>Cacomantis variolosus</i>	Brush Cuckoo	
	<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo	
	<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo	
	<i>Chalcites osculans</i>	Black-eared Cuckoo	
	<i>Cuculus pallidus</i>	Pallid Cuckoo	
	<i>Cuculus saturatus</i>	Oriental Cuckoo	
	<i>Eudynamys orientalis</i>	Pacific Koel	
	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	
Dicaeidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird	
Estrildidae	<i>Lonchura castaneothorax</i>	Chestnut-breasted Mannikin	
	<i>Neochmia modesta</i>	Plum-headed Finch	
	<i>Neochmia temporalis</i>	Red-browed Finch	
	<i>Stagonopleura bella</i>	Beautiful Firetail	
	<i>Stagonopleura guttata</i>	Diamond Firetail (V)	
	<i>Taeniopygia bichenovii</i>	Double-barred Finch	
	<i>Taeniopygia guttata</i>	Zebra Finch	
Eupetidae	<i>Cinclosoma punctatum</i>	Spotted Quail-thrush	✓
	<i>Psophodes olivaceus</i>	Eastern Whipbird	✓
Falconidae	<i>Falco berigora</i>	Brown Falcon	
	<i>Falco cenchroides</i>	Nankeen Kestrel	
	<i>Falco longipennis</i>	Australian Hobby	
	<i>Falco peregrinus</i>	Peregrine Falcon	
	<i>Falco subniger</i>	Black Falcon	
Fringillidae	<i>Carduelis carduelis*</i>	European Goldfinch	
Hirundinidae	<i>Cheramoeca leucosterna</i>	White-backed Swallow	

Family Name	Scientific Name	Common Name	Recorded
	<i>Hirundo neoxena</i>	Welcome Swallow	✓
	<i>Petrochelidon ariel</i>	Fairy Martin	
	<i>Petrochelidon nigricans</i>	Tree Martin	
Laridae	<i>Larus novaehollandiae</i>	Silver Gull	
Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren	✓
	<i>Malurus lamberti</i>	Variegated Fairy-wren	✓
	<i>Stipiturus malachurus</i>	Southern Emu-wren	
Megapodiidae	<i>Alectura lathamii</i>	Australian Brush-turkey	
Meliphagidae	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	
	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	✓
	<i>Anthochaera carunculata</i>	Red Wattlebird	✓
	<i>Anthochaera chrysoptera</i>	Little Wattlebird	
	<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater	
	<i>Epthianura albifrons</i>	White-fronted Chat	
	<i>Gliciphila melanops</i>	Tawny-crowned Honeyeater	
	<i>Grantiella picta</i>	Painted Honeyeater (V)	
	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	✓
	<i>Lichenostomus fuscus</i>	Fuscous Honeyeater	
	<i>Lichenostomus leucotis</i>	White-eared Honeyeater	✓
	<i>Lichenostomus melanops</i>	Yellow-tufted Honeyeater	
	<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater	
	<i>Manorina melanocephala</i>	Noisy Miner	
	<i>Manorina melanophrys</i>	Bell Miner	
	<i>Meliphaga lewinii</i>	Lewin's Honeyeater	✓
	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	
	<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies) (V)	
	<i>Melithreptus lunatus</i>	White-naped Honeyeater	✓
	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater	
	<i>Philemon citreogularis</i>	Little Friarbird	
	<i>Philemon corniculatus</i>	Noisy Friarbird	✓
	<i>Phylidonyris niger</i>	White-cheeked Honeyeater	
	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	✓
	<i>Phylidonyris pyrrhoptera</i>	Crescent Honeyeater	
	<i>Plectorhyncha lanceolata</i>	Striped Honeyeater	
	<i>Xanthomyza phrygia</i>	Regent Honeyeater (E, E*)	
Menuridae	<i>Menura novaehollandiae</i>	Superb Lyrebird	✓
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater	
Monarchidae	<i>Myiagra cyanoleuca</i>	Satin flycatcher	✓
	<i>Grallina cyanoleuca</i>	Magpie-lark	
	<i>Monarcha melanopsis</i>	Black-faced Monarch	
Motacillidae	<i>Anthus australis</i>	Australian Pipit	

Family Name	Scientific Name	Common Name	Recorded
Muscicapidae	<i>Turdus merula</i> *	Eurasian Blackbird	
	<i>Zoothera lunulata</i>	Bassian Thrush	✓
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird	
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella	
Oriolidae	<i>Oriolus sagittatus</i>	Olive-backed Oriole	
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	✓
	<i>Falcunculus frontatus</i>	Eastern Shrike-tit	
	<i>Pachycephala pectoralis</i>	Golden Whistler	
	<i>Pachycephala rufiventris</i>	Rufous Whistler	✓
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote	✓
	<i>Pardalotus striatus</i>	Striated Pardalote	✓
Passeridae	<i>Passer domesticus</i> *	House Sparrow	
Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican	
Petroicidae	<i>Eopsaltria australis</i>	Eastern Yellow Robin	
	<i>Melanodryas cucullata</i>	Hooded Robin	
	<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form) (V)	
	<i>Microeca fascians</i>	Jacky Winter	
	<i>Petroica boodang</i>	Scarlet Robin (V)	✓
	<i>Petroica goodenovii</i>	Red-capped Robin	
	<i>Petroica phoenicea</i>	Flame Robin (V)	✓
	<i>Petroica rosea</i>	Rose Robin	
Phalacrocoracidae	<i>Phalacrocorax carbo</i>	Great Cormorant	
	<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	
	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	
	<i>Phalacrocorax varius</i>	Pied Cormorant	
Phasianidae	<i>Coturnix pectoralis</i>	Stubble Quail	
	<i>Coturnix ypsilophora</i>	Brown Quail	
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth	✓
Podicipedidae	<i>Podiceps cristatus</i>	Great Crested Grebe	
	<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe	
	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	
Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler	
	<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies) (V)	
Psittacidae	<i>Alisterus scapularis</i>	Australian King-Parrot	✓
	<i>Glossopsitta concinna</i>	Musk Lorikeet	
	<i>Glossopsitta pusilla</i>	Little Lorikeet	
	<i>Lathamus discolor</i>	Swift Parrot (E,E*)	
	<i>Melopsittacus undulatus</i>	Budgerigar	
	<i>Neophema pulchella</i>	Turquoise Parrot (V)	
	<i>Platycercus adscitus eximius</i>	Eastern Rosella	

Family Name	Scientific Name	Common Name	Recorded
	<i>Platycercus elegans</i>	Crimson Rosella	✓
	<i>Psephotus haematonotus</i>	Red-rumped Parrot	
	<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet	
	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	
Psophodidae	<i>Cinclosoma punctatum</i>	Spotted Quail-thrush	
	<i>Psophodes olivaceus</i>	Eastern Whipbird	
Ptilonorhynchidae	<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird	✓
Pycnonotidae	<i>Pycnonotus jocosus</i> *	Red-whiskered Bulbul	
Rallidae	<i>Fulica atra</i>	Eurasian Coot	
	<i>Gallinula tenebrosa</i>	Dusky Moorhen	
	<i>Gallirallus philippensis</i>	Buff-banded Rail	
	<i>Porphyrio porphyrio</i>	Purple Swamphen	
	<i>Pozana fluminea</i>	Australian Spotted Crake	
	<i>Pozana pusilla</i>	Baillon's Crake	
	<i>Pozana tabuensis</i>	Spotless Crake	
	<i>Rallus pectoralis</i>	Lewin's Rail	
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail	✓
	<i>Rhipidura rufifrons</i>	Rufous Fantail	✓
Scolopacidae	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper (EM)	
	<i>Gallinago hardwickii</i>	Latham's Snipe (EM)	
Strigidae	<i>Ninox boobook</i>	Southern Boobook	
	<i>Ninox connivens</i>	Barking Owl (V)	
	<i>Ninox strenua</i>	Powerful Owl (V)	
Sturnidae	<i>Acridotheres tristis</i> *	Common Myna	
	<i>Sturnus vulgaris</i> *	Common Starling	
Sylviidae	<i>Acrocephalus australis</i>	Australian Reed-Warbler	
	<i>Cincloramphus cruralis</i>	Brown Songlark	
	<i>Cincloramphus mathewsi</i>	Rufous Songlark	
	<i>Megalurus gramineus</i>	Little Grassbird	
Threskiornithidae	<i>Platalea flavipes</i>	Yellow-billed Spoonbill	
	<i>Platalea regia</i>	Royal Spoonbill	
	<i>Threskiornis molucca</i>	Australian White Ibis	
	<i>Threskiornis spinicollis</i>	Straw-necked Ibis	
Turdidae	<i>Zoothra lunulata</i>	Bassian Thrush	
Turnicidae	<i>Turnix varia</i>	Painted Button-quail	
Tytonidae	<i>Tyto alba</i>	Barn Owl	
	<i>Tyto novaehollandiae</i>	Masked Owl (V)	
	<i>Tyto tenebricosa</i>	Sooty Owl (V)	
Zosteropidae	<i>Zosterops lateralis</i>	Silvereye	✓

Known and Expected Mammal List

Appendix Key: 1 = Results of ecological investigations conducted within the Project Application Area
✓ = Species Detected
* = introduced 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
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	<i>Acrobates pygmaeus</i>	Feathertail Glider	
Bovidae	<i>Bos taurus</i> *	European Cattle	
	<i>Capra hircus</i> *	Goat	
Burramyidae	<i>Cercartetus nanus</i>	Eastern Pygmy-possum (V)	
Canidae	<i>Canis lupus familiaris</i> *	Dog	
	<i>Canis lupus</i> *	Dingo, domestic dog	
	<i>Vulpes vulpes</i> *	Fox	
Cervidae	<i>Cervus sp.</i> *	Unidentified Deer	
Dasyuridae	<i>Antechinus flavipes</i>	Yellow-footed Antechinus	
	<i>Antechinus stuartii</i>	Brown Antechinus	
	<i>Antechinus swainsonii</i>	Dusky Antechinus	
	<i>Antechinus/Sminthopsis sp.</i>	unidentified 'Marsupial Mouse'	
	<i>Dasyuridae sp.</i>	unidentified dasyurid	
	<i>Dasyurus maculatus</i>	Spotted-tailed Quoll (V, V*)	
Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat (V)	✓
Equidae	<i>Equus caballus</i> *	Horse	
Felidae	<i>Felis catus</i> *	Cat	
Leporidae	<i>Lepus capensis</i> *	Brown Hare	
	<i>Oryctolagus cuniculus</i> *	Rabbit	
Macropodidae	<i>Macropus giganteus</i>	Eastern Grey Kangaroo	✓
	<i>Macropus robustus</i>	Common Wallaroo	
	<i>Macropus rufogriseus</i>	Red-necked Wallaby	✓
	<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby (E, V*)	
	<i>Wallabia bicolor</i>	Swamp Wallaby	✓
Molossidae	<i>Mormopterus "Species 2"</i>	Undescribed Freetail Bat	
	<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat (V)	
	<i>Mormopterus planiceps</i>	Little Mastiff-bat	
	<i>Mormopterus sp.</i>	Mastiff-bat	
	<i>Tadarida australis</i>	White-striped Freetail-bat	

Family Name	Scientific Name	Common Name	Recorded
Muridae	<i>Hydromys chrysogaster</i>	Water-rat	
	<i>Mus musculus</i> *	House Mouse	
	<i>Rattus fuscipes</i>	Bush Rat	
	<i>Rattus lutreolus</i>	Swamp Rat	
	<i>Rattus rattus</i> *	Black Rat	
Ornithorhynchidae	<i>Ornithorhynchus anatinus</i>	Platypus	
Peramelidae	<i>Isoodon/Perameles sp.</i>	unidentified Bandicoot	
Petauridae	<i>Petaurus australis</i>	Yellow-bellied Glider (V)	
	<i>Petaurus breviceps</i>	Sugar Glider	
	<i>Petaurus norfolcensis</i>	Squirrel Glider (V)	
Phalangeridae	<i>Trichosurus caninus</i>	Short-eared Possum	
	<i>Trichosurus sp.</i>	Brushtail possum	
	<i>Trichosurus vulpecula</i>	Common Brushtail Possum	
Phascolarctidae	<i>Phascolarctos cinereus</i>	Koala (V)	
Potoroidae	<i>Bettongia gaimardi</i>	Tasmanian Bettong	
Pseudocheiridae	<i>Petauroides volans</i>	Greater Glider	✓
	<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum	
Rhinolophidae	<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe-bat	
Suidae	<i>Sus scrofa</i> *	Pig	
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	
Vespertilionidae	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat (V, V*)	✓
	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	
	<i>Chalinolobus morio</i>	Chocolate Wattled Bat	✓
	<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle (V)	
	<i>Miniopterus australis</i>	Little Bentwing-bat (V)	
	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat (V)	
	<i>Myotis adversus</i>	Large-footed Myotis (V)	
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	
	<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat	
	<i>Nyctophilus sp.</i>	Long-eared bat	
	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat (V)	
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat	
	<i>Scotorepens orion</i>	Eastern Broad-nosed Bat	
	<i>Vespadelus darlingtoni</i>	Large Forest Bat	
	<i>Vespadelus pumilus</i>	Eastern Forest Bat	
	<i>Vespadelus regulus</i>	Southern Forest Bat	✓
	<i>Vespadelus vulturnus</i>	Little Forest Bat	
Vombatidae	<i>Vombatus ursinus</i>	Common Wombat	

Known and Expected Reptile List

Appendix Key: 1 = Results of ecological investigations conducted within the Project Application Area
 ✓ = Species Detected
 * = introduced 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
 (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	<i>Amphibolurus muricatus</i>	Jacky Lizard	✓
	<i>Amphibolurus nobbi</i>	Nobbi	
	<i>Physignathus lesueurii</i>	Eastern Water Dragon	
	<i>Pogona barbata</i>	Bearded Dragon	
	<i>Rankinia diemensis</i>	Mountain Dragon	✓
Chelidae	<i>Chelodina longicollis</i>	Eastern Snake-necked Turtle	
Elapidae	<i>Austrelaps ramsayi</i>	Highland Copperhead	
	<i>Austrelaps superbus</i>	Lowland Copperhead	
	<i>Cryptophis nigrescens</i>	Eastern Small-eyed Snake	✓
	<i>Drysdalia rhodogaster</i>	Mustard-bellied Snake	
	<i>Furina diadema</i>	Red-naped Snake	
	<i>Hoplocephalus bungaroides</i>	Broad-headed Snake (E, V*)	
	<i>Notechis scutatus</i>	Tiger Snake	
	<i>Parasuta dwyeri</i>	Dwyer's Snake	
	<i>Parasuta spectabilis</i>	Mallee Black-headed Snake	
	<i>Pseudechis guttatus</i>	Spotted Black Snake	
	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	
	<i>Pseudonaja textilis</i>	Eastern Brown Snake	
	<i>Vermicella annulata</i>	Bandy-bandy	
Gekkonidae	<i>Diplodactylus vittatus</i>	Wood Gecko	
	<i>Oedura lesueurii</i>	Lesueur's Velvet Gecko	
	<i>Phyllurus platurus</i>	Broad-tailed Gecko	
	<i>Underwoodisaurus milii</i>	Thick-tailed Gecko	
Pygopodidae	<i>Pygopus lepidopodus</i>	Common Scaly-foot	
Scincidae	<i>Acritoscincus duperreyi</i>	Eastern Three-lined Skink	
	<i>Acritoscincus platynota</i>	Red-throated Skink	
	<i>Carlia tetradactyla</i>	Southern Rainbow-skink	
	<i>Cryptoblepharus virgatus</i>	Cream-striped Shinning-skink	

Family Name	Scientific Name	Common Name	Recorded
	<i>Ctenotus robustus</i>	Robust Ctenotus	
	<i>Ctenotus taeniolatus</i>	Copper-tailed Skink	✓
	<i>Egernia cunninghami</i>	Cunningham's Skink	
	<i>Egernia saxatilis</i>	Black Rock Skink	✓
	<i>Egernia saxatilis intermedia</i>		
	<i>Egernia striolata</i>	Tree Skink	
	<i>Egernia whitii</i>	White's Skink	✓
	<i>Eulamprus heatwolei</i>	Yellow-bellied Water-skink	✓
	<i>Eulamprus leuraensis</i>	Blue Mountains Water skink (E, E*)	
	<i>Eulamprus quoyii</i>	Eastern Water-skink	✓
	<i>Eulamprus tenuis</i>	Barred-sided Skink	
	<i>Eulamprus tympanum</i>	Southern Water-skink	
	<i>Hemiergis decresiensis</i>	Three-toed Earless Skink	
	<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink	✓
	<i>Lampropholis guichenoti</i>	Pale-flecked Garden Sunskink	
	<i>Lampropholis sp.</i>	unidentified grass skink	
	<i>Lerista bougainvillii</i>	South-eastern Slider	
	<i>Lygisaurus foliorum</i>	Tree-base Litter-skink	
	<i>Morethia boulengeri</i>	South-eastern Morethia Skink	
	<i>Pseudemoia entrecasteauxii</i>	Tussock Cool-skink	
	<i>Pseudemoia pagenstecheri</i>	Tussock Skink	
	<i>Saiphos equalis</i>	Three-toed Skink	
	<i>Saproscincus mustelinus</i>	Weasel Skink	
	<i>Tiliqua nigrolutea</i>	Blotched Blue-tongue	
	<i>Tiliqua scincoides</i>	Eastern Blue-tongue	
Typhlopidae	<i>Ramphotyphlops nigrescens</i>	Blackish Blind Snake	
Varanidae	<i>Varanus rosenbergi</i>	Rosenberg's Goanna (V)	
	<i>Varanus sp.</i>	Unidentified Goanna	
	<i>Varanus varius</i>	Lace Monitor	

Known and Expected Frog List

Appendix Key: 1 = Results of ecological investigations conducted within the Project Application Area
 ✓ = Species Detected
 * = introduced 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
 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
Hylidae	<i>Litoria booroolongensis</i>	Booroolong Frog (E, E*)	
	<i>Litoria caerulea</i>	Green Tree Frog	
	<i>Litoria citropa</i>	Blue Mountains Tree Frog	
	<i>Litoria dentata</i>	Bleating Tree Frog	
	<i>Litoria ewingii</i>	Brown Tree Frog	
	<i>Litoria fallax</i>	Eastern Dwarf Tree Frog	
	<i>Litoria latopalmata</i>	Broad-palmed Frog	
	<i>Litoria lesueuri</i>	Lesueur's Frog	
	<i>Litoria peronii</i>	Peron's Tree Frog	
	<i>Litoria phyllochroa</i>	Leaf-green Tree Frog	
	<i>Litoria tyleri</i>	Tyler's Tree Frog	
	<i>Litoria verreauxii</i>	Verreaux's Frog	
	<i>Litoria wilcoxii</i>		
Myobatrachidae	<i>Crinia parinsignifera</i>	Eastern Sign-bearing Froglet	
	<i>Crinia signifera</i>	Common Eastern Froglet	
	<i>Heleioporus australiacus</i>	Giant Burrowing Frog (V, V*)	
	<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog	✓
	<i>Limnodynastes fletcheri</i>	Long-thumb Frog	
	<i>Limnodynastes ornatus</i>	Ornate Burrowing Frog	
	<i>Limnodynastes peronii</i>	Brown-striped Frog	✓
	<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog	
	<i>Mixophyes balbus</i>	Stuttering Frog (E, V*)	
	<i>Neobatrachus sudelli</i>	Sudell's Frog	
	<i>Pseudophryne australis</i>	Red-crowned Toadlet (V)	
	<i>Pseudophryne bibronii</i>	Bibron's Toadlet	
	<i>Pseudophryne sp.</i>		
	<i>Uperoleia laevis</i>	Smooth Toadlet	

Appendix 4

Flora Species List

Family	Scientific Name	Common Name
Trees		
Casuarinaceae	<i>Allocasuarina nana</i>	Dwarf She-oak
Myrtaceae	<i>Eucalyptus blaxlandii</i>	Blaxland's Stringybark
Myrtaceae	<i>Eucalyptus dalrympleana</i>	Mountain Gum
Myrtaceae	<i>Eucalyptus dives</i>	Broad-leaved Peppermint
Myrtaceae	<i>Eucalyptus fastigata</i>	Brown Barrel
Myrtaceae	<i>Eucalyptus gregsoniana</i>	Wolgan Snow gum
Myrtaceae	<i>Eucalyptus oreades</i>	Blue Mountains Ash
Myrtaceae	<i>Eucalyptus pauciflora</i>	Snow Gum
Myrtaceae	<i>Eucalyptus radiata</i>	Narrow-leaved Peppermint
Myrtaceae	<i>Eucalyptus sclerophylla</i>	Scribbly Gum
Myrtaceae	<i>Eucalyptus sieberi</i>	Silvertop Ash
Myrtaceae	<i>Eucalyptus viminalis</i>	Ribbon Gum
Shrubs		
Apiaceae	<i>Platysace linearifolia</i>	Narrow-leaved Platysace
Araliaceae	<i>Polyscias sambucifolia</i>	Elderberry Panax
Asteraceae	<i>Cassinia arcuata</i>	Sifton Bush
Asteraceae	<i>Cassinia cunninghamii</i>	Cunningham's Everlasting
Asteraceae	<i>Olearia erubescens</i>	Silky Daisy Bush
Casuarinaceae	<i>Allocasuarina distyla</i>	-
Epacridaceae	<i>Brachyloma daphnoides</i>	Daphne Heath
Epacridaceae	<i>Epacris microphylla</i>	Coral Heath
Epacridaceae	<i>Epacris pulchella</i>	Wallum Heath
Epacridaceae	<i>Leucopogon lanceolatus</i>	Lance-leaf Beard-heath
Epacridaceae	<i>Monotoca elliptica</i>	Tree Broom-heath
Epacridaceae	<i>Monotoca scoparia</i>	Prickly Broom-heath
Euphorbiaceae	<i>Amperea xiphoclada</i> var. <i>xiphoclada</i>	Broom Spurge
Fabaceae/faboideae	<i>Daviesia latifolia</i>	-
Fabaceae/faboideae	<i>Daviesia squarrosa</i>	-
Fabaceae/faboideae	<i>Gompholobium huegelii</i>	Pale Wedge Pea
Fabaceae/faboideae	<i>Mirbelia platylobioides</i>	-
Fabaceae/faboideae/Faboideae	<i>Phyllota squarrosa</i>	Dense Phyllota
Fabaceae/faboideae/Mimosoideae	<i>Acacia buxifolia</i>	Box-leaf Wattle
Fabaceae/faboideae/Mimosoideae	<i>Acacia rubida</i>	Red-stemmed Wattle
Fabaceae/faboideae/Mimosoideae	<i>Acacia terminalis</i>	Sunshine Wattle
Myrtaceae	<i>Baekkea linifolia</i>	Weeping Baekkea
Myrtaceae	<i>Leptospermum arachnoides</i>	-
Myrtaceae	<i>Leptospermum continentale</i>	Tea-tree
Myrtaceae	<i>Leptospermum grandifolium</i>	Woolly Tea-tree
Myrtaceae	<i>Leptospermum obovatum</i>	-
Myrtaceae	<i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i>	Tantoon

Family	Scientific Name	Common Name
Myrtaceae	<i>Leptospermum trinervium</i>	Slender Tea-tree
Proteaceae	<i>Banksia spinulosa</i>	Hairpin Banksia
Proteaceae	<i>Banksia ericifolia</i> var. <i>ericifolia</i>	Heath-leaved Banksia
Proteaceae	<i>Grevillea acanthifolia</i> subsp. <i>acanthifolia</i>	-
Proteaceae	<i>Grevillea laurifolia</i>	Laurel-leaf Grevillea
Proteaceae	<i>Hakea dactyloides</i>	Broad-leaved Hakea
Proteaceae	<i>Hakea sericea</i>	Needlebush
Proteaceae	<i>Isopogon anemonifolius</i>	Flat-leaved Drumsticks
Proteaceae	<i>Lomatia myricoides</i>	River Lomatia
Proteaceae	<i>Lomatia silaifolia</i>	Crinkle Bush
Proteaceae	<i>Persoonia chamaepitys</i>	Mountain Geebung
Proteaceae	<i>Persoonia hindii</i>	-
Proteaceae	<i>Persoonia myrtilloides</i> subsp. <i>myrtilloides</i>	-
Proteaceae	<i>Persoonia oblongata</i>	-
Proteaceae	<i>Persoonia recedens</i>	-
Proteaceae	<i>Petrophile pulchella</i>	Conesticks
Proteaceae	<i>Petrophile sessilis</i>	Conesticks
Rhamnaceae	<i>Pomaderris andromedifolia</i>	-
Rutaceae	<i>Boronia microphylla</i>	Small-leaved Boronia
Santalaceae	<i>Leptomeria acida</i>	Native Currant
Santalaceae	<i>Omphacomeria acerba</i>	-
Scrophularaceae	<i>Derwentia blakelyi</i>	-
Groundcovers		
Asteraceae	<i>Arrhenechthites mixta</i>	Purple Fireweed
Asteraceae	<i>Helichrysum rutidolepis</i>	Pale Everlasting
Asteraceae	<i>Hypochaeris glabra</i> *	Smooth Catsear
Asteraceae	<i>Hypochaeris radicata</i> *	Flatweed
Asteraceae	<i>Lagenophora stipitata</i>	-
Asteraceae	<i>Senecio linearifolius</i>	Fireweed
Clusiaceae	<i>Hypericum gramineum</i>	Small St Johns Wort
Cyperaceae	<i>Gahnia aspera</i>	Saw Sedge
Cyperaceae	<i>Gahnia microstachya</i>	-
Cyperaceae	<i>Gahnia sieberiana</i>	Red-fruited Saw-sedge
Cyperaceae	<i>Lepidosperma laterale</i>	Variable Sword-sedge
Cyperaceae	<i>Lepidosperma limicola</i>	-
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Bracken
Dilleniaceae	<i>Hibbertia obtusifolia</i>	Grey Guinea Flower
Droseraceae	<i>Drosera peltata</i>	Sundew
Droseraceae	<i>Drosera spathulata</i>	Common Sundew
Euphorbiaceae	<i>Poranthera microphylla</i>	-
Gentianaceae	<i>Centaurium erythraea</i> *	Common Centaury
Gleicheniaceae	<i>Gleichenia dicarpa</i>	Pouched Coral Fern
Goodeniaceae	<i>Dampiera stricta</i>	Blue Dampiera
Goodeniaceae	<i>Goodenia bellidifolia</i>	Daisy-leaved Goodenia
Goodeniaceae	<i>Goodenia hederacea</i> subsp. <i>hederacea</i>	Ivy-leaved Goodenia

Family	Scientific Name	Common Name
Haloragaceae	<i>Gonocarpus tetragynus</i>	Poverty Raspwort
Haloragaceae	<i>Gonocarpus teucroides</i>	Raspwort
Iridaceae	<i>Patersonia glabrata</i>	Leafy Purple-flag
Iridaceae	<i>Patersonia sericea</i>	Wild Iris
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Wattle Mat-rush
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Wattle Mat-rush
Lomandraceae	<i>Lomandra glauca</i>	Pale Mat-rush
Lomandraceae	<i>Lomandra longifolia</i>	Spiky-headed Mat-rush
Lomandraceae	<i>Lomandra multiflora</i>	Many-flowered Mat-rush
Orchidaceae	<i>Dipodium punctatum</i>	Hyacinth Orchid
Oxalidaceae	<i>Oxalis perrenans</i>	Yellow-flowered Wood Sorrel
Phormiaceae	<i>Dianella caerulea</i> var. <i>producta</i>	Blue Flax Lily
Phormiaceae	<i>Dianella revoluta</i> var. <i>revoluta</i>	Spreading Flax Lily
Poaceae	<i>Austrodanthonia racemosa</i> var. <i>racemosa</i>	Wallaby Grass
Poaceae	<i>Austrostipa pubescens</i>	Tall Speargrass
Poaceae	<i>Joycea pallida</i>	Silvertop Wallaby Grass
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Rice Grass
Poaceae	<i>Poa seiberiana</i> var. <i>cyanophylla</i>	-
Proteaceae	<i>Grevillea laurifolia</i>	Laurel-leaf Grevillea
Restionaceae	<i>Baloskion australe</i>	-
Restionaceae	<i>Empodisma minus</i>	-
Stylidiaceae	<i>Stylidium graminifolium</i>	Grass Trigger Plant
Stylidiaceae	<i>Stylidium lineare</i>	Narrow-leaved Trigger Plant
Thymelaeaceae	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	Slender Rice Flower
Tremandraceae	<i>Tetradlea rupicola</i>	Black-eyed Susan
Violaceae	<i>Hybanthus monopetalus</i>	Slender Violet
Violaceae	<i>Hybanthus vernonii</i> subsp. <i>vernonii</i>	-
Violaceae	<i>Viola betonicifolia</i>	Native Violet
Violaceae	<i>Viola hederacea</i>	Ivy-leaved Violet
Xanthorrhoeaceae	<i>Xanthorrhoea resinosa</i>	-
Climbers		
Pittosporaceae	<i>Billardiera scandens</i>	Hairy Appleberry

Species in **Bold** are listed as Threatened Species within the TSC Act (1995).