APPENDIX J

Ecological Impact Assessment



COALPAC CONSOLIDATION PROJECT

Ecological Impact Assessment

For:

Hansen Bailey

March 2012

Final Report

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Report No. 9023RP2

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

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Executive Summary

S1 Introduction

Cumberland Ecology was commissioned by Hansen Bailey on behalf of Coalpac to undertake an ecological impact assessment of the proposed Coalpac Consolidation Project, which will facilitate the development of a 21 year open cut coal mining operation and associated infrastructure. The ecological impact assessment will form part of an Environmental Assessment being prepared by Hansen Bailey to support an application for a contemporary Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979.*

The ecological assessment also followed the Environmental Assessment Requirements of the Director-General of the NSW Department of Planning for the Project.

The Commonwealth Department of Sustainability, Environment, Water, Population and Communities have determined that the Project is a Controlled Action under the *Environment Protection and Biodiversity Conservation Act 1999* and will utilise the Department of Planning's assessment process to assess the Project. The Project requires the approval of the Commonwealth Minister for the Environment.

The purpose of this report is to document the findings of an ecological investigation of the Project and to assess the impacts of the Project on current biodiversity values, including threatened species, populations and ecological communities protected under State and Commonwealth legislation.

The specific objectives of the report are as follows:

- Present and analyse the results of literature and database reviews;
- Present the results and describe the existing flora and fauna within the Project Boundary based upon the results of the latest survey information;
- Identify and consider the impacts of the Project upon threatened species and ecological communities, listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the *Threatened Species Conservation Act 1995 (NSW*) and the *Fisheries Management Act 1994 (NSW)* and recorded within the Project Boundary or likely to be present therein; and
- Prescribe an avoidance, mitigation and offsetting strategy that will protect threatened flora and fauna and provide for a net gain of conserved woodland and forest habitats in the long term.

The ecological assessment examines the terrestrial and aquatic flora and fauna assemblages and their habitats within the Project Boundary and determines the biological impacts of the construction and operation of the Project. It also describes the proposed ameliorative measures as well as the assessments of impacts required under Part 3A of the *Environmental Planning and Assessment Act 1979*.

The Project is located near the town of Cullen Bullen, on the western slopes of the Great Dividing Range on the western edge of the Sydney Basin bioregion, and in the Central West Catchment Management Authority, NSW. The Project Boundary is approximately 2,484 ha and includes areas of the approved Invincible Colliery and Cullen Valley Mine operations and parts of Ben Bullen State Forest and is over 2 km from the Gardens of Stone National Park.

S2 Methodology

S2.1 Literature Review

Relevant literature from previous studies conducted for the existing Invincible Colliery and Cullen Valley Mine operations within the Project Boundary and for other mines in the area was reviewed for this Project. Information from previous studies has been incorporated into this report. Additionally, the "*Vegetation of the Western Blue Mountains*" DEC (2006) mapping project has been used to assist with identifying and describing vegetation communities.

Database analysis was also conducted for the locality using the (then) Department of Environment, Climate Change and Water Atlas of NSW Wildlife Database and the Department of Sustainability, Environment, Water Population and Communities EPBC Protected Matters Search Tool.

S2.2 Surveys Within the Project Boundary

Cumberland Ecology conducted flora and fauna surveys to comply, where possible, with standards provided in the Threatened Biodiversity Survey and Assessment Guidelines for Development and Activities (Working Draft) (DEC (NSW) 2004).

Vegetation sampling conducted within the Project Boundary involved the following procedures:

- Quadrat sampling (20m x 20m and 20m x 50m (in Box Gum Woodland));
- Quadrat sampling (20m x 1m and 100m x 20m);
- Targeted searches for threatened species; and
- Random meander surveys.

Fauna surveys by Cumberland Ecology were conducted over three periods in autumn and spring to cover a range of seasonal conditions, specifically from 6-8 April 2009 (preliminary survey), 7-11 September 2009 and 19-23 October 2009. The following targeted surveys for fauna were conducted:

- Amphibians: habitat assessment, diurnal and nocturnal active searches, spotlighting, call playback;
- Birds: habitat assessment, bird census surveys, visual observation and call identification, nocturnal spotlighting, nocturnal call playback, diurnal call playback;
- Mammals: habitat assessment, trapping (ground and arboreal trapping), harp trapping, trip-lining, hair tubes, Anabat call recording, spotlighting, nocturnal call playback, infra-red cameras;
- Reptiles: habitat assessment, diurnal and nocturnal active searches; and

- Threatened insects: habitat assessment, diurnal searches, and nocturnal searches.

S2.3 Surveys for Potential Offset Sites

The Project will impact native forests and woodlands, including habitats of threatened flora and fauna. For this reason, it was apparent at the outset of this assessment that land to be designated as compensatory offsets would be required to address the ecological impacts of the Project. Offset surveys were conducted during late 2010 and throughout 2011. The latter part of the methods chapter of this report provides details regarding proposed offset land assessment procedures and the methods used to derive a final offset package, including criteria for the survey and selection of offsets.

S3 Results

S3.1 Vegetation Communities

The Project Boundary is generally forested and occurs across a landscape characterised by sandstone plateaus with 'pagoda' rocky out-cropping formations. The Project Boundary sits relatively high in the landscape with very few drainage lines. Most runoff would be expected to occur as overland flows, collecting at a point lower in the landscape than the Project Boundary. A wide variety of woodland and open forest flora and fauna are known to occur in the locality (within a 10km radius of the Project) and a considerable diversity of species has been identified in previous environmental surveys for the already approved mining projects. The vegetation of the Project Boundary is generally in good condition, with few exotic species occurring.

The following vegetation communities were recorded in the Project Boundary:

1. Pagoda Rock Sparse Shrubland;
2. Capertee Rough-barked Apple Red Gum Yellow Box Grassy Woodland;
3. Capertee Rough-barked Apple Red Gum Woodland – non grassy;
4. Tableland Gully Ribbon Gum – Blackwood Apple Box Forest;
5. Tableland Gully Mountain Gum – Broad-leaved Peppermint Grassy Forest;
6. Tableland Gully Snow Gum – Ribbon Gum Grassy Forest;
7. Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest/ Woodland;
8. Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Woodland;
9. Cox's Permian Red Stringybark – Brittle Gum Woodland;
10. Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest;
11. Tableland Broad-leaved Peppermint – Brittle Gum – Red Stringybark Grassy Open Forest;
12. Acacia Thickets; and
13. Native Grasslands.

Of these communities, Capertee Rough-barked Apple Red Gum Yellow Box Grassy Woodland and Derived Native Grasslands represents a form of the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland) endangered ecological community as listed under the *Threatened Species Conservation Act 1995,* also listed as a critically endangered ecological community under the *Environment Protection and Biodiversity Conservation Act 1999*.

The table below provides the details on the extent of each vegetation community in the Project Boundary and the areas of each vegetation community proposed to be cleared.

Table S.1 Summary of Vegetation Areas within the Project Boundary and within the Project Disturbance Boundary

Vegetation Community	Area of Vegetation in the Project Boundary (ha)	Area within Project Disturbance Boundary (ha)	Area retained within Project Boundary (ha)
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (EPBC)	46.18	16.21	29.97
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (EPBC)	0.27	0.27	0.00
Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy	0.12	0.11	0.01
Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (TSC EEC)	1.99	1.96	0.03
Tableland Gully Ribbon Gum Blackwood Applebox Forest	111.81	93.94	17.87
Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland	16.62	15.02	1.60
Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest	332.43	112.51	219.91
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland	13.71	13.02	0.68
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland Low Diversity Derived Native Grassland	215.23	42.72	172.51
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest	260.86	185.77	75.09
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest Derived Native Grassland	57.07	50.10	6.97
Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest	51.70	18.87	32.84
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland	12.84	12.43	0.41

Table S.1 Summary of Vegetation Areas within the Project Boundary and within the Project Disturbance Boundary

Vegetation Community	Area of Vegetation in the Project Boundary (ha)	Area within Project Disturbance Boundary (ha)	Area retained within Project Boundary (ha)
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland	2.79	0.85	1.94
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest	0.90	0.00	0.90
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland	23.35	0.00	23.35
Pagoda Rock Sparse Shrubland	32.87	0.05	32.83
Cox's Permian Red Stringybark - Brittle Gum Woodland	92.02	23.71	68.31
Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	679.11	370.43	308.68
TOTAL	**1951.88**	**957.98**	**993.90**

S3.2 Flora

More than 400 plant species were recorded in the Project Boundary, with a high proportion being native. Three threatened flora species were recorded within the Project Boundary:

- *Eucalyptus cannonii* (Capertee Stringybark);
- *Persoonia marginata* (Clandulla Geebung); and
- *Eucalyptus aggregata* (Black Gum).

These species are listed as Vulnerable under the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*.

S3.3 Fauna

The Project Boundary contains a variety of fauna habitats. These include forested steep slopes and gullies, woodlands on lower slopes with flatter topography, and sandstone outcropping with heath and woodland. This outcropping forms caves and crevices that are used as refugia by some fauna species. There are very few aquatic habitats present in the Project Boundary, limited to small old farm dams, and ephemeral drainage lines. Generally there is a paucity of permanent or reliable freshwater sources within the Project Boundary.

A large number of bird species, several common reptile species and eight amphibian species were recorded during the current survey. Mammal species recorded included macropods, microchiropteran bats and arboreal mammals, with very few small ground-dwelling mammals recorded. Eleven threatened fauna species were recorded, including eight birds and three mammals. In addition, the Project Boundary provides potential habitat for an array of threatened species.

The steep, forested gullies contain habitat for the Squirrel Glider, Powerful Owl and Gang-gang Cockatoo, all of which were recorded during surveys of the Project Boundary. The sandstone forests and woodlands provide known habitat for the Scarlet Robin, Speckled Warbler, Brown Treecreeper, Satin Flycatcher and Square-tailed Kite which have been detected during surveys of the Project Boundary as well as for the Varied Sittella, detected in 2003 by AES.

The gullies also provide potential habitat for the Yellow-bellied Glider, Masked Owl, Barking Owl, Glossy Black Cockatoo, and a suite of hollow dependant microbats listed under the *Threatened Species Conservation Act 1995*. The woodlands in lower parts of the Project Boundary contain potential habitat for Swift Parrot and Regent Honeyeater, Little Lorikeet, Diamond Firetail, Painted Honeyeater and Black-chinned Honeyeater. The pagodas (which will not be affected by mining or mining related activities) within the Project Boundary also provide potential habitat for a range of species including the threatened Large-eared Pied Bat and Eastern Bent-wing Bat. The sandstone plateaus provide potential habitat for the Broad-headed Snake and Rosenberg's Goanna, though neither species was detected during surveys. Suitable habitat also exists within the Project Boundary for the Spotted-tail Quoll.

S4 Impact assessment

S4.1 Project Boundary

The Project has potential to have a substantial impact on the ecology of the local area. It would impact significantly on the critically endangered Box Gum Woodland, hollow-dependent microchiropteran bats within the locality and threatened woodland birds, including potentially the Regent Honeyeater and Swift Parrot.

The Project Disturbance Boundary will be approximately 958 ha within the Project Boundary. Of this, the Project will remove approximately 835 ha of native forest and woodland that provides habitat for several threatened species and Critically Endangered Ecological Communities (CEEC). The remaining 123 ha includes native grasslands from various grassy communities in various conditions. Low Diversity Derived Native Grassland/Exotic provides very little ecological value and as such has not been further considered within the impact assessment.

The following is a summary of the impact of the Project on threatened biodiversity within the Project Disturbance Boundary:

- Approximately 16.21 ha of Box Gum Woodland and 0.27 ha of Derived Native Grassland, listed under the *Environment Protection and Biodiversity Conservation Act 1999* and the *Threatened Species Conservation Act 1995*. Approximately 29.97 ha of Box Gum Woodland shall remain undisturbed within the Project Boundary;
- Approximately 1.96 ha of Box Gum Woodland Derived Native Grassland listed under the TSC Act only;
- 278 ha of known and potential *Eucalyptus cannonii* habitat constituting an estimated 19,219 individuals. Approximately 630 ha of known and potential *E. cannonii* habitat or an estimated 18,382 individuals shall remain undisturbed within the Project Boundary;

- 3.28 ha of *Persoonia marginata* habitat constituting an estimated 321 individuals. Approximately 13.1 ha of *Persoonia marginata* habitat remains within the Project Boundary, or an estimated 4,457 individuals; and

- 835 ha of native forest and woodland, habitat for various fauna species known to occur or considered to potentially occur will be removed (787 ha shall remain).

The Project will remove approximately 835 ha of woodland and forest providing suitable foraging, shelter and breeding habitat for a suite of woodland birds including the Varied Sittella, Scarlet Robin, Speckled Warbler, Brown Treecreeper, Square-tailed Kite, Little Lorikeet and Diamond Firetail. Blossom dependant and migratory species are also expected to be impacted by the removal of these treed habitats. Species to be affected include the Regent Honeyeater, Painted Honeyeater and Black-chinned Honeyeater and the Swift Parrot. Other threatened birds expected to be impacted by habitat disturbance for the Project include the Gang-gang Cockatoo, Powerful Owl and Masked Owl.

Additionally, the following threatened mammals are expected to be impacted by habitat disturbance for the Project: Yellow-bellied Glider, Squirrel Glider and Spotted-tailed Quoll. A suite of threatened microbats including the hollow dependant Eastern False Pipistrelle, Eastern Freetail-bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat and cave dwelling Large-eared Pied Bat and Eastern Bent-wing Bat are also expected to be impacted.

Notwithstanding these expected impacts, large areas of suitable habitat will remain in the Project Boundary (787 ha of forest and woodland) and in the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other large remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of adjacent Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented, including protecting and conserving suitable habitat for these species via establishing offset properties, and progressively rehabilitating impacted land to develop high quality habitat within the Project Boundary.

S4.2 Impacts to Ben Bullen State Forest and Garden of Stone Stage 2 State Conservation Area Proposal

S4.2.1 Impacts to Ben Bullen State Forest

Ben Bullen State Forest covers approximately 6,783 ha. The Project is largely located within the State Forest, with approximately 1,442 ha of the Project Boundary (58%) occurring within it. Of this, approximately 752 ha lies within the Project Disturbance Boundary and will be impacted. Therefore the Project will result in the progressive removal of 11% of Ben Bullen State Forest over 21 years, at an average rate of 36 ha per annum. The removal of forest and woodland will occur on the western edge of Ben Bullen State Forest.

S4.2.2 Impacts to Gardens of Stone Stage 2 State Conservation Area

Non-Government Organisations have proposed to expand the Gardens of Stone conservation area. The proposal, known as the Gardens of Stone Stage 2 (GOS2) covers an area approximately 39,888 ha and consists of six divisions that are proposed to extend the Blue Mountains National Park and Gardens of Stone National Park by creation of two new conservation areas: Gardens of Stone State Conservation Area and Western Escarpment State Conservation Area. The division that the Project lies within is the Baal Bone and Long Swamp Division (BBLSD). The BBLSD has been nominated by the Colong Foundation for inclusion into GOS2 for its "massed pagoda 'villages' that stand above the diverse swampy plains".

Although the Project is located within the GOS2, it constitutes 1.3% of the proposed conservation area and the clearing of this vegetation is to be rehabilitated in stages. Moreover the proposed biodiversity offset areas will add to and complement some of the objectives of GOS2. The Project will not clear significant geological formations. It will not remove any pagoda villages or cliff lines within the Project Boundary. Of the 958 ha proposed to be disturbed by the Project, approximately 528 ha are located within the BBLSD. This constitutes approximately 6.8% of the total area of BBLSD. This value (528 ha) is lower because areas of Ben Bullen State Forest west of the Castlereagh Highway have not been included in the proposal for the BBLSD of GOS2.

A Project offset property, Hyrock Hartley, is located adjacent to the Western Escarpment Division of the GOS2, in an area proposed as an extension to the Blue Mountains National Park. The Western Escarpment Division covers 4,000 ha. The Hyrock Hartley property covers approximately 236 ha of intact native sandstone vegetation and will constitute 5.9% of the Western Escarpment Division and 0.6% of the total GOS2 area.

S4.3 Project Impacts in a Regional and State-wide Context

S4.3.1 Summary of Impacts in a Bioregional Context

The Project lies along the western edge of the Sydney Basin Bioregion. The vegetation communities to be removed within the Project Disturbance Boundary are well represented throughout the Sydney Basin Bioregion. Such habitats are also well conserved as there are broad areas of similar habitat that are protected in Wollemi National Park, Gardens of Stone National Park and the Blue Mountains National Park. There are also large areas of similar habitat within Newnes State Forest and Sunny Corner State Forest.

The Project will have a significant impact on the biodiversity values of the Project Boundary in the short term. However, the Sydney Basin Bioregion (3,627,008 ha in total) supports extensive areas of habitat in conservation tenure and has the third highest area of conservation-oriented tenures of the NSW bioregions. Together, they occupy about 1,384,418.33 hectares or 38.20 per cent of the bioregion for the EECs, threatened flora and threatened fauna that will be impacted by the Project. State Forests cover 178,066 hectares or 4.91% of the bioregion. The Project constitutes 0.4% of all State Forests within the bioregion.

S4.3.2 Summary of Impacts in a Regional Context

The Project Boundary lies within the eastern edge of the Central West Catchment. The Central West Catchment covers 8,484,200 ha. The Project will remove the following percentages of vegetation types mapped in the Central West Catchment estimated to cover the region:

- 0.86% of Mountain Gum – Red Stringybark Open Forest at High Altitudes;
- 0.39% of Mountain Gum – Peppermint Forest at High Altitudes;
- 0.21% of Scribbly Gum Woodland;
- 0.27% of Stringybark – Box – Gum Woodland; and
- 0.57% of Sydney Sandstone Woodland/Open Forest.

In total the Project will remove 835 ha, which constitutes 0.21% of the above mentioned vegetation types estimated to cover the CW Catchment.

The Project will remove 835 ha of forest and woodland which constitutes 0.01% of all forest and woodland mapped within the CW Catchment.

S4.3.3 Summary of Impacts in a State-wide Context

The NSW state covers approximately 80,160,000 ha.

The Project will remove the following percentages of vegetation classes estimated to currently extend across the entire State:

- <0.001% of Western Slopes Grassy Woodland;
- 0.067% of Southern Tableland Grassy Woodland;
- 0.051% of Southern Tableland Dry Sclerophyll Forest;
- 0.001 of Sydney Montane Heath; and
- 0.206% of Sydney Montane Dry Sclerophyll Forest.

In total the Project will remove 0.06% of the abovementioned forest and woodlands occurring within NSW.

S4.4 Cumulative Impacts

The locality surrounding the mine contains a variety of mining and other industrial development that includes:

- Baal Bone Colliery;
- Mount Piper Power Station Extension;
- Ivanhoe North Colliery; and
- Pine Dale Coal Mine – Yarraboldy Extension.

On current information publically available, the surrounding projects are not seeking approval to clear large areas of vegetation. Baal Bone Colliery proposes to continue underground mining in the northern parts of Ben Bullen State Forest. Mining has now concluded in Longwalls 28-31 and has not directly impacted vegetation through clearing. The Mount Piper Power Station Extension proposes to avoid direct impacts to remnant native vegetation by restricting construction to pre-cleared areas containing regrowth and planted gardens. Ivanhoe North Colliery will result in the clearance of approximately 12.3 ha of relatively undisturbed native vegetation. The Yarraboldy Extension of Pine Dale Coal Mine will remove 27 ha of vegetation, 14 ha being native vegetation. Collectively, the Project makes up a large proportion of the cumulative impacts. As such, areas of the Ben Bullen State Forest will be subject to open cut, highwall and underground mining within the next two to three decades, beyond which, no further disturbance is likely to occur as a result of mining. The coal being mined by the Project is the last remaining coal to be mined in the Cullen Bullen area, and as such the cumulative impacts are finite and known.

The cumulative impacts of mining and other industrial development on the GOS2 are not expected to increase dramatically. This is because the surrounding developments consist of either smaller surface impacts or subsurface (underground mine) operations. Excluding underground mines, Pine Dale Mine's Yarraboldy Extension is the only development, seeking to remove 20 ha of vegetation located in BBLSD.

The cumulative impacts of Pine Dale and the Project amount to 548 ha or 7% of the BBLSD.

S5 Amelioration Package

A number of amelioration measures have been designed to minimise the ecological impacts of the Project. The approach is based upon the following hierarchy of principles of avoidance, mitigation and compensation described within the Draft Discussion Paper for the use of environmental offsets under the *Environment Protection and Biodiversity Conservation Act 1999*:

- Avoid: developments should be designed to avoid or minimise ecological impacts, where possible;
- Mitigate: where certain impacts are unavoidable through design changes, mitigation measures should be introduced to ameliorate the ecological impacts of the proposed development; and

- Compensate: the residual impacts of the Project, following the implementation of mitigation measures, should be compensated for in some way to offset what would otherwise be a net loss of habitat.

S5.1 Avoidance

Avoiding environmental impacts has been considered throughout the Project planning and design phases to reduce vegetation clearance, avoid pagoda rock formations and cliffs, and to minimise clearance of the threatened plant *Persoonia marginata.* These avoidance measures were achieved through either implementing highwall mining to minimise surface impacts from clearing areas initially proposed for open cut mining or completely sterilising portions of coal resource from any form of extraction.

Vegetation: Significant modification to the design of the Project has reduced the need for vegetation clearance and most Box Gum Woodland on the lease area has now been avoided. This was largely achieved in the northern portions of the Project Boundary, around the Cullen Valley and East Tyldesley areas. The alignment of the Mount Piper Power Station conveyor has also been located adjacent to and partially within an existing powerline infrastructure alignment to reduce the amount of unnecessary vegetation clearing. These avoidance measures have excluded a further 186 ha of native vegetation from surface mining disturbance within the Project Boundary over the life of the mine (21 years).

Pagodas and Cliffs: Such modifications have also led to an avoidance of pagoda cliff formations and other cliff line areas. The mine plan was initially modified to avoid such rock formations, and then modified further after community engagement and consultation with OEH to provide a further setback or stand-off from the formations. The limit of open cut operations has been set back a further 50m from cliff lines and pagoda habitat to reduce potential impacts on cliff line dependant fauna. Additional to this, geotechnical reviews will be undertaken prior to within 500 m of these structures to record their condition and confirm individual management measures and monitoring criteria.

Coalpac has committed to the following:

- A 50 m buffer between mining operations and all pagodas or sandstone escarpments; and
- A 20 m buffer from any other significant rock exposure (outcrop) that does not fall into the above category.

Threatened Flora and Fauna: The Project mine plan has been modified to reduce impacts on Matters of National Environmental Significance: Box Gum Woodland and threatened plants. The alteration of disturbance footprints for the Project through changes to the planning and design phase also resulted in the avoidance of approximately 630 ha of potential and known *Eucalyptus cannonii* habitat; 9 ha of *Persoonia marginata* habitat and approximately 30 ha of Box Gum Woodland habitat.

S5.2 Mitigation Measures

For management and monitoring of the cliff line habitats Coalpac will complete the following prior to the commencement of any mining operations within 500 m of these areas (buffer zone):

- A photographic documentation of all visible cliff faces should be conducted to form a baseline of the existing condition;

- Detailed photographic documentation of the rock shelters of Aboriginal heritage significance, preferably utilising digital 3D photography where possible;
- Subsidence and vibration modelling for each area;
- Establishment of a series of survey stations in key locations on selected escarpments for re-survey on an annual basis following mining within the buffer zone;
- Risk assessment of the cliff faces to predict the impact of open cut mining and reassess as required to determine if any response is required to minimise or control any further impact; and
- Completion of hazard management plans for any areas deemed unsafe due to natural or induced instability.

All land disturbed for the Project will be progressively rehabilitated in accordance with the conceptual mine plans. The majority of disturbed land will be returned to native forest and woodland habitat; however some areas of grassland within the Project Disturbance Boundary may be rehabilitated back to grassland.

A detailed rehabilitation plan will be designed for the Project with the intention of providing pre-mining biodiversity values. Coalpac's rehabilitation of previously mined areas are progressing well and are within target levels, which provides confidence that future rehabilitation of newly mined areas will follow suit and be of high quality providing habitat for flora and fauna.

The following additional mitigation measures are based on the findings of this report and are recommended for the Project:

- Minimise disturbance of native vegetation during construction and ahead of Project mining operations;
- Prepare a consolidated Coalpac Biodiversity Management Plan that contains detailed mitigation measures for the Project and includes the existing Invincible Colliery and Cullen Valley Mine offsets to provide a cohesive, integrated and holistic approach. This plan should include (but not be limited to) information such as protocols for vegetation clearing (including inspection of hollows), feral animal and pest control, rehabilitation objectives, and further detailed design measures;
- Prepare and implement a nest box management procedure (refer below);
- Implement a two stage clearing protocol for all hollow-bearing trees. All hollow-bearing trees to be felled should be marked and a catalogue of their species and approximate dimensions recorded so that hollows or nest boxes can be affixed to similar standing trees located in offset, revegetation or rehabilitation areas;
- Undertake ongoing weed management and monitoring;
- Prepare a Rehabilitation/Revegetation Management Plan which should include (but not be limited to):

- Planting a variety of locally occurring native species, including trees, shrubs and selected herbaceous plants to compensate for any impacts to habitat;
- Increasing the overall vegetation cover;
- Incorporating existing natural vegetation and habitat features removed during clearing activities where appropriate; and
- Establishing linkages between patches of remnant native vegetation.

➢ As part of the Coalpac Biodiversity Management Plan, develop a flora and fauna monitoring program for the Project. This monitoring plan should enhance and complement the existing monitoring plan. This plan should also include monitoring and control of exotic weeds and feral animals; and

➢ As part of the Water Management Plan, prepare a consolidated Sediment and Erosion Control Plan which includes leading practice erosion and sediment controls.

S5.3 Compensatory Habitat

The rehabilitation of mined areas at Cullen Valley Mine and Invincible Colliery is progressing well and is of high quality. There is a relatively high degree of confidence that future rehabilitation will succeed and that local native forest and woodland species will be able to be replanted on rehabilitated land. This has been considered when designing an offset program for the Project.

Most of the impacted habitats within the Project Boundary are within "sandstone landscapes" that are relatively well represented in National Parks and other conservation reserves within the locality. The offsetting measures for the Project have been tailored to reflect this and the emphasis will be on conserving the Box Gum Woodland CEEC at an offset ratio of 13:1 and continuing high quality rehabilitation of mined areas. Overall, considering the well conserved status of the sandstone vegetation and the high quality of rehabilitation efforts to date, the proposed composite offsetting ratio of 2:1 is considered adequate.

S5.4 Existing Compensatory Habitat

Coalpac is currently managing land totalling approximately 166ha of woodland, open forest and grassland, which are being managed as long-term compensatory conservation areas for residual impacts associated with Invincible Colliery and Cullen Valley Coal Mine. In Coalpac's existing habitat compensation areas, two threatened plants have been recorded and further, another threatened species has been planted during rehabilitation. These include the following:

➢ Cullen Valley Mine Habitat Compensation Area no.5 contains 3.93 ha of known habitat of *Persoonia marginata*;

➢ Lot 112 DP 877190, part of Invincible Colliery's 2008 offset, contains approximately 20 *Eucalyptus aggregata* individuals; and

➢ *Eucalyptus cannonii* tubestocks have also been planted within Lot 113, DP 877190 and Lot 1 and DP 180294 "Renown Farm", part of Invincible Colliery's 2008 offset (R.W. Corkery & Co 2008a).

Collectively, in the long term, these existing habitat compensation and ecological offset areas will complement the surrounding remnant vegetation by adding to existing forest and woodland, create new corridors through the rehabilitation of grasslands and conserve known habitat of *Persoonia marginata, Eucalyptus aggregata* and *Eucalyptus cannonii.*

S5.5 Project Compensatory Habitat

In addition to the existing Biodiversity Offsets, Coalpac has developed a Biodiversity Offset Strategy for the Project with the objective of further offsetting the residual impacts on biodiversity, particularly on threatened ecological communities and habitat for threatened species, whilst taking into consideration the aims of the GOS2 State Conservation Area Proposal.

The Biodiversity Offset Strategy entails acquisition of offset properties for the permanent conservation of flora and fauna, including threatened flora and fauna predicted to be impacted by the Project. The protection of native vegetation occurring on these properties will contribute to increasing and improving the amount of forest and woodland under conservation tenure within the locality, and will complement other proposed offsetting arrangements by other local mining projects.

In addition to the principles set out by SEWPaC and OEH, the development of the Biodiversity Offset Strategy has been guided by the following key design concepts:

- Secure land for permanent conservation;
- Increase the area of forest and woodland under conservation above what will be lost through the Project;
- Improve the biodiversity values of the offset properties through changing land use (i.e. deliver conservation gains to offset properties that would otherwise not have taken place under current use);
- Improve the biodiversity values of the offset properties through the implementation of positive management interventions to actively stop degradation and to increase the area of native vegetation and habitat for native flora and fauna; and
- Time the offsets to minimise the lags between the Project's impacts and the offset achieving its objectives.

Consideration of the local and regional context of the Project and the offsets help to enhance the land in the vicinity of the Project and to provide longer term community benefits. The surrounding land, including the GOS2 (State Conservation Area) Proposal; existing corridors (e.g. creeks, rivers); and partial or incomplete links (Sunny Corner State Forest and Ben Bullen State Forest) have played a significant role in shaping the Biodiversity Offset Strategy. Thus, the development of the offsets was also influenced by the following design concepts:

- Locate potential offsets available in the locality of the Project;
- Enhance existing conservation reserves by;
    - Adding to the patch size of a reserve by locating offsets nearby or adjacent to the reserve,

- Adding additional land to the reserve system,
- Connecting an existing reserve to other areas of habitat by building corridors i.e. link Sunny Corner State Forest to Ben Bullen State Forest, and
- Buffering the reserve from surrounding land use.

- Build upon natural corridors like creeks and rivers to mitigate broad scale habitat fragmentation; and
- Build onto other nearby biodiversity offsets, which will add value by effectively increasing the net area of established offset areas in the locality.

In addition to the onsite rehabilitation of over 837 ha of forest and woodland, four offset areas of over 1,752 ha have been identified:

- Hillcroft Offset: property west of the Project Boundary supports 327 ha of known *Eucalyptus cannonii* habitat, 450 ha of suitable *E. cannonii* habitat requiring rehabilitation, 86 ha of *Persoonia marginata* habitat, adjoins a population of the Booroolong Frog (*Litoria booroolongensis*), suitable habitat for the Spotted-tailed Quoll and a suite of woodland birds and micro-bats. It contains similar vegetation and derived grasslands capable of being rehabilitated to vegetation communities consistent with those occurring within the Project Disturbance Boundary. Ultimately, rehabilitation of this property will link Sunny Corner State Forest to Ben Bullen State Forest;
- Yarran View Offset: property in Bylong Valley supports CEEC Box Gum Woodland and Derived Native Grassland and contains suitable habitat for the Regent Honeyeater, Swift Parrot, Spotted-tailed Quoll and a suite of woodland birds;
- Hillview/Billabong Offset: property to the west of the Project Boundary supports CEEC Capertee Rough-barked Apple Red Gum Yellow Box Woodland and Derived Native Grassland, known *Eucalyptus cannonii* habitat and similar vegetation impacted by the Project; and
- Hyrock Hartley: property within Hartley Vale supporting similar sandstone habitats to that within the Project Boundary, particularly sandstone escarpment complexes, and with historical records of the Spotted-tailed Quoll, Giant Dragonfly and Blue Mountains Water Skink. The property also provides suitable habitat for the Brush-tailed Rock-wallaby, Large-eared Pied Bat, Broad-headed Snake and a suite of woodland birds. This property will complete a gap in the Blue Mountain National Park extension as part of the GOS2.

Table S.2 provides calculations of Critically Endangered Ecological Community and non-Critically/Endangered Ecological Community vegetation within each offset property.

Table S.2 Project Offset Strategy

Vegetation Type	Hillcroft (ha)	Yarran View (ha)	Billabong/ Hillview (ha)	Hyrock Hartley (ha)	Total (ha)
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland	-	186.8	34.9	-	221.7
Non C/EEC (native only)	989.5	256.3	48.5	236.09	1,530.3
Total	989.5	443.1	83.4	236.09	1,752

Table S.3 provides the extent of CEEC and non-CEECs being disturbed within the Project Boundary and the amount of CEEC and non-EEC being conserved within offsets.

Table S.3 Project Offset Package

Vegetation Type	Project Boundary Disturbance1 (ha)	Proposed Offset2 (ha)	Proposed Offset Ratio
CEEC	16.48	221.7	13.5
EEC^	1.96	221.7	113.1
Non C/EEC (native only)	818.71	1,530	1.9
Total	837.15	1,752	2.1

[1] *does not include areas of low diversity native grassland and exotic grasslands*

[2] *includes areas of low diversity native grasslands*

^ *EEC Box Gum Woodland Derived native Grassland conforming to the TSC Act.*

S5.6 Benefits of Biodiversity Offset Package to Ben Bullen State Forest (including Gardens of Stone Stage 2)

The establishment of an offset package that is capable of connecting large areas of conservation is a major feature of the Biodiversity Offset Strategy for this Project. The Biodiversity Offset Strategy will add value to the existing reserve system in the area. The key concept underpinning this is to provide connectivity between these remnants and rehabilitation areas and to increase the patch size to enhance the contributions of each offset or reserve land.

The Project's biodiversity offset package has taken due consideration of Ben Bullen State Forest and the GOS2. Notwithstanding that some areas of Hillcroft will be mined and rehabilitated. The inclusion of Hillcroft will provide a missing link between two large and currently disconnected tracts of native forest vegetation: Ben Bullen State Forest and Sunny Corner State Forest (**Figure 6.1**).

The following objectives from the GOS2 proposal are addressed by the Project, as explained below:

> Objective 1: *Protection of the most outstanding pagoda landscapes in Australia – these include some of the best scenery in Australia, such as dramatically coloured escarpments, narrow canyons, cave overhangs, rock arches, lonely sandstone peninsulas and wind-formed but now well vegetated sand dunes that are remnants of an ancient paleo-landscape*.

The Project will avoid all pagoda landscapes and Coalpac has committed to a 50 m buffer between mining operations and all pagodas or sandstone escarpments, and a 20 m buffer from any other significant rock exposure (outcrop) that does not fall into the above category.

> Objective 2: *Reservation of ancient windswept montane heathlands, nationally endangered upland swamps, a unique subspecies of snowgum and other grassy high plateau woodlands, including poorly conserved grassy white box woodlands, and moist forest gullies between these woodland*.

Collectively, the offset package will conserve all these attributes. The Hyrock Hartley property is located adjacent to the proposed Western Escarpment Division of GOS2. This property contains Blue Mountains Swamps, likely to constitute areas as described in the GOS2 as "nationally endangered upland swamps". The Hillcroft property supports intact high plateau grassy Scribbly Gum woodland and Gully Snow Gum – Ribbon Gum Forest. The Yarran View and Hillview/Billabong properties will contribute to poorly conserved grassy white box woodland and other CEEC variants local to the area. Further, the rehabilitation of grassland areas on Hillcroft aim to resemble pre-cleared forest which include moist gully forests. The acquisition of Hillcroft will conserve land that connects the rocky pagoda landscapes in the east to the wider drier rolling hills in the west. Once rehabilitated, Hillcroft will create direct connection between a large tracts of remnant habitat consisting of Winburndale Nature Reserve and Sunny Corner State Forest to even larger tracts of remnant habitat proposed to be GOS2 (Ben Bullen State Forest, Newnes State Forest and Gardens of Stone National Park) and further (Wollemi National Park and Blue Mountains National Park) (see Figure 4.2).

> Objective 3: *Protection of the area with the highest density of rare plants anywhere in the Blue Mountains.*

Hillcroft property and Hillview/Billabong have known populations of two nationally listed threatened plants; *Eucalyptus cannonii* and *Persoonia marginata.* The Booroolong Frog has also been recorded adjacent Hillcroft in Williwa Creek.

S6 Conclusion

When mining impacts and offsetting measures are considered overall, the Project will provide major net increases in native forest, waterways and woodland under conservation and in particular, will significantly increase the area of Box Gum Woodland and Derived Grassland, *Persoonia marginata*, *Eucalyptus cannonii*, *Eucalyptus aggregata* habitat under conservation tenure in the region.

The Project would have a substantial impact on the ecology of the local area if no mitigation and compensation measures were proposed, removing 835 ha of native forest and woodland, including 16.48 ha of Box Gum Woodland and Derived Native Grassland listed under the EPBC Act, 278 ha of potential and known *Eucalyptus cannonii* habitat and impact on 3.28 ha of *Persoonia marginata* habitat.

The vegetation that is proposed to be cleared provides habitat for a range of threatened species. At least 35 threatened species listed by the TSC Act and/or the EPBC Act, were recorded or are likely to occur within the Project Boundary. Others also have potential to occur. Avoidance measures include; excluding 994 hectares of forest, woodland and grasslands from mining within the Project Boundary and altering disturbance footprints through mine plan design, including replacing open cut mining with highwall mining methods to avoid 630 ha of known and potential *Eucalyptus cannonii* habitat, 9.17 ha of *Persoonia marginata* habitat and approximately 30 ha of Box Gum Woodland habitat.

There will be minimal impacts to the area currently proposed as the GOS2. Although some of the mining proposal is within the area, all will be rehabilitated in the long term and the proposed biodiversity offset areas will add to and complement some of the stated objectives of GOS2.

In recognition of the potential ecological impacts of the Project, a substantial rehabilitation and offsetting package is proposed and will be implemented by Coalpac. All forest and woodland areas to be cleared by Project mining operations will be rehabilitated to forest and woodland in the long term using local native species, redeveloping treed habitat in the locality. In addition to this, 1,752 ha of forest, woodland, watercourses and grassland habitat within the offset lands will be permanently conserved, including 221 ha of Box Gum Woodland and Derived Native Grassland, 327 ha of known *Eucalyptus cannonii* habitat and 450 ha of suitable *Eucalyptus cannonii* habitat to be rehabilitated and 86 ha of *Persoonia marginata* habitat.

In the long term, the 175 ha of Derived Native Grassland within the offset sites will be regenerated to CEEC Box Gum Woodland. The ratio of CEEC Box Gum Woodland conserved to that cleared will exceed 13:1 for the Project, excluding areas to be rehabilitated within the Project Boundary. The offset package will provide a total offset of 2:1 ratio of native vegetation. This is considered adequate as Coalpac have committed to continuing high quality rehabilitation of disturbed areas for the Project.

Coalpac's rehabilitation of mined areas are progressing well and are within target levels, which provides confidence that future rehabilitation of newly mined areas will follow suit and provide 835 ha of high quality rehabilitated habitat for flora and fauna at the end of mining.

When the mitigation and offsetting package are considered, the Project will have a significant ecological benefit in the long term. It will substantially increase the area of forest and woodland under conservation tenure in the region, thereby providing large areas of habitat for threatened flora and fauna species including the Federally listed; *Eucalyptus cannonii*, *Persoonia marginata*, Regent Honeyeater, Swift Parrot, Spotted-tail Quoll, Brush-tailed Rock-wallaby, Broad-headed Snake, Large-eared Pied Bat, and other State listed threatened species. The Project will add substantial areas of Box Gum Woodland and Derived Native Grassland to conservation tenure.

Chapter 1

Introduction

1.1 Purpose

Cumberland Ecology was commissioned by Hansen Bailey to conduct a flora and fauna assessment of vegetated land within the Project Boundary which is generally the area within existing Mining and Exploration Leases held by Coalpac Pty Ltd (Coalpac). The land that has been considered by this report is under investigation for the Coalpac Consolidation Project (the Project).

The purpose of this report is to describe the ecological values of the Project and to assess the potential impacts of the proposed development on ecological communities as well as flora and fauna species protected under the New South Wales (NSW) *Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This report will be incorporated into an Environmental Assessment (EA) prepared by Hansen Bailey for submission to the NSW Minister for Planning for assessment under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

Specifically, the objectives of the assessment are to:

- Describe and map vegetation communities within the Project Boundary, identifying any listed threatened communities;
- Identify and map the location of threatened flora and fauna species;
- Assess the likelihood that threatened flora and fauna species could occur within the Project Boundary;
- Describe the types and extent of potential impacts on threatened communities and species arising from the Project;
- Where relevant, recommend measures for mitigation in order to manage potential impacts on threatened communities and species under the EPBC Act and TSC Act; and
- Provide a summary of the ecological values of the areas considered appropriate to offset the potential impacts of the Project.

1.2 Background

1.2.1 Project Overview

Coalpac seeks a Project Approval under Part 3A of the *Environmental Planning & Assessment Act 1979* (EP&A Act) to consolidate the operations and management of the Cullen Valley Mine and Invincible Colliery sites under a single, contemporary planning approval to allow coal mining operations within its current mining tenements to continue for a further period of 21 years. Refer to **Figure 1.2**, which illustrates the approved areas of Cullen Valley Mine and Invincible Colliery and the disturbance boundary proposed for the Project. The Project generally comprises the following:

- Consolidation and extension of the existing Cullen Valley Mine and Invincible Colliery operations to produce up to a total of 3.5 Mtpa product coal, including;
  - The continuation of mining operations at Cullen Valley Mine (the area west of the Castlereagh Highway) via both open cut and highwall mining methods to access an additional resource of approximately 40.1 Mt ROM,
  - The continuation of mining operations at Invincible Colliery including an extension north into the East Tyldesley area via open cut and highwall mining methods to access an additional resource of approximately 68.41 Mt ROM.
- Continuation of coal supply to the local Mount Piper Power Station (MPPS) via a dedicated coal conveyor over the Castlereagh Highway (to be constructed), and (emergency supply to) Wallerawang Power Station, with flexibility for supply to additional domestic destinations and Port Kembla for export;
- Upgrades to existing administration, transport and other infrastructure;
- Construction and operation of additional Offices at Cullen Valley Mine;
- Construction and use of the previously approved Coal de-shaling preparation Plant (CDP) at Cullen Valley Mine;
- Construction and use of a bridge over the Castlereagh Highway to link operations east and west of the highway and the development of required access roads to the East Tyldesley area;
- Construction and operation of a bridge and haul road across the Wallerawang - Gwabegar Railway line to permit access to mine the previously approved Hillcroft resource;
- The extraction of the Marangaroo Sandstone horizon from immediately below the Lithgow Coal Seam in the northern coal mining area of Cullen Valley Mine. This material will to be trucked for crushing on site prior to sale into the Sydney (and surrounds) industrial sand market;
- Construction of a rail siding (or rail loop) and associated infrastructure to permit transport of product coal and sand products;
- Integration of the water management of both sites into a single system; and

- Integration of the management of mine rehabilitation and conceptual final landform outcomes for Cullen Valley Mine and Invincible Colliery.

1.2.2 Site Description

The Project is located near the town of Cullen Bullen, on the western slopes of the Great Dividing Range on the western edge of the Sydney Basin Bioregion, and in the Central West Catchment Management Authority (CWCMA), NSW. The Project Boundary includes an area of approximately 2,490ha and includes the approved Invincible Colliery and Cullen Valley Colliery footprints and parts of Ben Bullen State Forest (**Figure 1.1**). The Project Boundary is surrounded by Baal Bone Colliery to the north, Ben Bullen State Forest to the east and south, and agricultural lands to the west and south west. The Castlereagh Highway roughly bisects the Project Boundary (**Figure 1.1**). There are several significant conservation reserves in the area including Gardens of Stone National Park and Wollemi National Park.

For the purposes of this report, the Project Boundary is divided into three main areas: Cullen Valley, which occurs west of the Castlereagh Highway; Invincible, which occurs to the east and south of the existing Invincible Colliery; and East Tyldesley, which occurs east of the Castlereagh Highway and north of the existing Invincible Colliery within the Ben Bullen State Forest (see **Figure 1.1**). The approved footprints of the Invincible Colliery and Cullen Valley Mine are shown on **Figure 1.2**.

The majority of the Project Boundary that has not been modified by previous mining operations contains large expanses of open forest and woodland communities with smaller areas to the west of the Castlereagh Highway supporting cleared grasslands on agricultural land.

The climate is cool temperate, characterised by relatively mild summers and cold winters, typical of the western slopes of the Great Dividing Range. Fog and frost are common in cooler months, although a range of factors including the ridge and valley topography, altitude, aspect and exposure result in small localised microclimates. These variables provide a diverse range of habitat for both flora and fauna.

i. Topography, Soil and Geology

The Sydney Basin consists of a series of shale and sandstone of Permo-Carboniferous age capped by massive sandstones of Triassic Age beneath which coal seams form the Upper Coal Measures.

The landscape within the Project Boundary ranges from steep sandstone escarpments and gullies associated with the Great Dividing Range to moderately undulating and gentle slopes around the township. The Project Boundary encompasses a wide variety of landscapes, from rugged ridgelines containing weathering pagodas and rocky escarpments to deep gullies and undulating rolling land. A series of steep sided gullies associated with the sandstone landscape form numerous ephemeral gullies.

ii. Land use

Existing land uses within the Project Boundary include grazing, mining and forestry. Ben Bullen State Forest is currently used for recreation activities including four-wheel driving, motorbike riding and conservation hunting. Numerous tracks and trails have been created through the Ben Bullen State Forest lands within the Project Boundary. The history of logging in the area was observed with tree stumps and coppiced trees present in more accessible areas.

1.3 Assessment Approach

1.3.1 Surveys within the Project Boundary

The contemporary ecological study was conducted to update existing knowledge of the biodiversity values within the Project Boundary in line with legislative changes, current survey guidelines and new protected species listings.

Detailed surveys within the Project Boundary were completed in 2009 and 2010 to provide updated flora and fauna baseline data for the Project in compliance with the OEH guidelines for flora and fauna survey (DEC (NSW), 2005). Floristic sampling was designed to meet SEWPaC (formerly the Department of the Environment, Water, Heritage and the Arts) guidelines for identifying the Critically Endangered Box Gum Woodland and Derived Grasslands (DEH 2006).

The increasing importance placed by government agencies on the conservation of Critically Endangered Ecological Communities (CEECs) and Commonwealth protected matters prompted the need for a highly accurate vegetation map over the Project Boundary and thus a large proportion of the most recent survey efforts have been dedicated to this purpose. For this reason, Federally listed threatened species such as the *Eucalyptus cannonii* (Capertee Stringybark), Swift Parrot (*Lathamus discolour*) and Regent Honeyeater (*Xanthomyza phrygia*) were also a particular focus of the surveys.

1.3.2 Surveys of Prospective Offset Sites

The Project Boundary is heavily wooded and it is not possible for open cut coal mining to occur without incurring impacts to native forests and woodlands, including habitats of threatened flora and fauna. For this reason, it was apparent at the outset that land to be designated as compensatory offsets would be required to address the ecological impacts of the Project. Detailed surveys were completed in 2010 and 2011 in an effort to quantify potential offset sites. The latter part of this chapter, **Section 2.7**, provides details about how proposed offset land was screened and how a final offset package was derived, including criteria for the survey and selection of offsets.

1.4 Terms and Abbreviations

This report uses the following terms and abbreviations:

Box Gum Woodland: White Box Yellow Box Blakely's Red Gum Grassy Woodland listed under the EPBC Act and TSC Act;

BVT: Broad vegetation type;

DECCW: NSW Department of Environment Climate Change and Water;

Disturbance Boundary: includes all lands to potentially be disturbed as part of the Project within the Project Boundary on Figure 1.2;

EEC: Endangered Ecological Community;

CEEC: Critically Endangered Ecological Community;

C/EEC: Critically Endangered Ecological Community and Endangered Ecological Community;

Current Survey refers to the survey work by Cumberland Ecology conducted in 2009, 2010 and 2011 for the Project;

EP&A Act: NSW *Environmental Planning and Assessment Act 1979*;

EPBC Act: Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*;

KTP: Key Threatening Process, listed under the TSC and EPBC Act as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities;

LGA: Local Government Area;

Locality: is the area within a 10 km radius of the Project Boundary;

Mining Lease: means the land within the Coalpac mining tenements;

OEH: Office of Environment and Heritage, formerly DECCW;

Previous Surveys: refer to all previous flora and/or fauna surveys conducted within the Project Boundary and reviewed by Cumberland Ecology;

Project Boundary: refers to Project Boundary (all land subject to this EA);

SEWPaC: Commonwealth Department of Sustainability, Environment, Water, Population and Communities;

Threatened flora and fauna: refers to communities, populations and species listed as threatened under the EPBC Act, the TSC Act and the Fisheries Management Act 1994; and

TSC Act: NSW *Threatened Species Conservation Act 1995*.

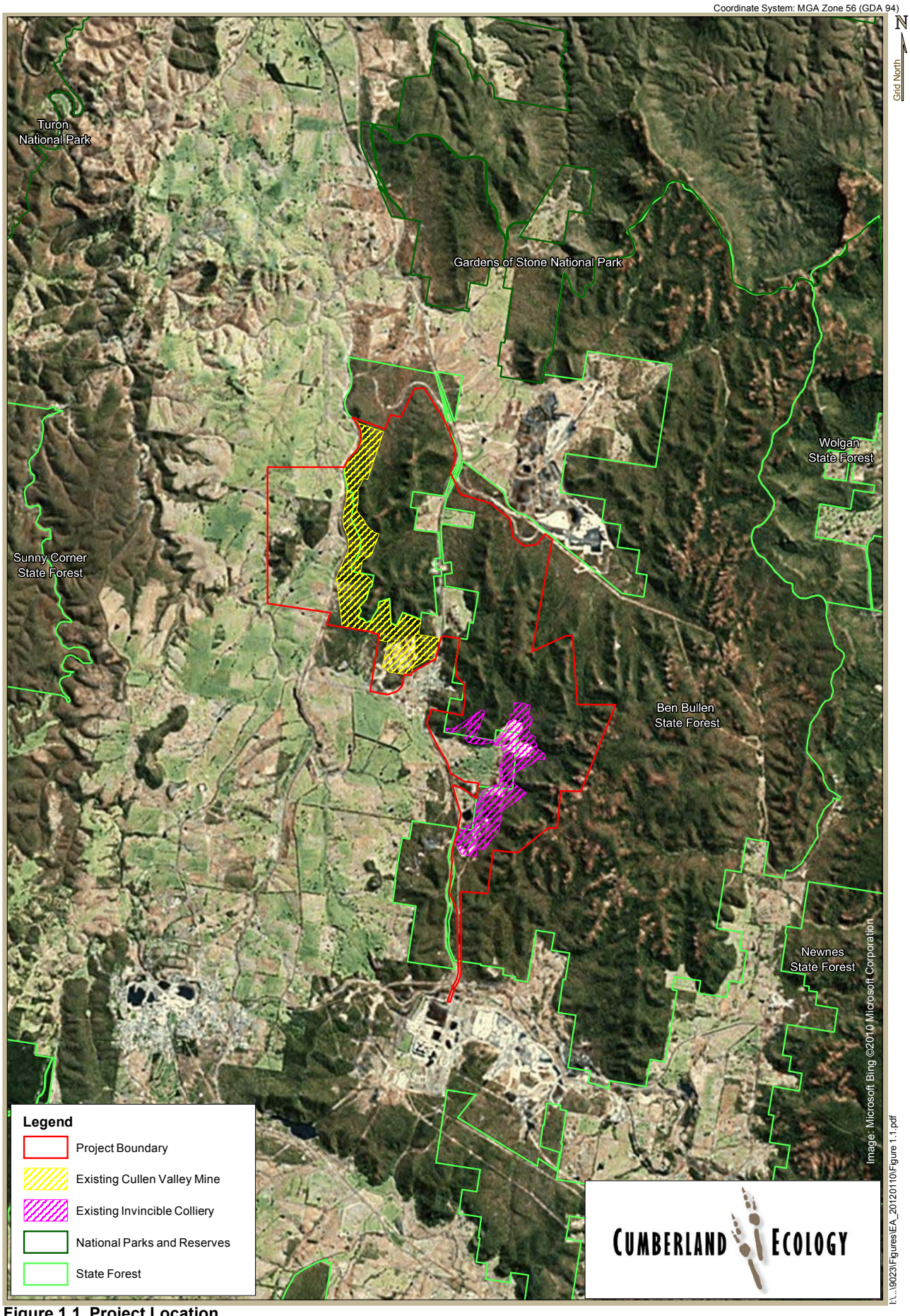


Figure 1.1. Project Location

23 March 2012

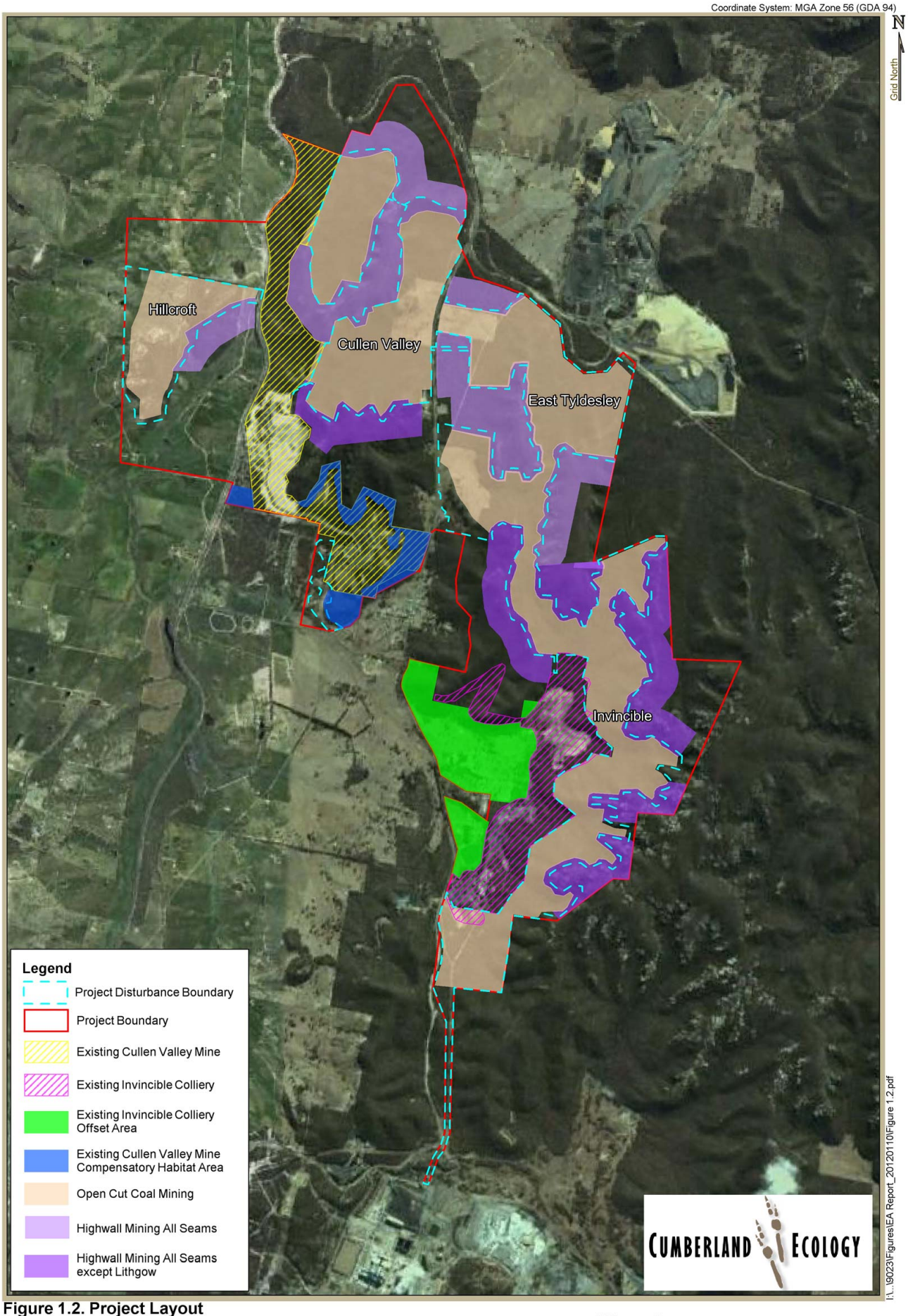


Figure 1.2. Project Layout

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Chapter 2

Methods

2.1 Literature Review

Relevant literature from previous studies conducted within and adjacent to the Project Boundary were reviewed for the Project and incorporated into this report. Relevant studies include:

- Cullen Valley Lease Extension Project Flora Survey (Lembit, 2003);
- Fauna Assessment Cullen Valley Mine Extension (AES, 2003);
- Flora Survey for Feldmast Coal Project (Lembit, 1997);
- Fauna Survey Proposed Feldmast Coal Project Cullen Bullen, NSW (Wildsearch, 1997);
- Environmental Assessment of the Proposed Extension to the Invincible Colliery Open Cut Mine and Production Increase (R.W. Corkery & Co, 2008b);
- Augmented Biodiversity Offset Strategy for the Invincible Colliery Open Cut Mine Extension (R.W. Corkery & Co, 2008a);
- Environmental Assessment - Baal Bone Colliery (AECOM, 2010);
- Environmental Assessment - Pine Dale Coal Mine Yarraboldy Extension (R.W. Corkery & Co, 2010); and
- Environmental Assessment - Ivanhoe North Rehabilitation Project (R.W. Corkery & Co 2006).

Additionally, the "*Vegetation of t*he *Western Blue Mountains*" mapping project (DEC (NSW) 2006) has been used to assist with identifying and describing vegetation communities. Although the Project Boundary is not covered by the mapping for this project, the vegetation of the Project Boundary is contiguous with the north western section of the map of the Cox's Valley and contains analogous diversities of species and habitats for some communities that occur in this catchment.

2.2 Database Analysis

Database analysis was conducted for the Lithgow LGA using both the OEH Atlas of NSW Wildlife (OEH 2011a) and the SEWPaC Protected Matters Search Tool (SEWPaC 2011b). The Atlas of NSW Wildlife search (last accessed 5th December 2011) was used to generate records of threatened flora and fauna species listed under the TSC Act within the Lithgow LGA.

The Protected Matters search generated a list of flora, fauna and ecological communities listed under the EPBC Act that were predicted to occur within a 10 km radius of the Project Boundary. The lists generated from these databases assisted with survey design for threatened species considered likely to occur in the Project Boundary.

2.3 Flora Survey

2.3.1 Vegetation Community Mapping

Vegetation communities were mapped using GPS during flora field surveys. In addition, aerial photographs and satellite imagery, as available from SIX Viewer (http://impagery.maps.nsw.gov.au/), Google Earth and topography maps were used to assist in the delineation of vegetation communities. The mapping was investigated in the field via the following methods:

- Quadrat sampling (20m x 20m, 20m x 50m) to characterise vegetation map units by their species composition and community structure;
- Meander quadrat surveys to obtain information on community distribution in the Project Boundary; and
- Detailed walks of vegetation units, recording boundaries using a handheld Geographical Positioning System (GPS) unit.

Plant communities were described based on the dominant canopies species and community structure according to Specht (1970). The "*Vegetation of the Western Blue Mountains*" (DEC (NSW), 2006) was used to predict the identity of the main vegetation communities present in the Project Boundary by identifying the communities that had been mapped on sandstone ridges and pagoda outcrops, upper slopes, mid slopes, steep gullies, lower slopes and valley floors within neighbouring parts of Ben Bullen State Forest and other nearby areas previously studied by Cumberland Ecology.

2.3.2 Criteria for the Identification of Box Gum Woodland and Derived Grasslands

The EPBC Act Policy Statement for assessing Box Gum Woodland and Derived Grasslands (DEH, 2006) provides a prescriptive, detailed methodology for determining the presence of the CEEC.

The flow chart that summarises the SEWPaC method for identifying Box Gum Woodland and Derived Native Grassland is reproduced in **Appendix H**. It demonstrates that to confirm the presence of this CEEC as listed under the EPBC Act, it is firstly essential to confirm the presence or historical presence of *Eucalyptus albens* (White Box), *E. melliodora* (Yellow Box) or *E. blakelyi* (Blakely's Red Gum) within the area of interest. Then, if one or more of these trees are present or was historically present as dominants, a quadrat should be completed within a plot of 1000 m^2 (0.1 ha). SEWPaC has published a list of plants characteristic of Box Gum Woodland and Derived Native Grasslands: if the survey plot contains 12 native non-grassy understorey species (including sedges, forbs, monocots, shrubs and excluding native grasses) and at least one is an "important" native plant as signified in the list of characteristic species, then the plant community is said to be present.

There is no such prescriptive methodology to identify Box Gum Woodland and Derived Native Grasslands under the TSC Act. A detailed description that defines the Box Gum Woodland and Derived Native Grasslands is included in the Final Determination made in 2004 by the NSW Scientific Committee to list Box Gum Woodland and Derived Native Grasslands as a CEEC under the TSC Act. The presence of the community is determined on the basis of its consistency with the community described within the Final Determination (NSW Scientific Committee 2004g) and Identification Guidelines (NSW NPWS 2005).

2.3.3 Quadrat Survey

Quadrats of 20x20m were surveyed in representative areas in order to characterise each of the vegetation communities that occur in the Project Boundary and to identify the plant species present. Quadrats of 20 x 50 m were used in areas suspected to conform to Box Gum Woodland and Derived Native Grassland. Each flora species observed within each quadrat was recorded and allocated an abundance rating according to a modified Braun-Blanquet scale (Mueller-Dombois and Ellenberg, 1974). The average height and projective foliage cover (PFC) for each stratum was also recorded. Forty-four quadrats were surveyed in total, the locations of which are shown in **Figure 2.1**.

The quadrat survey was supplemented with random meander searches. These involved walking or driving an irregular line through vegetated areas to determine where communities intergrade, to ascertain an understanding of how communities are distributed in the Project Boundary, to expand on undetected plant species and to search for threatened plants. Plant species not previously recorded in previous surveys or within quadrats during the current survey were also recorded.

All vascular plants were collected if not readily identifiable in the field and were identified using keys and nomenclature provided in Harden (Harden, 1990, Harden, 1991, Harden, 1992, Harden, 1993). Other references were used to assist identification, particularly for, difficult specimens (Law, 2000, Harden, 1990-1993). Eucalypt samples were identified by Van Klaphake from the Royal Botanic Gardens. Where known, taxonomic and nomenclatural changes have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust 2012).

2.3.4 Threatened Species Searches

Targeted threatened species searches were undertaken for threatened plants recorded in the Lithgow LGA with the potential to occur in the Project Boundary. Random meander surveys were employed within areas considered to provide suitable habitat. All plants found sharing the same genera as threatened species known to occur in the Lithgow LGA that could not be accurately identified were collected for later identification by the Royal Botanic Gardens Sydney.

The following threatened plant species were specifically targeted during threatened flora searches as these were considered to have the potential to occur within the Project Boundary:

- *Eucalyptus cannonii;*
- *Persoonia marginata;*
- *Eucalyptus pulverulenta;*
- *Grevillea evansiana;*

- *Grevillea obtusiflora;*
- *Prostanthera cryptandroides subsp. cryptandroides;*
- *Derwentia blakelyi; and*
- *Eucalyptus aggregata.*

2.3.5 Threatened Species Population Estimates

i. Eucalyptus cannonii

One threatened tree species listed as Vulnerable under both the TSC Act and the EPBC Act, *Eucalyptus cannonii* (Capertee Stringybark), had previously been recorded in the Project Boundary (Lembit 1997). As Stringybarks occur in almost every community in the Project Boundary, and because they occur so frequently within those communities, it was not possible to map or count every individual of *Eucalyptus cannonii*. Waypoints were recorded at random sites where either *Eucalyptus cannonii* or hybrids *Eucalyptus macrorhyhynca subsp. cannonii* were recorded. These were plotted, as well as locations of either species within vegetation quadrats.

Nineteen quadrats of 100m x 20m were surveyed to estimate the density of the *Eucalyptus cannonii* across its distribution within the Project Boundary. All *Eucalyptus cannonii* and *Eucalyptus macrorhyncha subsp. cannonii* recorded within these quadrats were counted and the total multiplied by five to give a density per hectare. This was then multiplied by the areas of each vegetation community in order to estimate the total number of *Eucalyptus cannonii* trees occurring in the Project Boundary. Juvenile saplings were not included in this count.

ii. Persoonia marginata

A new population of *Persoonia marginata* (Clandulla Geebung) listed as Vulnerable under the EPBC and TSC Act was recorded within the Project Boundary during targeted searches. This population occurs as three subpopulations in three disjunct locations within the Project Boundary (see **Figure 2.1**). Owing to the large size and high densities of this population, a high level of survey effort was undertaken.

In order to accurately estimate the population size, each occurrence or subpopulation was sampled separately. Before each subpopulation was sampled the boundary was walked to find the limit of outlying individuals. Once located, these individuals were flagged and a GPS waypoint recorded. A total of 288 randomly stratified quadrats of 20m x 1m were sampled within known *Persoonia marginata* habitat. This quadrat data was used to estimate the density of *Persoonia marginata* in each occurrence within the Project Boundary and beyond within Ben Bullen State Forest. All individuals of this species recorded within each quadrat were counted and calculated to give a density per square metre. These densities were averaged over the number of quadrats sampled per subpopulation and multiplied by 10,000 to give an average density per hectare value. Once an average density per hectare was calculated, it was multiplied by the area of habitat to give an approximate population size.

The results of the *P. marginata* quadrats are shown in **Appendix D**.

2.3.6 Flora Survey Effort

A summary of flora surveys and sampling effort during the Cumberland Ecology surveys is provided in **Table 2.1** and field survey locations are shown in **Figure 2.1**.

Table 2.1 Flora Survey Effort

Survey Technique	Dates	Effort
Vegetation Mapping,	21-25 September 2009 19-23 October 2009 28 January 2010 2-3 February 2010 14-19 October 2010 12-16 September 2011 11-12 October 2011 and throughout flora survey period	minimum 24 days two people plus throughout entire survey period.
Quadrat sampling	21-25 September 2009 19-23 October 2009 28 January 2010 2-3 February 2010 14-19 October 2010 12-16 September 2011	44 quadrats
Random meanders	Throughout flora survey period during vegetation mapping, quadrat sampling and threatened species searches.	Throughout survey period
Threatened flora searches and population estimates	Surveys undertaken concurrently with vegetation community mapping, random meanders and quadrat sampling with counts and additional searches undertaken on 20 April 2011 6 and 12 May 2011 16 and 22 June 2011 12-16 September 2011 11-12 October 2011 3 - 6 November 2011	Minimum 16 days for 2 people targeted and throughout survey period

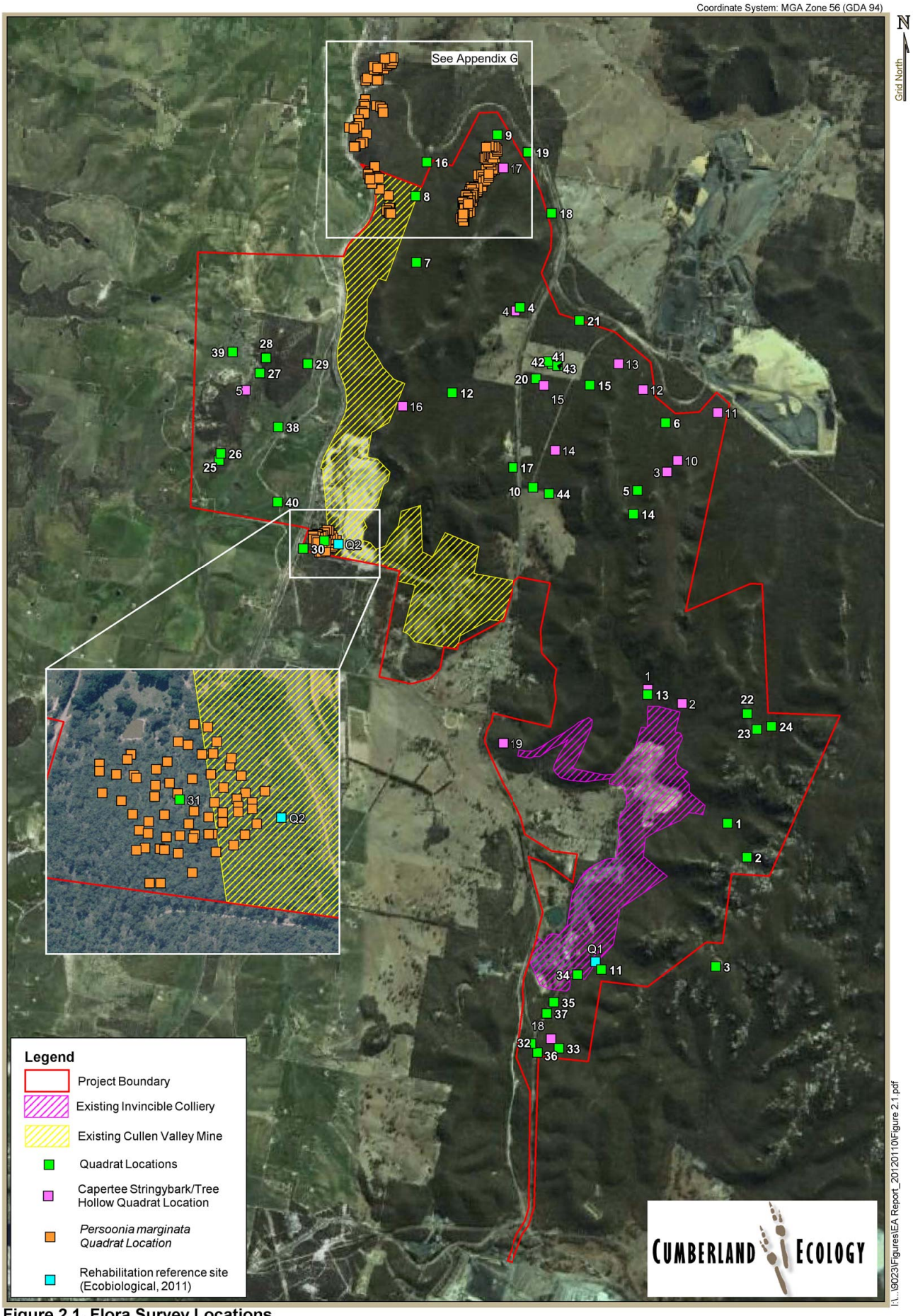


Figure 2.1. Flora Survey Locations

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2.4 Fauna Survey

2.4.1 Introduction

Fauna surveys were designed to fill gaps in ecological information not detailed in previous studies within and around the Project Boundary. Fauna surveys were conducted, where possible, in accordance with the DEC Threatened Biodiversity Survey and Assessment Guidelines (DEC (NSW), 2004a). The current fauna surveys were undertaken over three periods. The first survey (Survey period 1) was conducted between 6 and 8 April 2009. The second (Survey period 2) and third (Survey period 3) surveys were each one week in duration and were conducted between 14 – 18 September and 19 to 23 October 2009.

2.4.2 Trapping

Trapping was used to detect arboreal and terrestrial fauna occurring in the Project Boundary. The following traps were utilised during the survey:

- Cage traps for medium to large sized terrestrial fauna;
- Elliot B traps for small to medium sized arboreal fauna; and
- Elliot A traps for small terrestrial fauna.

Arboreal trap lines were established with Elliot B traps and set approximately 25m apart depending on available habitat. The traps were placed on platforms attached to habitat trees at a height of approximately 2m. Traps were baited with a mixture of peanut butter, honey and rolled oats. Each tree was sprayed with a honey and water mixture. Ten traps were placed along each of six quadrats, and were open for a period of four nights on each quadrat.

Terrestrial trap lines were established using Elliot A and cage traps. Elliot A traps were placed approximately 10m apart along each trapping quadrat, while cage traps were placed at the beginning, middle and end of each quadrat. Twenty-five Elliot A and three cage traps were placed along each of the trapping quadrats. The Elliot A traps were baited with peanut butter, honey and rolled oats to target small mammals. Cage traps were baited with chicken necks. Traps were left out for a period of four nights along each of 12 quadrats.

Trapping lines were checked early morning, and any fauna captured were identified and released.

2.4.3 Hair Tubes

'Faunatech' hair tubes were used during the survey period to detect arboreal and terrestrial mammals. Two quadrats of 40 hair tubes were established with one hair tube placed on the ground and one on a tree at each sampling location along the quadrats. All hair tubes were baited with rolled oats, peanut butter and honey. A total of 80 hair tubes were deployed for a period of 35 nights, giving a survey effort of 2,800 trap nights. Hair samples were analysed by Georgeanna Story of 'Scats About', Majors Creek, New South Wales.

2.4.4 Bat Surveys

Harp traps were erected at several locations throughout the Project Boundary to survey for bats. Harp traps were located in narrow areas (e.g. tracks and gullies) that microbats typically use as fly-ways. On some occasions harp traps were also located near to potential bat roost sites. Bats were captured as they flew into the tight wires of the harp trap and were forced into a capture bag. Harp traps were checked early each day. Captured bats were kept in cloth bags in the shade during the day, and were released at the point of capture the following night.

Anabat ZCAIM (Zero Crossing Analysis Interface Module) units were employed on most survey nights, depending upon weather conditions, to record calls of microbats. Anabats were set at dusk and collected the following morning after nocturnal surveys each night. Calls recorded on each Anabat were analysed to determine which species were present within the Project Boundary.

2.4.5 Diurnal Bird Surveys

Bird census surveys were conducted at several points throughout the Project Boundary. Bird census surveys involved looking and listening for birds from a central point for a period of 30 minutes, and recording all birds that were detected during these surveys. Diurnal birds were also identified and recorded as they were encountered incidentally throughout the Project Boundary during the survey periods. In addition, call playback was used to elicit a response from threatened diurnal bird species at several points throughout the Project Boundary.

2.4.6 Nocturnal Bird Surveys

Nocturnal bird surveys were undertaken over several nights during each survey period for threatened bird species detected within the Lithgow LGA and for which suitable habitat occurs within the Project Boundary. Surveys were preluded by a period of quiet listening prior to call playback. Surveys targeting the presence of Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Sooty Owl (*Tyto tenebrecosa*) and Bush Stone-curlew (*Burhinus grallarius*) were then undertaken by broadcasting taped calls through an amplifier. Calls were played for 2-minute periods at 5-minute intervals. This was followed with quiet listening and spotlighting.

2.4.7 Spotlight Surveys and Call Playback

Spotlighting was conducted for nocturnal mammals, birds and reptiles. Nocturnal surveys were conducted using a hand-held variable-beam spotlight whilst walking or from a slow moving vehicle. Spotlighting quadrats were spread throughout the Project Boundary, and incidental spotlighting was also conducted while travelling between quadrats at night.

During spotlighting surveys, call playback of nocturnal mammal calls were broadcast using a megaphone to illicit a response from targeted threatened nocturnal species. Koala (*Phascolarctos cinereus*), Spotted-tail Quoll (*Dasyurus maculatus*), Yellow- bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) were targeted by broadcasting taped calls through an amplifier. Calls were played for 2-minute periods at 5-minute intervals. This was followed with quiet listening and spotlighting.

2.4.8 Infrared (IR) Cameras

Infrared (IR) cameras were set up at four locations throughout the Project Boundary. The cameras were attached to trees and focussed on apparent fauna pathways or runways such as at the bases of cliffs and at the top of gullies. Cameras 1, 2 and 3 were left for 10 nights each and Camera 4 for 4 nights at the locations (**Figure 2.2**).

2.4.9 Amphibian and Reptile Surveys

Diurnal and nocturnal active searches were conducted in suitable habitat for amphibians and reptiles throughout the Project Boundary. Diurnal active searches were conducted at various points for a set period of 30 minutes per sample site. Opportunistic active searches were also conducted during other diurnal and nocturnal activities. Searches involved the lifting of bark, fallen logs and bushrock and the scraping of top soil. Caught animals were identified and then released.

2.4.10 Incidental Observations

Any incidental vertebrate fauna species that were observed, heard calling, or otherwise detected on the basis of tracks or signs were recorded and listed in the total species list for the Project Boundary. Incidental records of threatened flora and fauna recorded from areas adjacent to the Project Boundary during the survey period have also been included.

2.4.11 Habitat Assessment

The characteristic attributes of different types of fauna habitat generally influences the assemblage of fauna species that can be found within each habitat and also affects the general value of the habitat for fauna. The Project Boundary contains three broad habitat types that vary in their value for fauna. These are:

- Woodland and open forest;
- Pagodas and caves;
- Wetlands in the form of farm dams; and
- Grassland.

Habitat condition was assessed by noting ground, shrub/understorey and canopy cover, number and size of hollows present, habitat features such as bush rock and fallen trees, and signs of fauna usage such as scats and scratches.

Fauna habitat assessments also included consideration of important indicators of habitat condition and complexity including the occurrence of microhabitats such as tree hollows, fallen logs, bush rock and wetland areas such as creeks and soaks. An assessment of the structural complexity of vegetation, the age structure of the forest and the nature and extent of human disturbance throughout the Project Boundary was undertaken and considered.

2.4.12 Fauna Survey Effort

A summary of trapping and sampling effort during the Cumberland Ecology surveys is provided in **Table 2.2** and field survey locations are shown in **Figure 2.2**.

Table 2.2 Fauna Survey Effort

Survey Technique	Survey Effort 6-8 April 2009 (Survey period 1)	Survey Effort 14-18 Sept 2009 (Survey period 2)	Survey Effort 19-23 Oct 2009 (Survey period 3)
Amphibians			
Systematic day habitat search	1 hour	1 hour	1 hour
Night habitat search of damp and watery sites	1 hour	1 hour	1 hour
Night watercourse search	1 hour	1 hour	1 hour
Reptiles			
Habitat search	2 x 30 minutes (across 2 separate days)	2 x 30 minutes (across 2 separate days)	8 x 30 minutes (across 5 separate days)
Spotlighting	3 hours (across two separate nights)	4.5 hours (across three separate nights)	4.5 hours (across three separate nights)
Diurnal Birds			
Incidental searches	Throughout survey periods	Throughout survey periods	Throughout survey periods
Bird census surveys	Visual and auditory searches totalling 6 hours over 2 days across the Project Boundary	Visual and auditory searches totalling 10 hours over 5 days across the Project Boundary	Visual and auditory searches totalling 15 hours over 5 days across the Project Boundary
Nocturnal Birds			
Call playback	2 nights (30 minutes each night)	3 nights (30 minutes each night)	3 nights (30 minutes each night)
Day habitat search	Throughout survey period	Throughout survey period	Throughout survey period
Spotlighting on foot	2 nights (30 minutes each night)	3 nights (30 minutes each night)	3 nights (30 minutes each night)
Non-flying Mammals			
Small Elliott traps		300 trap nights	300 trap nights
Large Elliott traps (arboreal)		120 trap nights	120 trap nights
Cage traps		36 trap nights	36 trap nights
Terrestrial Hair tubes		1400 trap nights	1400 trap nights
Arboreal hair tubes		1400 trap nights	1400 trap nights
Spotlighting on foot	2 nights (30 minutes	3 nights (30 minutes	3 nights (30 minutes

Table 2.2 Fauna Survey Effort

Survey Technique	Survey Effort 6-8 April 2009 (Survey period 1)	Survey Effort 14-18 Sept 2009 (Survey period 2)	Survey Effort 19-23 Oct 2009 (Survey period 3)
	each night)	each night)	each night)
Call playback	2 nights (30 minutes each night)	3 nights (30 minutes each night)	3 nights (30 minutes each night)
Search for scats and signs	2 hours	3 hour	3 hour
IR cameras		30 survey nights (3 camera over 10 nights)	4 survey nights (1 camera over 4 nights)
Collection of predator scats	Throughout survey period	Throughout survey period	Throughout survey period
Bats			
Harp trapping	3 nights	8 night	8 night
Ultrasonic call recording	8 nights	12 nights	12 nights

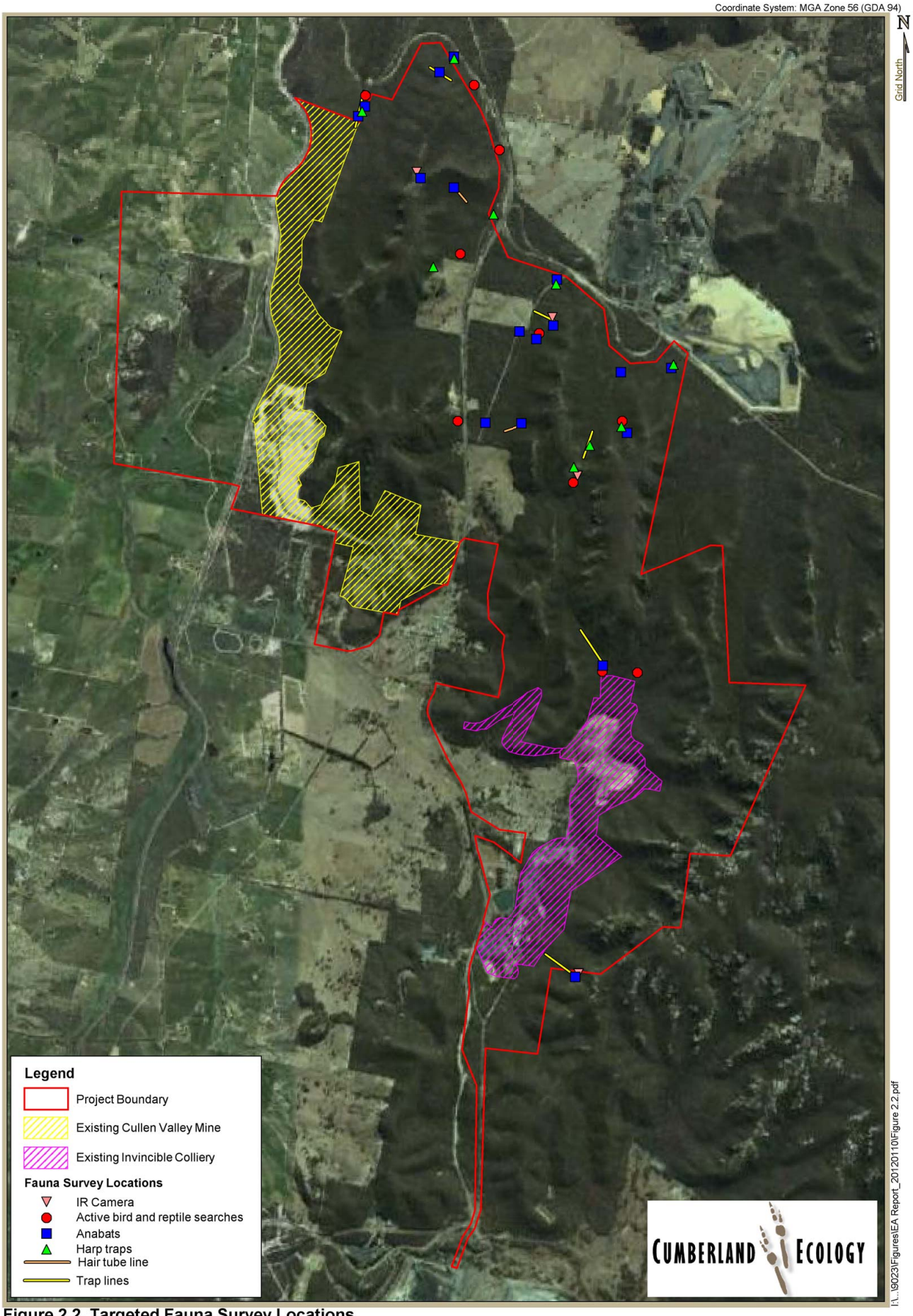


Figure 2.2. Targeted Fauna Survey Locations

23 March 2012

2.5 Weather Conditions

A summary of weather conditions in the locality of the Project Boundary during flora and fauna surveys is provided in **Table 2.3**. Weather conditions for all survey periods were relatively mild with no prolonged cold or hot periods experienced prior to or during the surveys. Daily temperatures during these periods ranged from –-3.2°C to 25.9°C. No significant rainfall was experienced immediately prior to or during any of the fauna surveys.

Table 2.3 Summary of Weather Conditions During the Current Survey

Date	Survey Group	Min. Temp. (oC)	Max. Temp. (oC)	Rainfall (mm)
6/04/2009	Fauna	3	18	0
7/04/2009	Fauna	10.3	17.3	0
8/04/2009	Fauna	7	18.4	0
14/09/2009	Fauna	12.8	24.4	0
15/09/2009	Fauna	10.1	20.3	0
16/09/2009	Fauna	4.4	19	0
17/09/2009	Fauna	9.8	24.3	0
18/09/2009	Fauna	10.4	18.8	2.2
19/10/2009	Flora, Fauna	1.7	20.2	0
20/10/2009	Flora, Fauna	4.1	23.2	0
21/10/2009	Flora, Fauna	4	25.9	0
22/10/2009	Flora, Fauna	8.7	24.9	0
23/10/2009	Flora, Fauna	8.9	25.7	0
28/01/2010	Flora	14.3	25.5	25.6
2/02/2010	Flora	15.3	21.3	0.4
3/02/2010	Flora	15.2	21.5	7.2
14/10/2010	Flora	12.8	21	0.6
15/10/2010	Flora	11.1	16.3	3
16/10/2010	Flora	0.6	7	23.8
17/10/2010	Flora	0.6	13	0.9
18/10/2010	Flora	4.6	15	0
19/10/2010	Flora	1.1	14.7	0
20/04/2011	Flora	4.9	17	0
6/05/2011	Flora	-2.1	15.5	0
12/05/2011	Flora	19	9	5
16/06/2011	Flora	6.8	9.9	10.4
22/06/2011	Flora	0.4	7.7	8
12/09/2011	Flora	0.5	13.5	0.6

Table 2.3 Summary of Weather Conditions During the Current Survey

Date	Survey Group	Min. Temp. (oC)	Max. Temp. (oC)	Rainfall (mm)
13/09/2011	Flora	-3.2	15	0
14/09/2011	Flora	6.4	17.4	0
15/09/2011	Flora	0.5	16.2	0
16/09/2011	Flora	2.2	21.4	0
11/10/2011	Flora	4.2	13.9	0
12/10/2011	Flora	-0.8	18.2	0
3/11/2011	Flora	7.6	16.8	0
4/11/2011	Flora	9.3	20.9	0
5/11/2011	Flora,	6.7	23.3	0
6/11/2011	Flora	9.8	23.7	0

Notes: Source for weather data was Bureau of Meteorology Daily Weather Observations for Lithgow.

2.6 Limitations

2.6.1 Flora

It is considered that the survey represents an accurate baseline of ecological information for the Project Boundary. Although it is impossible to record the entirety of the flora species present within the Project Boundary, it is considered that the surveys were comprehensive enough for the majority of species present to have been recorded, including threatened species. Cumberland Ecology is satisfied that conservation significance of the flora, condition and viability of vegetation communities and likely impacts of the Project on native vegetation has been satisfactorily assessed.

The Project Boundary is large and the topography poses difficulties of access to many areas due to steep slopes and a lack of good tracks to some areas. Also, there were access restrictions on some private properties occurring within the Project Boundary. In areas where access was restricted, binoculars were used to identify key features of the vegetation, i.e. the colour of individual tree crowns, bark colour and texture etc. to enable these areas to be mapped. Mapping of inaccessible areas was mapped extrapolating from the mapping undertaken in more accessible parts of the Project Boundary and using our knowledge of the local environment.

Some of the boundaries between non-listed vegetation communities are gradual and so not all vegetation communities are clearly separated (as they look in **Figure 3.1**) causing transitional zones (ecotones) of variable width between communities. In these transitional zones vegetation would comprise an assortment of species from each neighbouring vegetation community. This makes mapping of such communities difficult. In areas of Box Gum Woodland and Derived Native Grassland a precautionary approach was adopted and where there was uncertainty, it was assumed that the endangered ecological community occurred.

While extensive field surveys were undertaken, there is some potential for species that were not recorded during field surveys to occur in parts of the Project Boundary due to vast areas requiring surveys. It is possible that some orchid species were undetected because of their cryptic habit even though survey efforts were made during known flowering times. For this reason a precautionary approach was taken, and threatened species that were not actually detected, but which had considerable probabilities of occurrence, were still treated as occurring in the site.

2.6.2 Fauna

Despite the limitations noted below, it is considered that the fauna surveys were comprehensive enough to record the majority of the vertebrate species that occur on the site, and to allow the suitability of the habitat within the Project Boundary for fauna species to be adequately assessed.

The three survey periods were timed to survey for both winter migrant species as well as those groups that become more active during the warmer months (e.g. reptiles and microbats). Both the April and September 2009 surveys were suitable to detect winter migrants, particularly the Swift Parrot (*Lathamus discolor*).

The survey periods were also suitable to determine if the Project Boundary is frequented by the threatened honeyeater species: Regent Honeyeater (*Anthochaera phrygia*), Black-chinned Honeyeater (*Melithreptus gularis gularis*) and Painted Honeyeater (*Grantiella picta*). Despite surveying during appropriate seasons, the absence of significant forage for blossom-dependent species may have resulted in the under-representation of blossom-dependent species during the surveys. To overcome this limitation, habitat assessment was conducted during all surveys. This provides an adequate indication of the likelihood of occurrence for all threatened blossom-dependent species within the Project Boundary. Analysis of OEH records within the LGA also indicates that these species were considered likely to occur and utilise the Project Boundary.

The current surveys were conducted in the autumn and spring months, providing optimal conditions for detecting mixed flocks of non-breeding resident and winter-migratory species. Several summer migrant bird species were recorded during the October 2009 survey indicating that the timing of this survey was appropriate for detecting summer migrants.

Weather conditions during all survey periods were mild and dry. These conditions are typically unsuitable to detect most amphibian species that are likely to occur within the Project Boundary. The location of the Project Boundary, on the western side of the Great Dividing Range is typically temperate and dry, and results from the habitat assessment indicated that suitable amphibian habitat is rare. For this reason detailed targeted searches for amphibians were not warranted. The combination of results from habitat assessment, targeted searches, literature review from previous surveys from 1997 and OEH records was considered to be adequate.

The timing of the surveys were not optimal for detecting reptiles as they are known to enter a state of aestivation (short-term hibernation) during periods of cold weather (Wilson and Swan, 2003) and it is likely that reptile activity would increase with warmer weather following the third survey period. Reptile activity was low during the April and September surveys, with more activity noted during the October survey. Habitat assessment and active searches of shelter habitat were employed to compensate for the sub-optimal timing of surveys for this group, and it is considered that the survey effort for reptiles was adequate to detect the majority of the reptiles that could occur in the Project Boundary.

As with reptiles, many Microchiropteran bats enter a state of limited activity during the winter months, and it is likely that later surveys conducted during the summer months may record higher diversity and abundance of bats within the Project Area. Nevertheless, the combination of field survey results, habitat assessment and database analysis is considered to be sufficient to have adequately assessed the majority of species that may occur.

During the April 2009 survey, access was the primary limitation to survey effort. For this reason, April 2009 surveys were focused on the East Tyldesley section of the Project Boundary. This area supported an indicative selection of the natural habitats available for fauna throughout the Project Boundary. Track access throughout the East Tyldesley section provided an opportunity to survey a cross-section of these habitats in a limited area. Surveys in September and October 2009 were conducted in other parts of the Project Boundary, providing a thorough coverage of all habitat types that occur within the Project Boundary.

2.7 Surveys of Potential Offset Sites

At the time of preparing the Ecological Impact Assessment, it was apparent that areas of forest, woodland and threatened species habitat would be cleared as a result of the Project.

For this reason, surveys were undertaken for land that could provide suitable offsets, to compensate for the clearance of flora and fauna habitats within the Project Boundary. The objectives of the offsets work therefore included:

- Identifying land that contains or could be regenerated to Box Gum Woodland;
- Identifying land that contains or could be regenerated to provide sandstone vegetation; Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest, Tableland Gully Ribbon Gum - Blackwood - Applebox Forest; Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland; Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest and other non-EEC vegetation occurring within the Project Boundary;
- Providing land that includes habitat for all relevant threatened flora and fauna species that could be impacted by the Project;
- Providing land that contributes to an existing regional biodiversity conservation strategy;
- Obtain data on all offset lands to demonstrate that they contain suitable vegetation and other habitat, and to assist with future land management; and
- Prepare an Offsets Strategy, for inclusion in the Ecological Impact Assessment and the EA.

In general terms, it was intended that land to be acquired for offsetting purposes should:

- Build onto existing conservation areas;
- Form new, or improve existing ecological corridors;
- Be like for like in terms of bioregion, topography, soils, aspect, flora and fauna and habitat values;

- Contain or link to sustainable ecological features (particularly permanent water sources);
- Build corridors between Ben Bullen State Forest and vegetation east of Sunny Corner State Forest. This connection would provide a large tract on contiguous vegetation consolidating Wollemi National Park, Newnes State Forest, Gardens of Stone National Park and Ben Bullen State Forest in the east to Sunny Corner State Forest and Winburndale Nature Reserve;
- Link to rehabilitated mining areas to existing vegetation;
- Focus on current Coalpac land as well as land within the predicted zone of affectation; and
- Avoid land in the vicinity of other mining tenements.

The highest priorities for consideration as offsets are the closest properties with suitable vegetation to the Project Boundary. The highest priorities for inclusion in the offset package are along the edge and to the immediate west of the Project Boundary. These can potentially be acquired to form a basis for an offset between two very large areas of vegetation on each side of the Project Boundary.

i. Prioritised List of Properties for Investigation

Cumberland Ecology completed the following tasks to obtain a list of candidate properties for investigation to purchase:

1. Mapping of candidate habitats in the locality;
2. Overlaying potential vegetation areas with cadastral maps to show ownership (Lot and DP numbers);
3. Desktop estimation of broad areas of Box Gum Woodland and derived native grassland; and
4. Prioritising a list of properties for investigation.

Once Coalpac investigated potential vendors and short listed properties for purchase, limited field studies were made to validate the vegetation present on the short listed properties.

ii. Field Studies

Cumberland Ecology sent teams consisting of one ecologist and one botanist to investigate properties with reasonable prospects for offsets. Firstly, the investigation entailed a general reconnaissance and drive across (or around) the properties in an effort to gain a general understanding of the local ecology.

During the initial visit of a potential offset site, preliminary mapping of vegetation types were created, habitat values identified and Rapid Condition Assessments (RCA) of Box Gum Woodland or Derived Native Grassland areas were conducted. The RCAs considered the EPBC Act listing of Box Gum Woodland as described in EPBC Act Policy Statements - White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Grasslands (DEH, 2006).

RCAs included the following data collection:

- Native understorey species were identified within each patch of vegetation as defined in the Policy Statement (DEH, 2006);
- When 12 or more native non grassy understorey species in the patch were recorded the condition of each patch was estimated in terms of percentage weed cover; and
- If the Property was found to provide suitable offsets to compensate for the clearance of flora and fauna habitats within the Project Boundary, a more detailed follow up survey was conducted. Follow up surveys aimed at firming up vegetation boundaries, particularly CEECs and conducting quadrat surveys (20 m x 50 m) to assess whether vegetation conformed to the EPBC Act. Additional notes about vegetation condition, threatened species and habitat, key habitat features (rock outcrops, streams, etc), weed infestations etc. were also recorded.

Quadrat surveys for *Eucalyptus cannonii* and *Persoonia marginata* were also undertaken in offset properties where the species were recorded.

Chapter 3

Results

3.1 Introduction

This chapter presents the findings of all flora and fauna surveys across the Project Boundary.

The diversity of natural relief within the Project Boundary supports a variety of native vegetation communities including shrubland, woodland and open forest. A wide variety of woodland and open forest flora and fauna are known to occur in the locality and a considerable diversity of species has been identified in previous environmental surveys for the already approved mining projects. . Total flora and fauna species lists from previous surveys (as available to Cumberland Ecology) and from the current survey are provided in **Appendix A** and **Appendix B** respectively.

3.2 Vegetation Communities

Thirteen native plant communities occur within the Project Boundary. The distribution of these communities across the Project Boundary is shown in **Figure 3.1** and descriptions of each community are provided below:

1. Pagoda Rock Sparse Shrubland;
2. Capertee Rough-barked Apple, Red Gum, Yellow Box Grassy Woodland (listed CEEC under the EPBC Act and EEC under the TSC Act);
3. Capertee Rough-barked Apple, Red Gum, Yellow Box Woodland – non grassy and therefore not listed under the EPBC Act;
4. Tableland Gully Ribbon Gum, Blackwood Apple Box Forest;
5. Tableland Gully Mountain Gum, Broad-leaved Peppermint Grassy Forest;
6. Tableland Gully Snow Gum – Ribbon Gum Grassy Forest;
7. Tableland Scribbly Gum, Narrow-leaved Stringybark Shrubby Open Forest/ Woodland;
8. Exposed Blue Mountains Sydney Peppermint, Silvertop Ash Shrubby Woodland;
9. Cox's Permian Red Stringybark, Brittle Gum Woodland;
10. Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest;

11. Tableland Broad-leaved Peppermint – Brittle Gum – Red Stringybark Grassy Open Forest;
12. Acacia Thickets; and
13. Native Grasslands.

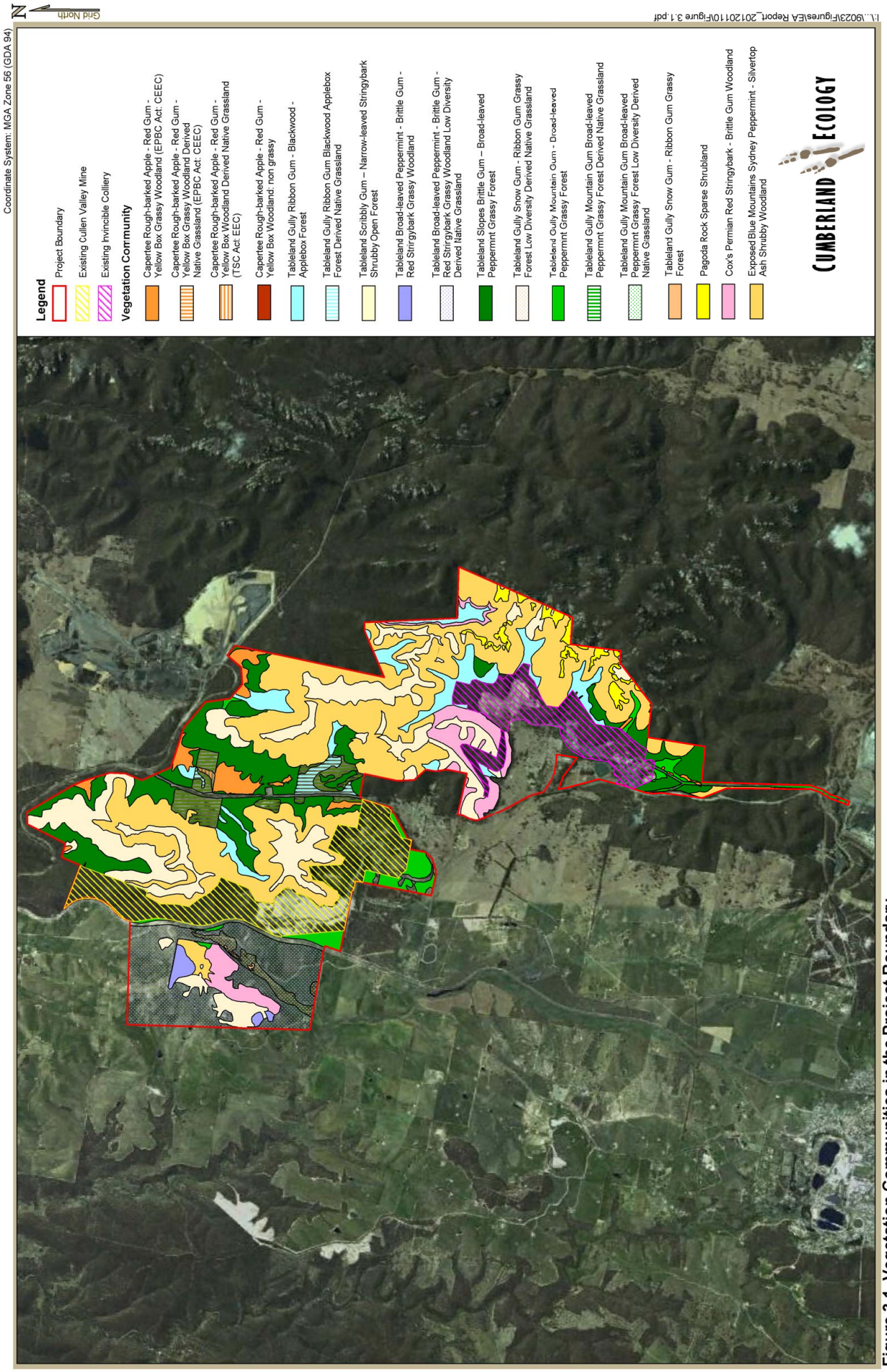


Figure 3.1. Vegetation Communities in the Project Boundary

3.2.1 Pagoda Rock Sparse Shrubland



Photograph 3.1 Pagoda Rock Sparse Shrubland

i. Corresponding Classifications

EPBC Act: not listed

TSC Act: not listed

DEC (NSW) (2006): MU 43 Pagoda Rock Sparse Shrubland

(DEC 2006): No match

Keith (2004): Sydney Montane Heath

ii. Description

This community occurs on skeletal soils on top of pagoda rocky out-cropping, along the tops of the plateaus. No quadrat data was collected from this community. It is dominated by low shrubs including Ericaceae species, *Micromyrtus* sp. and *Zieria* sp. Occasional stands of *Callitris endlicheri* occur. The community occurs on skeletal soils and in rock cracks and in the Project Boundary it occurs at high altitudes that are beyond the area of direct impact of the Project. Below this shrubland, the vegetation grades to taller woodland and open forest dominated by a range of eucalypts.

3.2.2 Capertee Rough-barked Apple – Red Gum –Yellow Box Grassy Woodland (CEEC under the EPBC Act and EEC under the TSC Act)



Photograph 3.2 **Scattered Yellow Box amid Derived Native Grassland forming the Commonwealth and State listed CEEC & EEC respectively.**



Photograph 3.3 **An intact form of the Capertee Rough-barked Apple Red Gum Yellow Box Grassy Woodland CEEC**

i. Corresponding Classifications

EPBC Act: CEEC White Box – Yellow Box – Blakely's Red gum Grassy Woodland and Derived Native Grassland

TSC Act: EEC White Box – Yellow Box – Blakely's Red gum Grassy Woodland and Derived Native Grassland

DEC (NSW) (2006): MU 20 Capertee Rough-barked Apple Red Gum Yellow Box Grassy Woodland

DEC (2006): BVT 41 Stringybark – Box – Gum Woodland

Keith (2004): Western Slopes Grassy Woodland

ii. Description

Capertee Rough-barked Apple Red Gum Yellow Box Grassy Woodland is a form of grassy woodland that occurs on the valley floor and some lower hillsides in the Project Boundary. In some areas, particularly along the conveyor corridor, the community was found growing in niche habitats, of small areas restricted to narrow gullies or small depressions. Typically this community occurs low in the landscape, in broad, flat areas, and is dominated by Blakely's Red Gum (*Eucalyptus. blakelyi*), Apple Box (*E. bridgesiana*) and, to a lesser extent, Yellow Box (*E. melliodora*). Other species that may occur include *E. dalrympleana*, *E. rubida, E. praecox* and *E. mannifera*. The canopy has a height of 10-22m and Projective Foliage Cover (PFC) of 20-40%.

A variety of shrubs occur, including *Acacia buxifolia, A. falciformis, Podolobium ilicifolium, Leucopogon muticus* and *L. virgatus,* with a shrub layer height of approximately 0.5-2m and PFC of 2-25%. Ground cover varies between patches of this woodland type. In some places it is dominated by Wallaby Grasses (*Austrodanthonia* spp), *Austrostipa scabra, Poa sieberi, Themeda australis* and *Echinopogon ovatus*. In other drier places it is dominated by *Lomandra filiformis, Joycea pallida* and *Poa sieberiana.* In some patches herb species are very diverse and species with high coverage include *Hydrocotyle laxiflora* and *Dichondra repens*. The ground cover has a height of 0.1-0.3m and PFC of 30-50%.

This community is a form of the State listed EEC and Commonwealth listed CEEC Box-Gum Woodland.

Under the TSC Act, this vegetation community is known as: White Box – Yellow Box – Blakely's Red Gum Woodland. Following the TSC Act guidelines for identification the community present is considered to meet the definition of the EEC because:

1. The site is in the NSW Sydney Basin Bioregion;
2. The community contains predominantly native species;
3. The community in the Project Boundary has trees but is mostly cleared;
4. Two of the requisite dominant tree species co-dominate this vegetation: Yellow Box and Blakely's Red Gum; and
5. The community within the Project Boundary is a grassy woodland, with ground stratum dominated by native grasses and herbaceous species.

Under the EPBC Act, the CEEC community is known in brief as "White Box Yellow Box Blakely's Red Gum Grassy Woodland". The community present is considered to meet the Commonwealth criteria for this community because:

1. Two of the requisite dominant tree species co-dominate this vegetation: Yellow Box and Blakely's Red Gum;
2. The ground stratum is dominated (>50%) by native perennial grasses and herbs. The patch contains 12 or more native non grassy understorey species (including forbs, shrubs, ferns and sedges), one of which is a listed important species; and
3. Old and dominant trees have a woodland growth form rather than an open forest form.

In one place on the eastern side of the Cullen Valley mining area, the community has been largely cleared for agriculture and consists of scattered Yellow Box trees above derived native grassland (see **Photo 3.2**), Derived Native Grassland also occurs within one area of the existing powerline easement. Other occurrences of the community are much more intact with intact canopy, sub-canopy and ground stratum as shown in **Photo 3.3**.

3.2.3 Capertee Rough-barked Apple – Red Gum – Yellow Box Woodland – non grassy



Photograph 3.4 **Rough-barked Apple, Red Gum, Yellow Box Woodland – non grassy. Grass-like plants in the understorey are *Lomandra* spp.**

i. Corresponding Classifications

TSC Act: not listed

EPBC Act: not listed

DEC (NSW) (2006): MU 20 Capertee Rough-barked Apple Red Gum Yellow Box Woodland – non grassy

DEC (2006): BVT 41 Stringybark – Box – Gum Woodland

Keith (2004): Western Slopes Grassy Woodland

ii. Description

This vegetation community is very similar to the Capertee Rough-barked Apple – Red Gum – Yellow Box Grassy Woodland. However, it lacks Yellow Box and the ground stratum is relatively bare, and not dominated by perennial grasses. Rather it is dominated by matt rushes (*Lomandra* spp) as shown in **Photo 3.4**. Owing to the lack of a native perennial grassy ground stratum this community does not classify as the CEEC for Box Gum Woodland. It is found in drier sites than the CEEC and is found solely in the north western portion of the Project Boundary.

3.2.4 Tableland Gully Ribbon Gum – Blackwood – Apple Box Forest



Photograph 3.5 Tableland Gully Ribbon Gum, Blackwood Apple Box Forest

i. Corresponding Classifications

TSC Act: not listed

EPBC Act: not listed

DEC (NSW) (2006): MU 13 Tableland Gully Ribbon Gum Blackwood Apple Box Forest

DEC (2006): BVT 1 Mountain Gum – Peppermint Forest at High Altitudes

Keith (2004): Southern Tableland Grassy Woodland

ii. Description

This tall open forest community occurs in the low points of steep-sided gullies and on some steep eastern slopes (see **Photo 3.5**). The dominant canopy species are Ribbon Gum (*E. viminalis*) and often Applebox (*E. bridgesiana*). However, this is a variable and widespread community. Other co-dominants variously include the threatened Stringybark Capertee Stringybark (*Eucalyptus cannonii*) and Silvertop Ash (*E. sieberi*). In some gullies, *E. cannonii* is replaced with Blaxlands Stringybark (*E. blaxlandii*).

The canopy height is approximately 20-30m with approximately 20% projective foliage cover (PFC). There is a small tree layer present of approximately 15m in height comprising younger eucalypts and *Acacia falciformis*. The shrub layer is sparse, with a projective foliage cover (PFC) of approximately 5% and a height range of 0.5-2m. Frequent shrub species include *Hibbertia obtusifolia, Styphelia triflora, Acacia dealbata*, *Pomaderris sp, Leucopogon lanceolata, L. muticus and Podolobium ilicifolium.* The low herbaceous ground cover is maintained as a "macropod lawn" by wallabies and kangaroos to approximately 0.05m and PFC of approximately 40%. Dominant species include native grasses and graminoids *Poa sieberiana, Lomandra filiformis, Microlaena stipoides* and *Echinopogon caespitosus*. Bracken (*Pteridium esculentum*) forms dense localised patches over approximately 10% of this community with a height of approximately 0.6m.

3.2.5 Tableland Gully Mountain Gum – Broadleaved Peppermint Grassy Forest



Photograph 3.6 Tableland Gully Mountain Gum – Broadleaved Peppermint Grassy Forest

i. Corresponding Classifications

TSC Act: not listed

EPBC Act: not listed

DEC (NSW) (2006): MU 35 Tableland Gully Mountain Gum – Broadleaved Peppermint Grassy Forest

DEC (2006): BVT 1 Mountain Gum – Peppermint Forest at High Altitudes

Keith (2004): Southern Tableland Dry Sclerophyll Forest

ii. Description

This open forest community has somewhat varied tree composition (**Photo 3.6**). It is dominated by Mountain Gum (*E. dalrympleana*), and co-dominated by a suite of other species including Broadleaved Peppermint (*E. dives*), Narrow-leaved Stringybark (*E. sparsifolia*), Scribbly Gum (*E. rossii*) and Brittle Gum (*E. mannifera*). Other eucalypts that also occur in this community, generally infrequently and in localised patches, include *E. praecox* and Ribbon Gum (*E. viminalis*). The canopy has a height of 15-22m and a PFC of 30%.

This is a forest with sparse to mid dense shrubs with typical shrub species including *Persoonia myrtilloides*, *Acacia ulicifolia*, *Hakea dactyloides, Acacia terminalis* and *Podolobium ilicifolium.* Ground cover species are dominated by *Joycea pallida, Poa sieberiana* and *Lomandra filiformis.* The average ground cover height here is 0.5m as there is less grazing and PFC is 40%.

3.2.6 Tableland Gully Snow Gum – Ribbon Gum Grassy Forest



Photograph 3.7 Tableland Gully Snow Gum – Ribbon Gum Grassy Forest

i. Corresponding Classifications

TSC Act: not listed

EPBC Act: not listed

DEC (NSW) (2006): MU 11 Tableland Gully Snow Gum – Ribbon Gum Grassy Forest

DEC (2006): BVT 1 Mountain Gum – Peppermint Forest at High Altitudes

Keith (2004): Tableland Clay Grassy Woodland

ii. Description

This community occupies lower slopes, gullies and flats on Permian sediments in areas of cool air drainage and frost hollows. The canopy comprises of largely *Eucalyptus pauciflora* with some *E. bridgesiana* in lower number and localised stands of *E. stelullata. E. viminalis,* and *E. dalrympleana* may be scattered throughout. Naturally the most frequently occurring shrub is *Acacia dealbata,* though within the Project Boundary the community exists only in the western extent as scattered trees above semi-natural grassland with few native herbs. The groundcovers contain cool temperate *Poa* species and a range of exotic grasses and herbs, a result of past farming practices.

3.2.7 Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest and Woodland



Photograph 3.8 Tableland Scribbly Gum – Narrow –leaved Stringybark Shrubby Woodland



Photograph 3.9 **Tableland Scribbly Gum – Narrow –Leaved Stringybark Shrubby Open Forest**

i. Corresponding Classifications

TSC Act: not listed

EPBC Act: not listed

DEC (NSW) (2006): MU 32, Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest

DEC (2006): BVT 6 Inland Scribbly Gum Woodland

Keith (2004): Southern Tableland Dry Sclerophyll Forests

ii. Description

This community varies from open forest to woodland as shown in **Photos 3.8** and **3.9**. It largely occurs in the highest points of the landscape and where there are locally very low fertility soils. *Eucalyptus rossii* occurs as the only tree species in this community. No quadrat data was collected from this community but it is a shrubby woodland with low forb diversity and high litter coverage. The understorey is similar to that of the Scribbly Gum – Stringybark Woodland community. Typical shrub species include *Leptospermum polygalifolium, Monotoca scoparia, Brachyloma daphnoides* and *Leucopogon muticus*. A variety of orchids also occur in this community.

3.2.8 Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Woodland



Photograph 3.10 Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Woodland

i. Corresponding Classifications

TSC Act: not listed

EPBC Act: not listed

DEC (NSW) (2006): MU 30, Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Woodland

DEC (2006): BVT 2 Sydney Sandstone Woodland/Open Forest

Keith (2004): part of Sydney Montane Dry Sclerophyll Forest

ii. Description

This woodland (and sometimes open forest) community occurs at the top of gullies, immediately under pagodas and is a wetter, sheltered forest (**Photo 3.10**). It is dominated by *E. piperita* and *E. sieberi* and also contains *E. cannonii*, with a canopy height of 25-30m and PFC of approximately 25%. A small tree layer occurs including *Acacia falciformis, A. obtusifolia* and *Leptospermum polygalifolium* occurring in the drainage line. Shrubs are rare. The ground cover is typified by a dense covering of Bracken (*Pteridium esculentum*) and False Bracken Fern (*Calochlaena dubia*).

This community is similar to Stringybark – Ribbon Gum –Sydney Peppermint - Silvertop Ash Open Forest and Sydney Peppermint – Silvertop Ash – Stringybark Open Forest.

3.2.9 Cox's Permian Red Stringybark – Brittle Gum Woodland



Photograph 3.11 Cox's Permian Red Stringybark – Brittle Gum Woodland

i. Corresponding Classifications

TSC Act: not listed

EPBC Act: not listed

DEC (NSW) (2006): MU 37 Cox's Permian Red Stringybark – Brittle Gum Woodland

DEC (2006): BVT 4 Mountain Gum – Red Stringybark Open Forest at High Altitudes

Keith (2004): Southern Tableland Dry Sclerophyll Forests

ii. Description

This community occurs on exposed escarpment slopes and ridges of the Upper Cox's catchment and is defined by low growing and open woodland with an inconsistent understorey. The dominant tree species include *Eucalyptus macrorhyncha* and *E. mannifera*; however several other species may appear in combination or at localised sites including *E. rossii* and *E. dives*. The shrub layer if present consists of *Lissanthe strigosa*. The groundcover retains a sparse though consistent cover of forbs and occasional grasses, *Acaena novae-zelandiae, Galium gudichaudii, Geranium solanderi, Hibbertia obtusifolia, Hypericum gramineum* and *Lomandra filiformis.*

3.2.10 Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest



Photograph 3.12 Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest

i. Corresponding Classifications

TSC Act: not listed

EPBC Act: not listed

DEC (NSW) (2006): MU 34 Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest

DEC (2006): BVT 4 Mountain Gum – Red Stringybark Open Forest at High Altitudes

Keith (2004): Southern Tableland Dry Sclerophyll Forest

ii. Description

This community occurs mainly on the metamorphic slopes of west Lithgow (DEC (NSW), 2006). The canopy comprises of *Eucalyptus mannifera*, *E. rossii* and *E. dives* at heights 20-25m. On more exposed sites *E. mannifera* and *E. rossii* tend to dominant the canopy. On lower slopes occasional *E. bridgesiana* are found amongst the canopy. This community occurs largely on gentle foot slopes with a westerly or northerly aspect and acts as a transitional forest between grassy gully forests and mid and upper slope shrubby forests. The varying species composition exemplifies this with an incursion of species from neighbouring communities. The shrub layer contains *Hibbertia obtusifolia, Leucopogon muticus. Persoonia linearis, Indigofera australis* and *Acacia buxifolia*. The ground layer is made of largely of dense clumps of tussock grasses including *Joycea palida* or *Lomandra filiformis*. Other species found in the ground layer include; *Lagenifera stipitata, Wahlenbergia gracilis, Galium propinquum* and *Plantago debilis.*

3.2.11 Tableland Broad-leaved Peppermint – Brittle Gum – Red Stringybark Grassy Open Forest



Photograph 3.13 Tableland Broad-leaved Peppermint – Brittle Gum – Red Stringybark Grassy Open Forest

i. Corresponding Classifications

TSC Act: not listed

EPBC Act: not listed

DEC (NSW) (2006): MU 33 Tableland Broad-leaved Peppermint – Brittle Gum – Red Stringybark Grassy Open Forest

DEC (2006): BVT 4 Mountain Gum – Red Stringybark Open Forest at High Altitudes

Keith (2004): Southern Tableland Dry Sclerophyll Forest

ii. Description

This community occurs on Permian strata in the western portions of the Project Boundary, where the terrain widens and becomes rolling hills. Within the Project Boundary the community is found in gullies with little western relief. This community is found more extensively further west. This low open forest or woodland is dominated by *Eucalyptus dives* and *E. mannifera*, with *E. macrorhyncha* also found to be common. The height of the canopy is 8-12m with an average PFC of 30%. The shrubs are scattered and sparse containing *Hibbertia obtusifolia, Brachyloma daphnoides, Leucopogon virgatus, Dillwynia philicoides* and *Pultenaea microphylla.* The ground cover is dense containing *Hydrocotele laxiflora, Helichrysum scorpioides, Poranthera microphylla, Goodenia hederacea, Lomandra filiformis, Microlaena stipoides* and *Poa sp*.

3.2.12 Acacia Thickets



Photograph 3.14 Acacia Thickets

i. Corresponding Classifications

TSC Act: not listed

EPBC Act: not listed

DEC (NSW) (2006): MU 58 *Acacia* Thickets

DEC (2006): no match

Keith (2004): subunit of woodland or forest

ii. Description

This community is mostly a result of recovery from past disturbance and is easily distinguished by an evenly-aged stand of wattles forming a closed canopy. The community is usually composed of a single dominant canopy species with occasional eucalypt emergents (*E. dealbata, E.dives, E. viminalis* and *E. melliodora*). The small tree and shrub layer varies with location and contains mainly *Acacia* species, *Acacia ixiophylla*, *A. binervia,* and *A. falciformis.* The understorey varies from nearly absent to moderate densities of grass and forbs including but not limited to *Austrodanthonia racemosa, Cheilanthes sieberi, Dichondra repens* and *Oxalis perennans.*

Within the Project Boundary, this community forms small localised patches, too small to map accurately. For this reason it should be assumed that the community occurs sporadically through the lower slopes and valley floors, particularly within Tableland Gully Ribbon Gum – Blackwood – Apple Box Forest.

3.2.13 Native Grasslands

i. Derived Native Grassland

Much of the native grasslands within the Project Boundary have historically been derived from the clearing of trees and shrubs to create pasture for livestock. Derived Native Grassland (also known as secondary grassland) can remain relatively intact, but by nature, the floristic composition of these grasslands will vary according to the forest or woodland community from which it originated. Slope, aspect, soil, underlying geology and land use also heavily influences the floristic composition. These factors were used to aid identifying a grassland's original forest or woodland state.

Native grasslands within the Project Boundary that are derived from the clearing of the grassy community Capertee Rough-barked Apple, Red Gum, Yellow Box Woodland have been identified and mapped as Capertee Rough-barked Apple, Red Gum, Yellow Box Woodland Derived Native Grasslands. Within this grassland community there are varying conditions.

For the grassland to conform to the EPBC Act (DEH, 2006) the grassland must contain 50% native cover and at least 12 native non-grassy species with one being a recognised "important" species within a 0.1 ha plot (see explanation in **Appendix H**).

There are no conditional thresholds described under the TSC Act. There are however key characteristics to help identify if grasslands conforms under TSC Act. These include the following questions:

- Is the site on the tablelands or western slopes of NSW?
- Does the site contain, or would be likely to contain, White Box, Yellow Box or Blakely's Red Gum?
- Is the ground layer mainly grassy?

- If the site has been degraded, is there potential for assisted natural regeneration of the tree layer or the understorey?

A combination of information on species assemblage within grasslands, slope, aspect, soil, underlying geology and land use were also considered in determining the grasslands original forest or woodland state.

Capertee Rough-barked Apple, Red Gum, Yellow Box Woodland Derived Native Grasslands is consistent with the CEEC Box Gum Woodland and Derived Grasslands, which is listed under the EPBC Act and TSC Act (**Photo 3.15**).



Photograph 3.15 **Capertee Rough-barked Apple, Red Gum, Yellow Box Derived Native Grassland (EPBC and TSC Act)**

There is a small area of Capertee Rough-barked Apple, Red Gum, Yellow Box Woodland Derived Native Grasslands that conforms to the TSC Act only (**Photo 3.16**).

Other areas of Derived Native Grasslands occur in the Project Boundary that are not listed under Commonwealth or State legislation. This is because the grasslands are derived from a non-listed forest or woodland i.e. Tableland Gully Mountain Gum, Broad-leaved Peppermint Grassy Forest (**Photo 3.17**).



Photograph 3.16 **Capertee Rough-barked Apple, Red Gum, Yellow Box Woodland Derived Native Grassland (TSC Act)**



Photograph 3.17 **Tableland Gully Mountain Gum, Broad-leaved Peppermint Grassy Forest Derived Native Grassland – non C/EEC**

ii. Low Diversity Derived Native Grasslands / Exotic

The native grassland within the Project Boundary has generally been degraded to varying degrees across its extent by past clearing, farming and grazing practices, recreational activities (e.g. 4WD and trailbikes), and exploration and mining activities. Therefore, areas of native grasslands containing a very low diversity of native species and a presence of pasture grasses are referred to as *Low Diversity Derived Native Grasslands / Exotic.*

Within the Project Boundary, these grasslands are derived from non-listed vegetation communities. If these grasslands were derived from Capertee Rough-barked Apple, Red Gum, Yellow Box Woodland they would not conform to the C/EEC Box Gum Woodland and Derived Grasslands listed under the EPBC Act or TSC due to the poor quality. This is because the diversity of the groundcover non-grassy assemblage is too low to meet the condition criteria under Commonwealth legislation or definitions of the community in the NSW Scientific Committee's Final Determination.

Notwithstanding this, there is an inherent value in derived native grasslands, particularly where rehabilitation objectives require the re-establishment of an ecological community. This is because it is generally recognised that re-establishing understorey is very difficult. To this end, this vegetation unit has been mapped and differentiated according to the original community from which it was derived from.

3.3 Flora

An extensive amount of flora survey has been conducted within the Project Boundary over a period of several years. A combined species list has been compiled from the flora surveys previously (AES, 2003, Lembit, 2003) conducted in the Project Boundary and the species identified during the Cumberland Ecology study. Extra species detected during random meanders not previously on the list were also added to this list (**Appendix A**).

More than 400 species have been recorded in the Project Boundary, with less than 20% of these being exotic. The dominant plant families encountered in the open forest and woodland have been consistently represented by the Myrtaceae, Fabaceae, Asteraceae and Poaceae families. The most common genera encountered are *Eucalyptus* and *Acacia*. Poaceae is the family represented by the highest diversity of species, although it is not strongly represented by any one genus.

3.3.1 Threatened Flora Species

A number of threatened flora species have been recorded in the Lithgow LGA. **Table E.1** in **Appendix E** analyses the likelihood of occurrence within the Project Boundary of threatened species known to occur within the Lithgow LGA.

Those known to occur or have potential to occur within the Project Boundary are discussed further below.

Please note that the Project Boundary is located in the Central Tableland Botanical Subdivision.

i. EPBC Act Listed Species

a. *Eucalyptus cannonii*

Eucalyptus cannonii (Capertee Stringybark) was recorded within the Project Boundary. This species is listed as Vulnerable under both the TSC Act and the EPBC Act. *Eucalyptus cannonii* is restricted to an area of approximately 100 km by 60 km in the central tablelands of NSW. The western border generally aligns between Bathurst and Mudgee, while the eastern locations occur approximately between Lithgow and the town of Bylong. Within this area the species is often locally frequent (DEC (NSW) 2005b). The altitude range of *Eucalyptus cannonii* is from about 460 m to 1040 m (DEC (NSW), 2005a). The species mostly occurs on rocky, usually poor, steep ridges in dry sclerophyll forest, although it can also be found in valleys and on gentle slopes (NSW Scientific Committee 2004b) but less commonly on valley floors (DEC (NSW), 2005a). Associated tree species include Red Stringybark (*E. macrorhyncha*), Thin-leaved Stringybark (*E. eugenioides*), Red Box (*E. polyanthemos*) and Scribbly Gum (*E. rossii*). On the intermediate slopes there may also be Narrow-leaved Red Ironbark (*E. crebra*), *E. blakelyi*, *E. melliodora*, *E. bridgesiana*, *E. dalrympleana* and *E. viminalis,* whilst on the on lower slopes it may occur with *E. mannifera* subsp. *praecox*, *E. laevopinea*, *E. oblonga*, *E. sparsifolia*, *E. dives* and *E. goniocalyx.* On rocky areas *Angophora intermedia* has been recorded co-existing. *E cannonii* is also known to hybridise with *E. macrorhyncha* (NSW Scientific Committee 2004b).

From observations, the species was found to occur sporadically over much of the Project Boundary. For this reason its habitat cannot be accurately mapped, unlike *Persoonia marginata* which has specific niche habitats that can be mapped. Where recorded, the species seemed to form localised patches, sometimes forming monotypic stands. The densities varied from vegetation community to vegetation community (**Table 3.1**). Generally, the species was commonly found within the mid to lower slopes and the valley floors, particularly within Tableland Gully Ribbon Gum Blackwood – Apple Box Forest and Cox's Permian Red Stringybark - Brittle Gum Woodland. Densities within Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland were variably different. The species was not recorded within Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Woodland and was rarely found in Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest, usually close to community transitional zones. As topography steepened in the Project Boundary and the vegetation changed into Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Woodland or Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest *Eucalyptus cannonii* dropped out and *Eucalyptus sparsifolia* became the dominant Stringybark.

The results of the *Eucalyptus cannonii* quadrats within the Project Boundary are shown in **Appendix C**. The numbers of the species recorded in each quadrat have been multiplied to provide an estimate of density per hectare. A extrapolated population count of *Eucalyptus cannonii* individuals was estimated by multiplying the average density per hectare found in each vegetation community by the amount of each vegetation community (with *E. cannonii* present) occurring within the Project Boundary and within the Project Disturbance Boundary. A total of 908 ha of potential and known habitat within the Project Boundary were calculated by extrapolating average densities of *Eucalyptus cannonii* found in quadrats located in each vegetation community across the Project Boundary.

An estimated 37,602 *Eucalyptus cannonii* specimens are predicted occur within the Project Boundary. Of these, an estimated 19,219 individuals occur within the Project Disturbance Boundary. The results are provided in **Table 3.1** below.

Table 3.1 *Eucalyptus cannonii* Population Estimates and Estimated Areas of Habitat

Vegetation Community	Map Unit	quadrat number	No of *Eucalyptus cannonii* recorded per quadrat	Average no of *Eucalyptus cannonii* detected in quadrats	Average Density per hectare	Extent of Community in Project Boundary (ha)	Extrapolated No. of Individuals in Project Boundary	Extent of Community in Project Disturbance Boundary (ha)	Extrapolated No. of Individuals in Project Disturbance Boundary (i.e. No. to be removed)	Estimated No of Individuals remaining
Tableland Gully Ribbon Gum - Blackwood - Applebox Forest		1	14							
		2	31							
	13	3	18	21	105	111.81	11,740	93.94	9,864	1,876
Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland		15	2							
	20	11	24	13	65	46.18	3,002	16.21	1,054	1,948
Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland		10	0							
	30	16	0	0	0	679.11	0	370.43	0	n/a
Tableland Scribbly Gum - Narrow-leaved Stringybark Shrubby Woodland		13	0							
	32	17	1	1	3	332.43	831	112.51	281	550
Tableland Slopes Brittle Gum - Broad-leaved Peppermint Grassy Forest		4	4							
		14	6							
	34	18	0	3	17	260.86	4,348	185.77	3,096	1,252
Cox's Permian Red Stringybark - Brittle	37	5	55	33	165	92.02	15,183	23.71	3,912	11,271

Table 3.1 ***Eucalyptus cannonii*** **Population Estimates and Estimated Areas of Habitat**

Vegetation Community	Map Unit	quadrat number	No of *Eucalyptus cannonii* recorded per quadrat	Average no of *Eucalyptus cannonii* detected in quadrats	Average Density per hectare	Extent of Community in Project Boundary (ha)	Extrapolated No. of Individuals in Project Boundary	Extent of Community in Project Disturbance Boundary (ha)	Extrapolated No. of Individuals in Project Disturbance Boundary (i.e. No. to be removed)	Estimated No of Individuals remaining
Gum Woodland		19	11							
Tableland Gully Mountain Gum – Broad-leaved Peppermint Grassy Forest	35	12	9	9	45	51.70	2,327	18.87	849	1,478
Tableland Broad-leaved Peppermint – Brittle Gum – Red Stringybark Grassy Forest*	33	8	0	3	13	13.71	171	13.02	163	9
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest*^	11	n/a	n/a	0	0	0.90	0	0.00	0	n/a
Pagoda Rock Sparse Shrubland^	43	n/a	n/a	0	0	32.87	0	0.05	0	n/a
Total						**908.70**	**37,602**	**278.27**	**19,219**	**18,382**

Notes: ** data used from quadrats on adjacent Hillcroft Property*
^ Eucalyptus cannonii not known to occur in this community

b. *Persoonia marginata*

Persoonia marginata (Clandulla Geebung) was also recorded within the Project Boundary and is listed as Vulnerable under both the TSC Act and the EPBC Act. *Persoonia marginata* is known from only four disjunct locations on the Central Tablelands and Central Coast (DEC (NSW) 2005h). The core of the species' distribution is within Clandulla State Forest, west of Kandos. Disjunct populations occur to the north at Dingo Creek and Mount Dangar within the Wollemi and Goulburn River National Parks; to the south within Ben Bullen State Forest, south-east of Capertee; and to the south-east at Devils Hole, north of Colo Heights within Parr State Recreation Area (DEC (NSW) 2005h). Two of these disjunct populations occur close to the Project Boundary, within the Wollemi National Park and within Ben Bullen State Forest (DEC (NSW) 2005h) (DEC (NSW), 2005c). Known populations have been recorded to date on flat ground within dry sclerophyll forest and woodland on sandy loam, clayey, and/or rocky soils derived from Permian rock (Threatened Species Scientific Committee 2008b).

A new population was recorded at three locations within the Project Boundary. These three subpopulations occur: (1) in the north of the approved footprint of Cullen Valley Mine (but within the Cullen Valley Mining Exclusion Zone), which extends beyond the Project Boundary into Ben Bullen State Forest; (2) within Cullen Valley Mine's existing Habitat Compensation Area no. 5; and (3) in the northern extent of the Project Boundary to the east of occurrence found within the approved Cullen Valley Mine footprint (see **Figure 3.2** and **Appendix G**).

The total size of the *Persoonia marginata* population is estimated at approximately 21,088 individuals occurring within approximately 49.77 ha of habitat, with the majority of the occurrence belonging to the Cullen Valley Mine subpopulation. The average subpopulation density varies with each subpopulation but the overall average population density is calculated to be approximately 384 individuals per hectare (**Table 3.2**). Within the north-eastern subpopulation there was an observable difference in average density outside and within the proposed Project Disturbance Boundary (**Table 3.2**).

Examination of the geological profile at each subpopulation occurrence suggests that this population is closely associated with the Upper Irondale Seam, which is comprised of coal, oil shale, minor shale and sandstone; and the Irondale Seam, which contains coal and minor shale. The populations were rarely found above these seams within the skeletal sandstone soil along the plateaus or at lower landscape positions such as in gullies containing deeper wetter soils. The population may also be strongly influenced by aspect, with individuals in the Project Boundary subpopulations recorded exclusively on western slopes and none on eastern slopes. All three subpopulations were also recorded on sloping and relatively flat land facing west in dry sclerophyll forest or woodland with a sparse understorey. The vegetation in which these subpopulations have been recorded has been classified as Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest.

Table 3.2 ***Persoonia marginata*** **Subpopulation Estimates and Estimated Areas of Habitat**

Measured Parameter	Cullen Valley Mine Subpopulation*			Cullen Valley Mine Habitat Compensatory Area 5 Subpopulation*			North-eastern Subpopulation			Population Total
	Outside Project Boundary	Within Project Boundary	Total	Outside Project Boundary	Within Project Boundary	Total	Outside Project Disturbance boundary	Inside Project Disturbance boundary	Total	
Average density per hectare (no. individuals/ha)	482	300	466	0	517	517	240	98	169	384
Estimated population size (no. of individuals)	16,186	1,350	17,745	0	2,032	2,032	1,121	303	1,311	21,088
Estimated area of habitat (ha)	33.58	4.5	38.08	0	3.93	3.93	4.67	3.09	7.76	49.77

**These subpopulations are not within the proposed Project Disturbance Boundary but are within or partially within the Project Boundary.*

Note, that the Cullen Valley Mine and Habitat Compensation Area no. 5 subpopulations are not located within the proposed Project Disturbance Boundary but fall partially within the existing approved mining lease area and an existing habitat compensatory area, respectively. The assessment of these subpopulations is outside the scope of this study. Notwithstanding this, these subpopulations will not be disturbed by current operations and provisions exist for their protection and management (**see Chapter 5**).

Very little is known about this species as a result of its restricted distribution. It is possible that suitable habitat occurs in other areas of dry sclerophyll forest and woodland communities within the Project Boundary; albeit no other individuals were detected during current targeted surveys or previous surveys for the species within the Project Boundary outside the area where this species has been previously identified within the current approval area of Cullen Valley Mine.

c. *Eucalyptus pulverulenta*

Eucalyptus pulverulenta (Silver-leaved Mountain Gum) is listed as Vulnerable under the EPBC Act and TSC Act. Silver-leaved Mountain Gum has a highly disjunct distribution and is found in two quite separate areas, the Lithgow to Bathurst area and the Monaro area (DEC (NSW) 2005d). Silver-leaved Mountain Gum grows in shallow soils as an understorey plant in open forest, typically dominated by *Eucalyptus mannifera* (Brittle Gum), *E. macrorhynca* (Red Stringybark), *E. dives* (Broad-leafed Peppermint), *E. sieberi* (Silvertop Ash) and *E. bridgesiana* (Apple Box). Silver-leaved Mountain Gum occurs on the crests or upper slopes of moderately steep hillsides or mountains, at altitudes of 800–1,000 m, usually on well-drained skeletal soils with frequent rock outcrops (DEC (NSW) 2005d).

Ostensibly, suitable habitat for this species occurs within the Project Boundary in areas mapped as Exposed Blue Mountains Sydney Peppermint, Silvertop Ash Shrubby Woodland and Tableland Scribbly Gum Narrow-leaved Stringybark Shrubby Open Forest. The Project Boundary occurs at similar altitudes (800-1,020m above sea level (ASL)). Other Species generally associated with this species are found within the upper and mid slopes within the Project Boundary. However, repeated targeted surveys during flowering times within these communities have failed to locate the species.

The Atlas of NSW Wildlife holds 12 records of *Eucalyptus pulverulenta* within the Lithgow LGA. The closest record occurs approximately 6 km (dated 1974) from the Project Boundary. Additional records of this species occur within the Central Tableland bioregion. *Eucalyptus pulverulenta* is not known from any conservation reserves within Lithgow LGA.

d. *Grevillea evansiana*

Grevillea evansiana is listed as Vulnerable under the EPBC Act and TSC Act. It is restricted to a small area east of Olinda in the Kandos-Rylstone district, mostly on the western catchment, but also extending into the Colo River catchment (Threatened Species Scientific Committee 2008a). The species inhabits dry sclerophyll forest or woodland, occasionally in swampy heath, in sandy soils, usually over Hawkesbury sandstone (DEC (NSW) 2005g).

Ostensibly, suitable habitat for this species occurs within the Project Boundary in areas mapped as Pagoda Rock Sparse Shrubland and Sydney Peppermint, Silvertop Ash Shrubby Woodland. DEC (2006) have identified these two communities as providing possible habitat for the species, while Benson & Keith (1990) have identified Scribbly Gum Stringybark Woodland mapped as Tableland Scribbly Gum Narrow-leaved Stringybark Shrubby Open Forest within the Project Boundary.

However, repeated targeted surveys during flowering periods in these communities failed to locate the species within Pagoda Rock Sparse Shrubland, a suitable habitat worth targeting (NSW NPWS 2000a).

The Atlas of NSW Wildlife holds 17 records of *Grevillea evansiana* within the Lithgow LGA. The closest records occur approximately 15 km away within Gardens of Stone National Park. Additional records of this species occur within the western side of Wollemi National Park within Lithgow LGA.

e. *Grevillea obtusiflora*

Grevillea obtusiflora ssp. obtusiflora

Grevillea obtusiflora ssp. obtusiflora is listed as Endangered under the EPBC Act and TSC Act. *Grevillea obtusiflora ssp. obtusiflora* is known to occur near Rylstone in the Central Tablelands bioregion (NSW NPWS 2000c). *G. obtusiflora* subsp. *obtusiflora* occurs in the understorey of low open eucalypt forest at an altitude of 730 metres ASL (NSW NPWS 2000c).

Ostensibly suitable habitat for this species occurs within the Project Boundary, albeit above the altitude of known populations. The Project Boundary's elevation ranges between 800-1,020 m above sea level, considerably higher than what is documented as suitable habitat. Species generally associated with this species found within the mid and upper slopes and exposed plateaus within the Project Boundary include *Acacia buxifolia, Leucopogon sp., Caustis flexulosa, Dianella sp*. and *Patersonia sp*. Repeated targeted surveys during flowering periods within these communities on mid and upperslopes have failed to locate the species.

The Atlas of NSW Wildlife holds 43 records of *Grevillea obtusiflora* within the Lithgow LGA. Numerous records are found within the nearby Gardens of Stone National Park. Additional records of this species occur within the western side of Wollemi National Park within Lithgow LGA.

Grevillea obtusiflora ssp. fecunda

Grevillea obtusiflora ssp. fecunda is listed as Endangered under the EPBC Act and TSC Act. *G. obtusiflora* ssp. *fecunda* is known to occur in the Capertee Valley, west of Lithgow, and in the Gardens of Stone National Park (NSW NPWS 2000c). Both sites are in the Central Tablelands botanical division. *G. obtusiflora* subsp. *fecunda* occurs on orange sandy loam soils with sandstone boulders in low open scrub beneath open dry sclerophyll forest, at an altitude of 570 m (NSW NPWS 2000c). Species found growing alongside include *Eucalyptus tenella, E. fibrosa, E. macrorhyncha, E. punctata, Callitris endlicheri, Acacia buxifolia, Leptospermum continentale, Monotoca elliptica., Persoonia linearis, Indigofera sp., and Pomax umbellata* (NSW NPWS 2000c).

Ostensibly suitable habitat for this species occurs within the Project Boundary within the drier woodland and forest communities. Common species generally associated with habitat for this species are found within the mid and upper slopes and exposed plateaus within the Project Boundary; however these habitats occur around 900 m above sea level, far beyond known populations of *Grevillea obtusiflora ssp. fecunda*. Repeated targeted surveys during flowering periods on mid and upper slopes and exposed plateaus have failed to locate the species.

The Atlas of NSW Wildlife holds 43 records of *Grevillea obtusiflora* within the Lithgow LGA. Numerous records are found within the nearby Gardens of Stone National Park. Additional records of this species occur within the western side of Wollemi National Park within Lithgow LGA.

f. *Prostanthera cryptandroides subsp. cryptandroides*

Prostanthera cryptandroides subsp. cryptandroides is listed as Vulnerable under the EPBC Act and TSC Act. *Prostanthera cryptandroides* is known from Glen Davis to Capertee and extends to the Goulburn River Valley, NSW (Threatened Species Scientific Committee 2008c). *Prostanthera cryptandroides* occurs in dry sclerophyll forested slopes and gullies, in rocky ridgelines and rocky areas especially at the base of scree slopes and sandstone boulders, and in shallow sandy loam, as an understorey species (Threatened Species Scientific Committee 2008c).

Ostensibly suitable habitat for this species occurs within the Project Boundary within open forest and woodland communities. DEC (2006) identifies Pagoda Rock Sparse Shrubland, Tableland Scribbly Gum Narrow-leaved Stringybark Shrubby Open Forest and Capertee Rough-barked Apple Red Gum Yellow Box Woodland as providing possible habitat for the species, which occurs within the Project Boundary. One record of the species has been found within Pagoda Rock Complex at Glen Davis (NSW NPWS 2000b). However, repeated targeted surveys during flowering periods in dry sclerophyll forested slopes and gullies, in rocky ridgelines and rocky areas especially at the base of scree slopes and sandstone boulders, and in shallow sandy loam have failed to locate the species.

The Atlas of NSW Wildlife holds 22 records of *Prostanthera cryptandroides subsp. cryptandroides* within the Lithgow LGA. The closest record occurs within Ben Bullen State Forest near Baal Bone Colliery. Additional records of this species occur within the Central Tableland bioregion. *Prostanthera cryptandroides subsp. cryptandroides* is conserved in Wollemi National Park and Gardens of Stone National Park within Lithgow LGA.

ii. TSC Act Listed Species

a. *Eucalyptus aggregata*

Eucalyptus aggregata (Black Gum) was recorded within the Project Boundary and is listed as Vulnerable under the TSC Act. Black Gum is found in the NSW Central and Southern Tablelands, with small isolated populations in Victoria and the ACT (NSW Scientific Commitee 2010). In NSW it occurs in the South Eastern Highlands Bioregion and on the western fringe of the Sydney Basin Bioregion (NSW Scientific Commitee 2010). Black Gum has a moderately narrow distribution, occurring mainly in the wetter, cooler and higher parts of the tablelands (NSW Scientific Commitee 2010). It grows in the lowest parts of the landscape on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers (NSW Scientific Commitee 2010).

The Atlas of NSW Wildlife holds 9 records (post 1980) of *E. aggregata* within the Lithgow LGA. The two known records occur within 5 km from the Project Boundary, in Gardens of Stone National Park to the north, and Blackmans Flats to the south. Additional records of this species occur within the Central Tableland bioregion. Black Gum is not known from any conservation reserves within Lithgow LGA.

This species was recorded in Lot 112, DP 877190, Invincible Colliery's 2008 Offset. Approximately 20 trees were recorded within a cleared valley floor (**Figure 3.2**). Other species recorded in the offset area included *Eucalyptus bridgesiana.*

b. *Derwentia blakelyi*

Derwentia blakelyi is listed as Vulnerable under the TSC Act. This species is known to be restricted to the western Blue Mountains, near Clarence, near Mt Horrible, on Nullo Mountain and in the Coricudgy Range (NSW Scientific Commitee 2000). It grows in eucalypt forest often in moist areas (NSW Scientific Commitee 2000).

Ostensibly suitable habitat for this species occurs within the Project Boundary within areas mapped as Tableland Gully Mountain Gum Broad-leaved Peppermint Forest, Tableland Gully Ribbon Gum Blackwood Apple Box Forest and Capertee Rough-barked Apple Red Gum Yellow Box Woodland, particularly in the lowest areas or floors of these communities. DEC (2006) has found the species within Gully Ribbon Gum Blackwood Apple Box Forest and have identified Tableland Gully Mountain Gum Broad-leaved Peppermint Forest as providing possible habitat also. However, repeated targeted surveys during flowering periods in the aforementioned vegetation communities have failed to locate the species.

The Atlas of NSW Wildlife holds 50 records of *Derwentia blakelyi* within the Lithgow LGA. The distribution within Lithgow LGA largely occupies Newnes Plateau, less than 5km away. Additional records of this species occur within the Central Tableland bioregion. *D. blakelyi* is not known from any conservation reserves within Lithgow LGA.

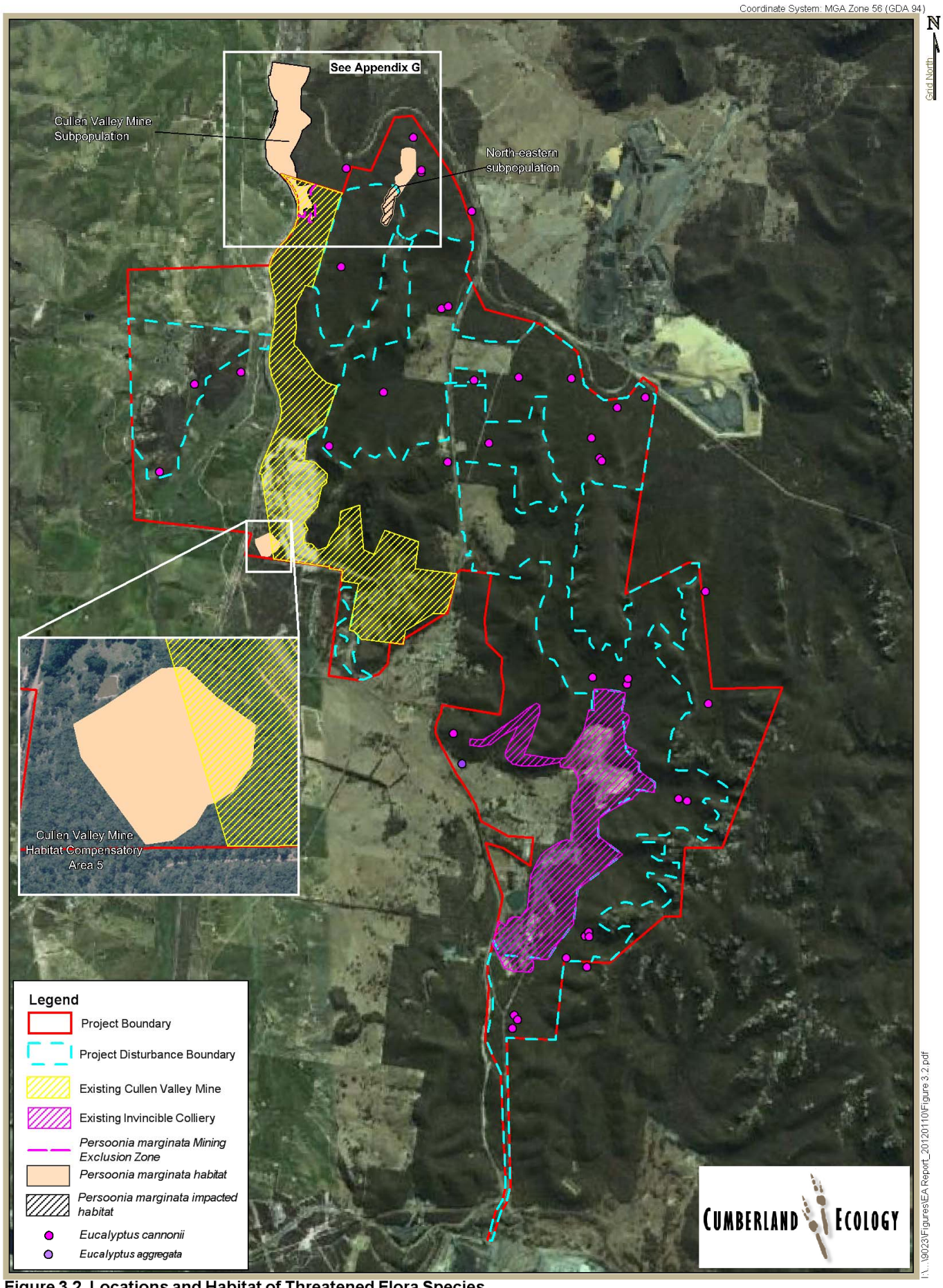


Figure 3.2. Locations and Habitat of Threatened Flora Species in the Project Boundary

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3.3.2 Regionally Significant Species

A small number of regionally significant flora species have been identified as having potential to occur within the vegetation communities known to occur within the Project Boundary. Whilst there is no legal requirement to take measures to protect them unless they are also listed under the TSC Act or EPBC Act, their significance in the region is noted in this ecological assessment.

The following regionally significant flora species have been recorded within the Project Boundary:

- *Gonocarpus longifolius* (3RC-);
- *Eucalyptus cannonii* (2VCi); and
- *Persoonia marginata* (2V).

Table 3.3 (below) provides a definition for each of the above listed flora species.

Table 3.3 ROTAP Coding System for Plants

Category	Coding	Definition
Plant Distribution	1	Known only from the type* collection
	2	Restricted distribution - range extending over less than 100km
	3	Range more than 100km but in small populations
Conservation Status	X	Presumed extinct - not collected for 50 years or the only known populations destroyed
	E	Endangered - at serious risk in the short term (one or two decades) **
	V	Vulnerable - at risk over a longer period (20-50 years) **
	R	Rare but with no current identifiable threat
	K	Poorly known species suspected of being at risk
Reservation Status	C	Species is known to occur within a proclaimed reserve
	a	Species is considered to be adequately reserved. 1000 or more plants occur within a proclaimed reserve
	i	Species is considered to be inadequately reserved. Less than 1000 plants occur within a proclaimed reserve
	-	Species is recorded from a reserve but the population size is unknown
	t	Total known species population is within a reserve

Table 3.3 ROTAP Coding System for Plants

Category	Coding	Definition
	Px	Western Australian Department of Conservation and Land Management (CALM) Priority Flora Code. Range from P1 (highest priority) to P4 (lowest priority).
	+	Species also occurs outside of Australia

3.4 Fauna

Extensive fauna surveys have been conducted within the Project Boundary over several years (Wildsearch, 1997, AES, 2003). Current fauna surveys were designed to provide additional information for particular fauna groups as well as to address current listings of species under State and Commonwealth legislation.

Previous survey efforts have resulted in an extensive fauna species list for the Project Boundary (**Appendix B**). Despite this, the current surveys resulted in a number of additional fauna species that were not previously recorded from within the Project Boundary.

This section first considers the fauna habitats present in the Project Boundary and then assesses the threatened species with potential to occur.

3.4.1 Fauna Habitat Assessment

The primary fauna habitats located within the Project Boundary are:

- Open forest communities;
- Woodland communities;
- Pagodas and caves; and
- Permanent and ephemeral water bodies such as dams and creeks.

Forest and woodland communities occur extensively throughout the Project Boundary and provide suitable habitat for a range of fauna types including: amphibians, reptiles, birds, bats and arboreal and terrestrial mammals. Key habitat features recorded during the current study included:

- Woodland and forest vegetation – shelter and forage for birds including raptors and microbats;
- Dense understorey vegetation – shelter and foraging habitat for amphibians, reptiles, small birds and terrestrial mammals;
- Fallen logs, debris and leaf litter – shelter habitat for amphibians, reptiles and terrestrial mammals;

- Rocky outcrops – shelter and breeding habitat for amphibians, reptiles terrestrial mammals and cave dwelling microbats;
- Hollow-bearing living trees and stags – providing shelter and breeding habitat for a range of reptiles, birds, arboreal mammals and microbats;
- Nectar-producing trees and shrubs – foraging habitat for insects, blossom-dependant birds, arboreal mammals and megachiropteran bats (flying-foxes);
- Feed trees, shrubs and grasses for a range of species – food for small birds, cockatoos and herbivorous mammals;
- Ecotonal (edge) communities – foraging habitat for many species, particularly birds;
- Ephemeral drainage lines - foraging, shelter and breeding habitat for amphibians, aquatic reptiles, wetland birds and aquatic mammals; and
- Constructed farm dams with limited aquatic vegetation - foraging and breeding habitat for amphibians, aquatic reptiles and wetland birds.

There are no wetlands and permanent streams within the Project Boundary. However, there are a small number of ephemeral streams and farm dams. The network of intermittent drainage lines present in the Project Boundary would create temporary pools following heavy rain and provide suitable foraging and breeding habitat for a number of amphibian species. The dams within the Project Boundary do not generally support aquatic vegetation and are typically small, however they do provide limited habitat for some wetland-dependent species such as wetland birds and amphibians. The water contained within dams and temporary pools also provides a drinking source for terrestrial and arboreal mammals, birds and reptiles.

Features such as rock outcrops, fallen logs, leaf litter and ground vegetation, which provide shelter for many of the small to medium sized terrestrial fauna species known from the wider locality, were abundant within the forest and woodland communities of the Project Boundary. However, the results of current and previous (Wildsearch, 1997) surveys indicate that the Project Boundary supports a low abundance and diversity of small terrestrial fauna when compared to more intact areas. This may be a result of past land use (logging) and inappropriate fire regimes, combined with the presence of feral predators (e.g. foxes) which are abundant throughout the Project Boundary. Generally, the types of terrestrial native species using the Project Boundary are likely to be restricted to those that are common and well-adapted to disturbed forest and woodland areas.

The mature living trees and stags that remain in forest and woodland communities within the Project Boundary provide a number of small to medium-sized tree hollows for fauna species dependent on this resource as shelter and breeding habitat. Large hollows in tall trees that provide breeding and shelter habitat, particularly for large forest owls and large gliders, are relatively abundant in the taller forest communities of the Project Boundary.

All open forest and woodland vegetation communities within the Project Boundary would provide suitable foraging habitat for a wide range of nectivorous birds during blossom periods. It is likely that a number of nectar-dependent bird species would be attracted to the Project Boundary during the blossoming periods of dominant trees.

Habitat assessments during the current surveys indicated that the sandstone escarpments of the Project Boundary support suitable habitat for cave-dependent fauna, particularly various Microchiropteran bats. Records of cave-dependent microbats from both current and previous (Wildsearch, 1997) surveys indicate that the Project Boundary provides suitable forage, roosting and breeding habitat for these species.

3.4.2 Threatened Fauna Species

A number of threatened fauna species have been recorded in the Lithgow LGA. **Table F.1** in **Appendix F** analyses the likelihood of occurrence within the Project Boundary of threatened species known to occur within the Lithgow LGA.

Those known to occur or with a potential to occur within the Project Boundary are discussed below.

i. EPBC Act and TSC Act Listed Species

a. Invertebrates

Invertebrates were not generally the focus of this assessment, with the exception of threatened species, Bathurst Copper Butterfly and the Giant Dragonfly, which are both recorded in the OEH database Wildlife Atlas in the locality of the Project Boundary. The latter of the two, the Giant Dragonfly, was considered unlikely to occur due to unsuitable habitat observed during habitat assessment and a lack of nearby records (**Appendix F**).

It is recommended that potential habitat for Bathurst Copper Butterfly be identified by the presence of *Bursaria spinosa* subsp*. lasiophylla* at locations above approximately 900 metres in altitude (NSW NPWS 2001a). Aspect, geology, vegetation overstorey species are sufficiently variable at known locations of the butterfly to preclude their use as factors in identifying potential habitat (NSW NPWS 2001a). Nevertheless, the reliance on *Bursaria spinosa* subsp*. lasiophylla* further constrains potential habitat to forest and woodlands on heavier soils. The majority of the vegetation above 900m in Project Boundary comprises of sandstone soils unsuitable for the host plant. Some small areas of Tableland Gully Ribbon Gum – Blackwood – Applebox Open Forest and Capertee Rough-barked Apple – Red Gum – Yellow Box Woodland above 900m were targeted within the Project Boundary as these communities contain clay soils and could support the host plant. However, no sparse understorey dominated by *Buursaria spinosa* subsp. *lasiophylla* was recorded. Additionally, there may be other biotic factors dictating the distribution of the species, as some potential habitat may contain both the host plant and the attendant ant, but not the Bathurst Copper Butterfly (NSW NPWS 2001b).

Surveys failed to locate these habitat requirements within the Project Boundary. However, given the large area and limited access to some portions, it is possible that the required habitat for the Bathurst Copper Butterfly may occur within the Project Boundary, albeit in very low abundance. For this reason, the occurrence of this species within the Project Boundary cannot be completely discounted. The potential impacts to this species are discussed in **Chapter 4**.

b. Amphibians

The lack of pools and streams, and the relatively dry conditions experienced throughout the current survey period provided sub-optimal conditions for amphibians. No Federally or State listed threatened amphibian species were recorded during current or previous surveys, and none are likely to occur within the Project Boundary as no suitable habitat was recorded during habitat assessments.

c. Reptiles

Although no federally listed threatened reptiles were recorded during current or previous surveys, the Project Boundary provides suitable habitat for the Broad-headed Snake (*Hoplocephalus bungaroides*) listed as Vulnerable under the EPBC Act and Endangered under the TSC Act.

The Broad-headed Snake centres its habitat around vegetation communities (mainly woodland, open woodland and/or heath) on exposed sandstone outcrops and benching (DEC (NSW) 2005a). They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer within 200 m of their winter habitat (DEC (NSW) 2005a).

Given the proximity of a nearby recent record (less than 1km), the extent of suitable winter and summer habitat recorded in the Project Boundary and ample connectivity to other areas of extensive high quality habitat in Ben Bullen State Forest, Newnes State Forest and Wollemi National Park to the east, it is highly possible that the Project Boundary could support the Broad-headed Snake, despite the species not being detected during the survey period. Habitat assessments combined with nearby OEH records indicated the potential occurrence of this threatened reptile species within the Project Boundary.

d. Birds

A number of bird species were recorded during current and previous surveys indicating that the Project Boundary supports a high diversity of birds. A full list of these species is provided in **Appendix B.**

Blossom-dependent birds

All of the open forest and woodland communities within the Project Boundary would provide suitable foraging habitat for the range of threatened blossom-dependent birds known from the locality, especially during the blossom periods of dominant trees within these communities. These include the Regent Honeyeater, Swift Parrot, Little Lorikeet, Black-chinned Honeyeater and Painted Honeyeater.

Both the Regent Honeyeater (listed as Critically Endangered under the EPBC and TSC Act) and Swift Parrot (listed Endangered under the EPBC Act and TSC Act) can undertake large-scale movements in the order of hundreds of kilometres. The Regent Honeyeater is a nomadic species that will move to areas where food is abundant, however, the exact nature of these movements is still poorly understood. The Capertee and Wolgan Valleys to the northeast of the Project Boundary are known breeding locations for this species and therefore it is likely that this species would utilise the Project Boundary for foraging purposes from time to time.

The Swift Parrot breeds in Tasmania during spring and summer, migrating between March and October to south-eastern Australia. They will return to some foraging sites on a cyclic basis depending on food availability. The Swift Parrot has been recorded from the Capertee Valley during the winter months and therefore it is likely that this species would utilise the Project Boundary for foraging purposes from time to time.

The Regent Honeyeater and the Swift Parrot were not recorded within the Project Boundary during current or previous surveys. However, given both are wide-ranging blossom nomads it is possible that either of these species may forage within the Project Boundary during intense blossom periods.

Migratory Birds

A number of birds listed as migratory under the EPBC Act have potential to occur within the Project Boundary. These include:

- White-throated Needletail (*Hirundapus caudacutus*);
- Satin Flycatcher (*Myiagra cyanoleuca*);and
- Swift Parrot (*Lathamus discolor*).

The White-throated Needle-tail is a summer migrant that forages over the canopy of forest and woodland communities for small flying insects. This is a wide-ranging species and it is unlikely that the Project will result in the removal of any significant foraging habitat for the White-throated Needle-tail as adjacent protected areas provide a more extensive habitat.

The Satin Flycatcher is a migratory species that has been recorded during current surveys and previous surveys (Wildsearch 1996; AES 2003). It's a warm season migrant that forages and nests within forest and woodland. This bird species utilise forest and woodland habitats and will lose foraging and/or nesting habitat as a result of the Project.

Wetland Birds

The Project Boundary supports a small number of farm dams and ephemeral water courses. These water features do not generally support aquatic vegetation, and habitat assessment and the results of fauna surveys indicate that the Project Boundary does not provide suitable habitat for the majority of bird species dependent on wetland habitats. Only common, adaptable wetland birds are likely to occur.

e. Mammals

The threatened mammal species that have either been recorded within the Project Boundary during current surveys or are considered to have potential to occur are discussed below.

Terrestrial mammals

The Spotted-tail Quoll (*Dasyurus maculatus*) is listed as Endangered under the EPBC Act and vulnerable under the TSC Act. A number of records exist for this species within the Lithgow LGA including some near to the Project Boundary; however this species has not been recorded within the Project Boundary. This species creates dens in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields or rocky-cliff faces.

Numbers of the Spotted-tail Quoll are low, and males of the species are known to have extensive home ranges up to 3500 ha. The Project Boundary provides an abundance of suitable forage, den and breeding habitat for the Spotted-tail Quoll. Despite the absence of records during current and previous surveys, this species could potentially occur within the Project Boundary.

The Brush-tailed Rock-wallaby (*Petrogale penicillata*) is listed as Vulnerable under the EPBC Act and Endangered under the TSC Act. Despite targeted survey efforts during the current surveys, including the deployment of several infra-red remote cameras, no Brush-tailed Rock-wallabies were recorded within the Project Boundary. Habitat assessment indicates that the sandstone escarpments provide an abundance of suitable shelter habitat for the Brush-tailed Rock-wallaby. It is likely that this species historically occurred within the Project Boundary, and may still potentially occur here, albeit in low densities.

Microbats

Habitat assessments indicated that a number of hollow-bearing dead and living trees within the Project Boundary would provide suitable roosting and breeding habitat for hollow dwelling species known to occur in the locality. The sandstone escarpments of the Project Boundary also provide suitable roosting or breeding habitat for cave-dependent microbats recorded during the current and previous surveys (Wildsearch, 1997) and known to occur in the locality. Although each of these bat species has specific habitat requirements for roosting and breeding, many utilise a variety of forest, woodland and grassland communities as foraging habitat. Given the extent of these habitats within the Project Boundary, microbats known to occur in the locality could potentially forage within the Project Boundary on occasion.

Several Anabat records during current surveys demonstrate some of the characteristics of calls emitted by the Large-eared Pied Bat. However the few calls recorded were not substantial enough to conclusively identify this bat as the Large-eared Pied Bat, and no individuals of this species were captured during harp trapping. The sandstone escarpments provide an abundance of shelter habitat for cave-dependant bats such as the Large-eared Pied Bat, and OEH records indicate that this species occurs in the locality. It is therefore likely that the Large-eared Pied Bat forages and roosts within the Project Boundary.

In addition to the threatened microbats recorded, the Project Boundary may also provide potential foraging and roosting habitat for the Little Bent-wing Bat (*Miniopterus australis*) (Vulnerable under the EPBC Act and the TSC Act; however only one record is known within the LGA.

Habitat assessments indicate that the Project Boundary would provide suitable foraging and roosting habitat for all of these species. The occurrence of any of these threatened microbats within the Project Boundary cannot therefore be completely discounted.

ii. TSC Act Listed Species

a. Reptiles

Although no threatened reptiles were recorded during current or previous surveys, the Project Boundary provides suitable habitat for both Rosenberg's Goanna (*Varanus rosenbergi*) listed as Vulnerable under the TSC Act.

The Rosenberg's Goanna occurs in heath, open forest and woodland. Given the extent of suitable habitat, and ample connectivity to even more extensive habitat in other areas of Ben Bullen State Forest and Wollemi National Park to the east, it is possible that the Project Boundary could support the Rosenberg's Goanna despite the absence of detection during the survey period.

Habitat assessments combined with nearby DECCW records indicated the potential occurrence of this threatened reptile species within the Project Boundary.

b. Birds

A number of bird species were recorded during current and previous surveys indicating that the Project Boundary supports a high diversity of birds. A full list of these species is provided in **Appendix B**.

The following threatened species listed as Vulnerable under the TSC Act have been recorded within the Project Boundary:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Brown Treecreeper (*Climacteris picumnus*);
- Scarlet Robin (*Petroica boodang*);
- Speckled Warbler (*Chthonicola sagittata*);
- Square-tailed Kite (*Lophoictinia isura);*
- Powerful Owl (*Ninox strenua*); and
- Varied Sittella (*Daphoenositta chrysoptera*) recorded by AES (2003).

A more detailed discussion of the threatened birds species recorded is included below as well as those threatened species that were not recorded but have potential to occur. The locations of all threatened species identified in current surveys are provided in **Figure 3.3**.

The threatened bird species that have either been recorded within the Project Boundary during current surveys or are considered to have potential to occur are discussed below.

<u>Blossom-dependant Birds</u>

The Little Lorikeet has recently been listed as Vulnerable under the TSC Act. Although not recorded during current or previous surveys, this blossom dependent nomad could potentially forage in all of the open forest and woodland communities within the Project Boundary at any time of year, providing there is substantial blossoming of the dominant trees present. Although the Project Boundary does provide suitable breeding habitat for this species, it is unlikely that Project Boundary forms critical breeding habitat due to the absence of records of this species.

The Black-chinned Honeyeater *(Melithreptus gularis*) is listed as Vulnerable under the TSC Act. The species occupies a number of forest and woodland habitats, but requires large areas of intact habitat with nectar-producing trees.

Given the large home-range required for this species, there is potential that Black-chinned Honeyeaters in the wider locality would use flowering *Eucalyptus* / *Corymbia* / *Angophora* species as a food source during blossoming periods.

The Painted Honeyeater (*Grantiella picta*) is listed as Vulnerable under the TSC Act. This species is known to occupy a range of habitats, including Box-Gum woodlands such as those that occur within the Project Boundary. The Painted Honeyeater is a specialist feeder on the fruits of mistletoes, particularly of the genus *Amyema* which occurs within the Project Boundary. Nectar from these mistletoes and insects present on them are also consumed. Given the abundance of *Amyema sp.* mistletoes it is likely that the Painted Honeyeater could occur within the Project Boundary at various times.

Woodland Birds

The Brown Treecreeper (*Climacteris picumnus*) and Speckled Warbler (*Chthonicola sagittata*) both listed as Vulnerable under the TSC Act were recorded within grassy woodland during current flora surveys in September 2010.

The Varied Sittella (*Daphoenositta chrysoptera*) listed as Vulnerable under the TSC Act was recorded during previous surveys by AES in 2003.

Although not recorded from the Project Boundary, the grassy woodland communities of the Project Boundary also provide suitable habitat for a range of woodland birds listed as Vulnerable under the TSC Act. These are:

- Grey-crowned Babbler (*Pomatostomus temporalis*);
- Turquoise Parrot (*Neophema pulchella*);
- Hooded Robin (*Melanodryas cucullata*);
- Scarlet Robin (*Petroica boodang*); and
- Diamond Firetail (*Stagonopleura guttata*).

Given the absence of records during the survey periods, it is unlikely that the Project Boundary provides significant habitat for any of these species. However, any of these species could potentially occur within areas of woodland which cover approximately 835 ha of the Project Boundary (refer to **Figure 3.1** for location and distribution of woodland communities).

Cockatoos

The Gang-gang Cockatoo (*Callocephalon fimbriatum*) has been frequently recorded from the Project Boundary, with groups of up to four individuals being observed at any one time. This species was also detected during previous surveys (Wildsearch, 1997). The majority of records for the Gang-gang Cockatoo within the Project Boundary were during the October 2009 survey, suggesting that this species may occupy the Project Boundary primarily in the Spring and Summer months. Individuals were observed examining hollows in tall trees during this period, indicating that suitable breeding habitat is present and that breeding may occur within the Project Boundary in Spring/Summer.

The Glossy Black Cockatoo (*Calyptorhynchus lathami*) is listed as Vulnerable under the TSC Act and occupies a range of forest and woodland communities. This species requires productive specimens of *Allocasuarina* sp. for forage, and nests in tall hollow-bearing trees. Although not recorded during the current or previous surveys, it is possible that the Glossy Black Cockatoo may nest within the Project Boundary, given the extent of suitable habitat present, although suitable foraging habitat is rare in the Project Boundary.

Large Forest Owls and Raptors

Although no large forest owls were recorded during current surveys, the Powerful Owl (*Ninox strenua*) was recorded within the Project Boundary during previous surveys (Wildsearch 1996). Habitat assessment indicates that the tall forest and open woodland communities within the Project Boundary provide suitable habitat for three large forest owls. In addition to the Powerful Owl, these are:

- Masked Owl (Tyto novaehollandiae); and
- Barking Owl (Ninox connivens).

These three large forest owl species are all listed as Vulnerable under the TSC Act. All three owls have very large foraging ranges and require tall hollow-bearing trees as nesting habitat. Suitable roost and nest habitat for all of these species occurs primarily in the taller forest communities of the Project Boundary. The more open grassy woodland of the Project Boundary would also provide foraging habitat for both the Masked and Barking Owls. Although the Masked Owl or Barking Owl were not recorded during the current nor previous surveys it is possible that suitable habitat within the Project Boundary may form a component of a much larger home range for either or both of these species.

The Square-tailed Kite (*Lophoictinia isura*) has been recorded foraging in the Project Boundary. The species is listed as Vulnerable under the TSC Act and requires a large hunting range of forest/woodland habitat, particularly containing timbered watercourses. Being a specialist hunter of passerines, particularly honeyeaters, it is likely that the blossom periods of dominant trees within the Project Boundary would attract prey species for the Square-tailed Kite. It is likely that the Square-tailed Kite utilises the Project Boundary for foraging and that it is a component of a much larger home range.

Habitat assessments indicated that the site provides suitable foraging, shelter and breeding habitat for a range of common bird species, in addition to numerous species listed as threatened or migratory under both the EPBC Act and the TSC Act. The Project Boundary provides suitable habitat for birds dependent on tall wet forest communities as well as for woodland and grassland-dependent birds.

c. Mammals

During the current surveys two State listed threatened mammal species were recorded from within the Project Boundary. These were:

- Squirrel Glider (*Petaurus norfolcensis*) (Vulnerable under the TSC Act);
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) (Vulnerable under the TSC Act); and

- The threatened mammal species that have either been recorded within the Project Boundary during Project surveys or are considered to have potential to occur are discussed below.

Arboreal Mammals

Two individual Squirrel Gliders (*Petaurus norfolcensis*) listed as Vulnerable under the TSC Act were detected while spotlighting in the East Tyldesley portion of the Project Boundary during the April 2009 survey (**Figure 3.4)**. Although these were the only individuals recorded, habitat assessment indicates that suitable habitat for the Squirrel Glider occurs throughout the Project Boundary. It is therefore likely that this species would occur in other portions of the Project Boundary where suitable habitat occurs.

The Koala (*Phascolarctos cinereus*) is listed as Vulnerable under the TSC Act. This species was not recorded within the Project Boundary during current and previous surveys. Habitat assessments during the current surveys indicated that some portions of the Project Boundary support primary and secondary food tree species for the Koala. Feed tree species occurring within the Project Boundary include Grey Gum (*Eucalyptus punctata*) and Ribbon Gum (*Eucalytpus viminalis*). Although Koalas have the potential to occur within the Project Boundary, the absence of records during current and previous surveys indicates that abundance here would be low.

The Eastern Pygmy-possum (*Cercartetus nanus*) is listed as vulnerable under the TSC Act. This species was not recorded during current or previous surveys. The Eastern Pygmy-possum is found in a broad range of habitats, including forest and woodland communities similar to those occurring within the Project Boundary. Although not recorded during surveys, nearby DECCW records combined with habitat assessments indicate that this sometimes cryptic species could possibly occupy suitable habitat within the Project Boundary.

During the current surveys a range of arboreal mammals were recorded within the Project Boundary. The highest diversity of arboreal mammal species were recorded from the tall forest communities of the Project Boundary, that provide suitable forage and tree hollows for large species such as the Greater Glider (*Petauroides volans*), and smaller gliders such as the Squirrel Glider (*Petaurus norfolcensis*), listed Vulnerable under the TSC Act and Sugar Glider (*Petaurus breviceps*), as well as Common Brushtail Possums (*Trichosurus vulpecula*) and Common Ringtail Possums (*Pseudocheirus peregrinus*). Although not recorded during the current or previous surveys, the Project Boundary also provides suitable habitat for the Yellow-bellied Glider (*Petaurus australis*), listed Vulnerable under the TSC Act.

Microbats

Habitat assessments indicated that a number of hollow-bearing dead and living trees within the Project Boundary would provide suitable roosting and breeding habitat for hollow dwelling species known to occur in the locality. The sandstone escarpments of the Project Boundary also provide suitable roosting or breeding habitat for cave-dependent microbats recorded during the current and previous surveys (Wildsearch, 1997) and known to occur in the locality. Although each of these bat species has specific habitat requirements for roosting and breeding, many utilise a variety of forest, woodland and grassland communities as foraging habitat. Given the extent of these habitats within the Project Boundary, microbats known to occur in the locality could potentially forage within the Project Boundary on occasion.

The following State listed threatened micro-bats were recorded during current and previous surveys of the Project Boundary.

One individual Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) listed as Vulnerable under the TSC Act was captured in a harp trap during the October 2009 survey. In addition, numbers of Eastern Bent-wing Bats were recorded from Anabat bat call detection at several places throughout the Project Boundary. The Eastern Bent-wing Bat breeds annually in spring and summer in maternity caves, with populations dispersing within about 300 km range of maternity caves when not breeding. At these times this species will roost predominantly in caves but may also utilise culverts, mine shafts and the roofs of artificial structures. The sandstone escarpments of the Project Boundary are likely to support suitable roosting and breeding habitat while the forests, woodlands and to a lesser extent semi-cleared grasslands could provide suitable forage for the Eastern Bent-wing Bat.

The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), listed as Vulnerable under the TSC Act was not recorded within the Project Boundary during the current surveys; however previous surveys (Wildsearch 1996) indicate one probable record of this species. Further, a recent Atlas record (dated 2003) is located within the Project Boundary. This species utilises tree hollows as roosting and breeding habitat and, unlike the previously discussed species, is not cave-dependant. The forest and woodland communities within the Project Boundary provide an abundance of suitable roosting, breeding and foraging habitat for this species.

The following State listed threatened micro-bats have been historically recorded within the Project Boundary.

The Eastern Freetail-bat (*Mormopterus norfolkensis*) is listed as Vulnerable under the TSC Act and has not been recorded during current or previous surveys of the Project Boundary. There is however, a recent OEH Atlas record (dated 2003) located within the Project Boundary. This species utilises tree hollows as roosting and breeding habitat. The forest and woodland communities within the Project Boundary provide an abundance of suitable roosting, breeding and foraging habitat for this species.

The Greater Broad-nosed Bat (*Scoteanax rueppellii*) is listed as Vulnerable under the TSC Act and has not been recorded during current or previous surveys of the Project Boundary. There is however, a recent OEH Atlas record (dated 2003) located within the Project Boundary. This species utilises predominantly tree hollows as roosting and breeding habitat. The forest and woodland communities within the Project Boundary provide an abundance of suitable roosting, breeding and foraging habitat for this species.

In addition to the threatened microbats recorded during previous and current surveys, the Project Boundary may also provide suitable foraging and roosting habitat for the Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) (Vulnerable under the TSC Act).

This microbat species has not been recorded within the Project Boundary during the current or previous surveys, habitat assessments indicate that the Project Boundary would provide suitable foraging and roosting habitat for all of these species. The occurrence of any of these threatened microbats within the Project Boundary cannot therefore be completely discounted.

3.4.3 Common Species

i. Amphibians

The small dams within the Project Boundary provide permanent water sources constituting habitat for a number of common amphibian species including *Crinia signifera, Limnodynastes peronii, Limnodynastes tasmaniensis* and *Litoria peronii.* A total of eight amphibian species were recorded within the Project Boundary during the current and previous surveys (refer to **Appendix B**).

ii. Reptiles

A total of 13 common reptile species including six skinks, five lizards and monitors, one snake and one gecko were recorded during active searches of various sites throughout the Project Boundary (refer to Appendix B). It is likely that a number of additional common species would also occur as indicated by previous surveys (Wildsearch 1996), as the Project Boundary provides suitable forest and woodland habitat for many of the reptiles known to occur in the wider locality. None of the reptile species recorded is listed as threatened under the TSC or EPBC Acts.

iii. Birds

Habitat assessment and fauna survey results indicate that the Project Boundary provides suitable foraging habitat for a range of common diurnal raptors, cockatoos, owls and small woodland birds and potential foraging habitat for some threatened species. However, the large trees within riparian habitats required by some raptors for nesting were largely absent from within the Project Boundary. The area also provides suitable foraging habitat for a range of forest and woodland-dependent owls. The tall forest communities within the Project Boundary provide abundant forage, roosting and nesting opportunities for these species.

iv. Mammals

Despite the presence of relatively good habitat for terrestrial mammals, the results of the current and previous surveys indicate that the Project Boundary supports only a low abundance and diversity of small terrestrial mammals. Only two native small terrestrial mammal species were recorded during the current and previous surveys. Surprisingly, introduced species that are commonly recorded in disturbed habitats (e.g. House Mouse and Black Rat) were absent during the surveys. The low diversity and abundance of small terrestrial mammals is likely to be a result an abundance of introduced (feral) predators such as the European Red Fox (*Vulpes vulpes*).

Records of native terrestrial fauna within the Project Boundary during the current and previous surveys are dominated by larger species, including macropods, Short-beaked Echidna (*Tachyglossus aculeatus*), and Common Wombat (*Vombatus ursinus*). These species are generally more resilient to disturbance and predation, and are able to traverse larger areas of cleared land to migrate back into regenerating communities such as those within the Project Boundary.

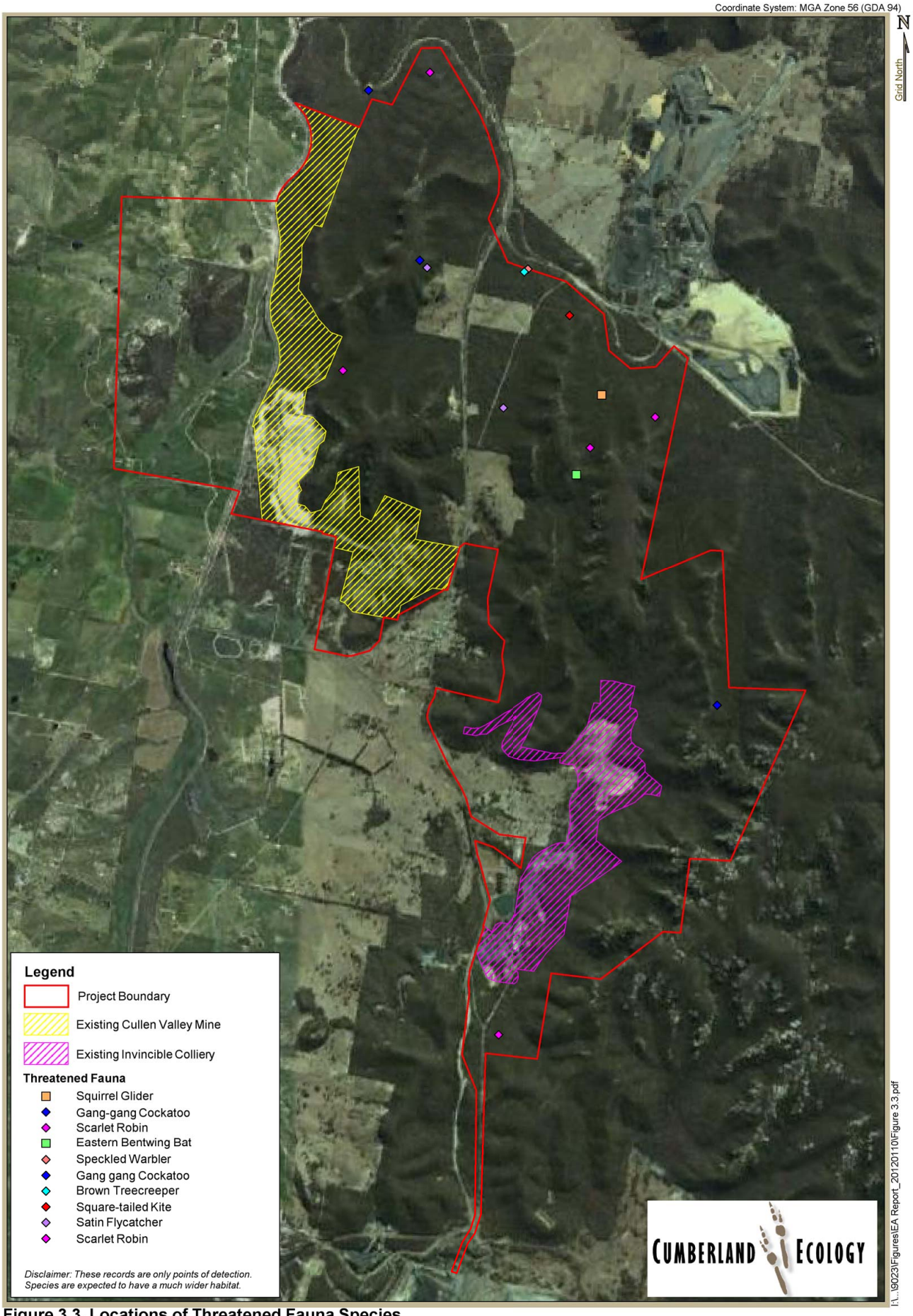


Figure 3.3. Locations of Threatened Fauna Species in the Project Boundary

23 March 2012

Chapter 4

Impact Assessment

4.1 Introduction

This Chapter considers the ecological impacts of the Project on the biodiversity values of the Project Boundary. The draft Part 3A guidelines (DEC and DPI, 2005) identify the following key thresholds for consideration when assessing the impacts of development proposals:

- Whether or not the proposal, including actions to avoid or mitigate impacts or *compensate to prevent unavoidable impacts will maintain or improve biodiversity values;*
- Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community;
- Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction; and
- Whether or not the proposal will adversely affect critical habitat.

The ecological impacts of the Project on the biodiversity values within the Project Boundary are mostly related to habitat removal and fragmentation within the open cut disturbance footprint. The predicted subsidence from highwall mining is less than 20mm (Geonet 2011) and therefore the surface impacts are generally related to open cut mining disturbance areas. Subsidence impacts are discussed in **Section 4.3.4**.

The kinds of impacts are similar for both flora and fauna as a large area of forest and woodland will be removed that provide significant habitat for native flora and fauna species, including several threatened species and an endangered ecological community. Despite some area of forest and woodland in the Project Boundary being subject to logging and partial clearing, much of it is still in good ecological condition.

4.2 Vegetation/Habitat Removal

4.2.1 Local Scale

The largest direct impact of the Project is the removal of habitat for flora, fauna and ecological communities. Approximately 835 ha of forest and woodland habitats will be removed by the Project, comprising of a suite of communities as shown in **Table 4.1** and **Figure 4.1** below. These vegetation communities provide habitat for a range of flora and fauna, including species listed as threatened or migratory under the EPBC Act and/or TSC Act.

Of the 835 ha, approximately 818 ha is non-listed native forest and woodland communities and will also be removed through open cut extraction techniques. The vegetation communities that would be most significantly impacted by the Project include Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Forest, Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest, Tableland Gully Ribbon Gum – Blackwood Apple Box Forest and Tableland Scribbly Gum Narrow-leaved Stringybark Shrubby Open Forest. These communities occur in the valley and lower to mid slopes. The least impacted communities are the ones which grow on the plateaus and upper slopes under which highwall mining will occur.

Table 4.1 provides a summary of each vegetation community within the Project Boundary, the extent within the Project Disturbance Boundary which is proposed for removal and the area of each community being retained.

Table 4.1 Summary of Vegetation Areas within the Project Boundary and Within the Project Disturbance Boundary

Vegetation Community	Area of Vegetation in the Project Boundary (ha)	Area within Project Disturbance Boundary (ha)	Area retained within Project Boundary (ha)
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (EPBC)	46.18	16.21	29.97
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (EPBC)	0.27	0.27	0.00
Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy	0.12	0.11	0.01
Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (TSC EEC)	1.99	1.96	0.03
Tableland Gully Ribbon Gum Blackwood Applebox Forest	111.81	93.94	17.87
Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland	16.62	15.02	1.60
Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest	332.43	112.51	219.91
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland	13.71	13.02	0.68

Table 4.1 Summary of Vegetation Areas within the Project Boundary and Within the Project Disturbance Boundary

Vegetation Community	Area of Vegetation in the Project Boundary (ha)	Area within Project Disturbance Boundary (ha)	Area retained within Project Boundary (ha)
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland Low Diversity Derived Native Grassland	215.23	42.72	172.51
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest	260.86	185.77	75.09
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest Derived Native Grassland	57.07	50.10	6.97
Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest	51.70	18.87	32.84
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland	12.84	12.43	0.41
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland	2.79	0.85	1.94
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest	0.90	0.00	0.90
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland	23.35	0.00	23.35
Pagoda Rock Sparse Shrubland	32.87	0.05	32.83
Cox's Permian Red Stringybark - Brittle Gum Woodland	92.02	23.71	68.31
Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	679.11	370.43	308.68
TOTAL	**1951.88**	**957.98**	**993.90**

The area of direct impact has been calculated from the extent of the Project Disturbance Boundary as shown on **Figure 4.1**. The majority of vegetation to be cleared will be from within intact areas of forest and woodland. In addition to the direct removal of these native vegetation communities, the Project will also negatively affect vegetation that will remain by additional fragmentation, isolation impacts and edge effects. The Project has the potential to remove large areas of good quality habitat within the western portions of Ben Bullen State Forest.

The direct removal of open forest and woodland will impact the vegetation communities of the Project Boundary, both threatened and non-listed, by reducing their overall extent. This includes approximately 16.48 ha of CEEC Box-Gum Woodland and Derived Native Grassland which is discussed further in **Section 4.2.3**.

The direct removal of vegetation communities is likely to result in the following impacts to remaining habitat by:

- Removing or reducing the availability of important habitat features that may offer forage, shelter or breeding opportunities for fauna, thus putting more pressure on remaining habitat to provide these features;
- Exacerbating some fragmentation and isolation (this is considered low as the woodland is within forest);
- Increasing edge effects, particularly along linear patches;
- Reducing connectivity by removing areas of woodland and forest that would serve as "habitat corridors" for mobile fauna;
- Reducing nutrient and water cycling through the system;
- Loss of soil to wind or water erosion as a result of the lack of groundcover shelter; and
- Removing important pollinators such as birds, bats and insects critical for the pollination of native plants.

Offset strategies have been developed to address and mitigate such predicted impacts. These are discussed in **Chapter 6**.

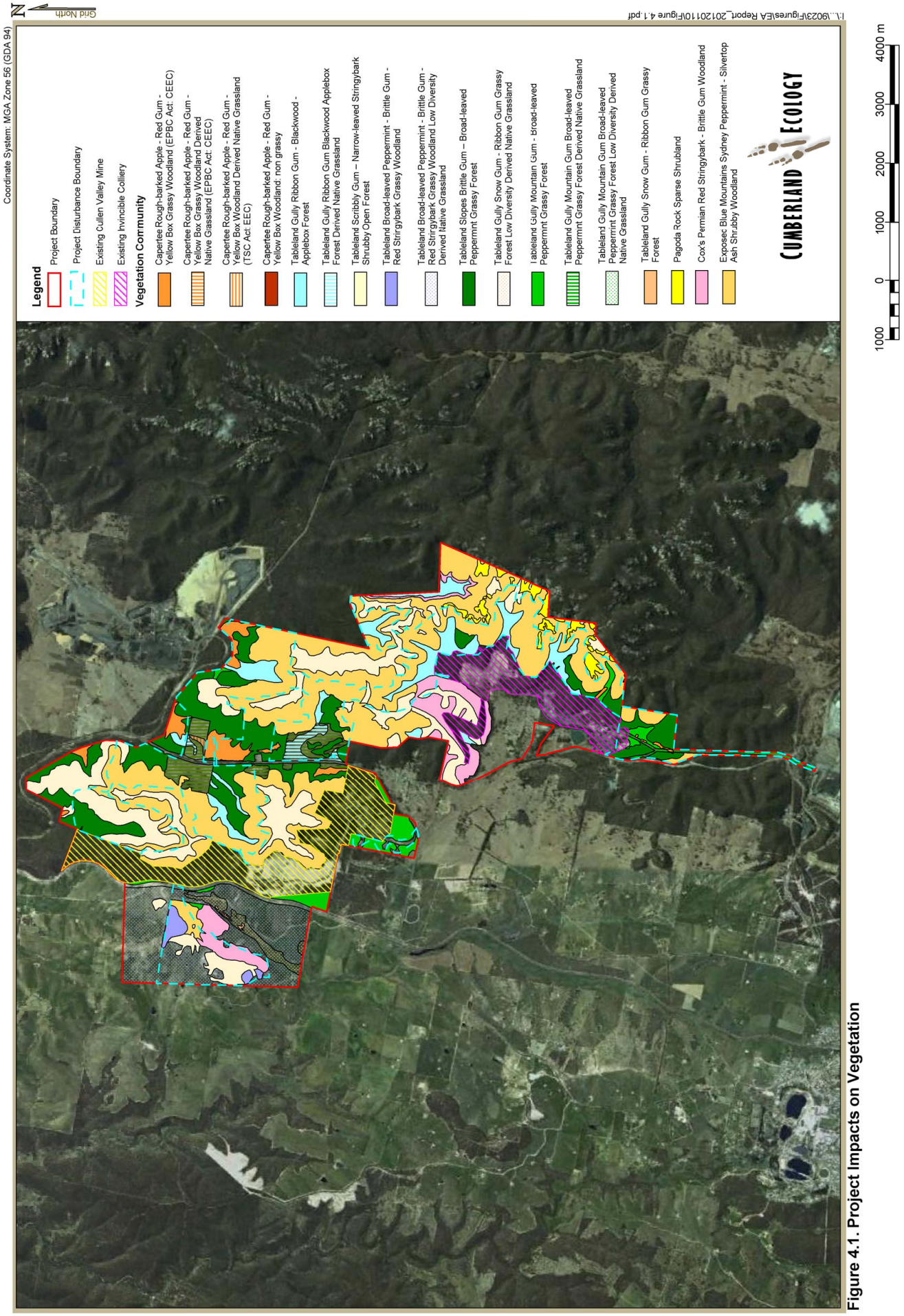


Figure 4.1. Project Impacts on Vegetation

4.2.2 Regional and State-wide Scale

Due to the location of the Project impacts in a Bioregional, Catchment Management Authority (CMA) and State-wide contexts have been assessed. These are provided in more detail below.

i. Summary of Impacts in a Bioregion Context

The Project lies along the western edge of the Sydney Basin Bioregion. The vegetation communities to be removed within the Project Disturbance Boundary are well represented throughout the Sydney Basin Bioregion. Such habitats are also well conserved as there are broad areas of similar habitat that are protected in Wollemi National Park, Gardens of Stone National Park and the Blue Mountains National Park. There are also large areas of similar habitat within Newnes State Forest and Sunny Corner State Forest.

The Project will have a significant impact on the biodiversity values of the Project Boundary in the short term. However, the Sydney Basin Bioregion (3,627,008 ha in total) supports extensive areas of habitat in conservation tenure and has the third highest area of conservation-oriented tenures of the NSW bioregions. Together, they occupy about 1,384,418.33 hectares or 38.20 per cent of the bioregion for the EECs, threatened flora and threatened fauna that will be impacted by the Project. State Forests cover 178,066 hectares or 4.91% of the bioregion. The Project constitutes 0.4% of all State Forests within the bioregion.

ii. Summary of Impacts in a Regional Context

The Project Boundary lies within the eastern edge of the Central West Catchment. The CW Catchment covers 8,484,200 ha. The catchment is flanked by the Barwon and Darling catchments to the north and west, Lachlan to the south and the Sydney/Shoalhaven Basin to the east. Intact native vegetation covers around 30% of the region and overall extent is below the state average (DECCW, 2010c). Vegetation condition rated only fair as most vegetation communities show some degree of modification. Greatest modification, by area, is associated with dryland agriculture and plantations (DECCW, 2010c).

To assess impacts on a regional scale the best available information was used. Although DEC (2006) of the Central West Catchment is not as detailed or accurate as the vegetation mapping conducted in the Project Boundary for this assessment, it still provides indicative areas of similar vegetation types mapped throughout the entire catchment.

The Central West Catchment Management Authority (CWCMA) commissioned a vegetation mapping study of the catchment "*Reconstructed and Extant Distribution Native Vegetation in the Central West Catchment*" (DEC 2006) to show the extent and importance of native vegetation. The study identified 81 broad vegetation types (BVTs) in the catchment, shown in the form of a map detailing existing vegetation coverage, alongside a reconstructed "Pre-European Clearing" map. Using this mapping project, it has been estimated that approximately 38% of the Central West catchment is currently vegetated to some extent and 62% has been cleared. Grasslands within the Project Boundary were not included in this mapping project.

The Project will remove the following percentages of similar vegetation estimated to currently extend across the CW Catchment:

- 0.86% of Mountain Gum – Red Stringybark Open Forest at High Altitudes;
- 0.39% of Mountain Gum – Peppermint Forest at High Altitudes;
- 0.21% of Scribbly Gum Woodland;
- 0.27% of Stringybark – Box – Gum Woodland; and
- 0.57% of Sydney Sandstone Woodland/Open Forest.

In total the Project will remove 835 ha, which constitutes 0.21% of the above mentioned vegetation types estimated to cover the CW Catchment.

The Project will remove 835 ha of forest and woodland which constitutes 0.01% of all forest and woodland mapped within the CW Catchment.

iii. Summary of Impacts in a State-wide Context

The NSW State covers approximately 80,160,000 ha.

The Project will remove the following percentages of vegetation classes estimated to currently extend across the entire State:

- <0.001% of Western Slopes Grassy Woodland;
- 0.067% of Southern Tableland Grassy Woodland;
- 0.051% of Southern Tableland Dry Sclerophyll Forest;
- 0.001 of Sydney Montane Heath; and
- 0.206% of Sydney Montane Dry Sclerophyll Forest.

In total the Project will remove 0.06% of the abovementioned forest and woodlands occurring within NSW.

Table 4.2 provides a summary of impacts from the removal of each vegetation community on a local scale (Project Boundary), CW Catchment (CWCMA 2008) and state-wide scale (NSW). The table also provides an estimated extent and percentage reduction of each vegetation community within the Project Boundary, region and NSW. The Western Blue Mountains mapping exercise (DEC 2006) does not cover the Project Boundary and thus percent reductions cannot be calculated.

Note: When calculating the percentage loss within NSW the lowest estimated extent of remaining vegetation provided in Keith (2004) was used as a precautionary approach and to compensate for clearing since publication in 2004.

Table 4.2 Summary of Percentage Loss of Vegetation within Project Boundary, CW Catchment and NSW

Vegetation Community (DEC 2006)	Central West Catchment Broad Vegetation Type	Vegetation Class	Area of Vegetation in the Project Boundary (ha)	Area within Project Disturbance Boundary (ha)	Area retained within Project Boundary (ha)	CWCMA Extent (ha)	% removed within CW Catchment	Extent of vegetation within NSW (ha)	% Removed within NSW
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (EPBC)	Stringybark - Box - Gum Woodland	Western Slopes Grassy Woodland	46.18	16.21	29.97	224,242.13	0.007%	500,000-900,000	0.0032%
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (EPBC)	Stringybark - Box - Gum Woodland	Western Slopes Grassy Woodland	0.27	0.27	0.00	224,242.13	0.000%	500,000-900,000	0.0001%
Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy	Stringybark - Box - Gum Woodland	Western Slopes Grassy Woodland	0.12	0.11	0.01	224,242.13	0.000%	500,000-900,000	0.0000%
Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (TSC EEC)	Stringybark - Box - Gum Woodland	Western Slopes Grassy Woodland	1.99	1.96	0.03	224,242.13	0.001%	500,000-900,000	0.0004%
Tableland Gully Ribbon Gum Blackwood Applebox Forest	Mountain Gum – Peppermint Forest at High Altitudes	Southern Tableland Grassy Woodland	111.81	93.94	17.87	28,651.11	0.328%	140,000-230,000	0.0671%
Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland	n/a	n/a	16.62	15.02	1.60	n/a	n/a	n/a	n/a

Table 4.2 Summary of Percentage Loss of Vegetation within Project Boundary, CW Catchment and NSW

Vegetation Community (DEC 2006)	Central West Catchment Broad Vegetation Type	Vegetation Class	Area of Vegetation in the Project Boundary (ha)	Area within Project Disturbance Boundary (ha)	Area retained within Project Boundary (ha)	CWCMA Extent (ha)	% removed within CW Catchment	Extent of vegetation within NSW (ha)	% Removed within NSW
Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest	Inland Scribbly Gum Woodland	Southern Tableland Dry Sclerophyll Forests	332.43	112.51	219.91	53,049.15	0.212%	650,000-1,250,000	0.0173%
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland	Mountain Gum – Red Stringybark Open Forest at High Altitudes	Southern Tableland Dry Sclerophyll Forest	13.71	13.02	0.68	81,070.92	0.016%	650,000-1,250,000	0.0020%
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland Low Diversity Derived Native Grassland	Mountain Gum – Red Stringybark Open Forest at High Altitudes	Southern Tableland Dry Sclerophyll Forest	215.23	42.72	172.51	n/a	n/a	n/a	n/a
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest	Mountain Gum – Peppermint Forest at High Altitudes	Southern Tableland Dry Sclerophyll Forest	260.86	185.77	75.09	81,070.92	0.229%	650,000-1,250,000	0.0286%
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest Derived Native Grassland	n/a	n/a	57.07	50.10	6.97	n/a	n/a	n/a	n/a

Table 4.2 Summary of Percentage Loss of Vegetation within Project Boundary, CW Catchment and NSW

Vegetation Community (DEC 2006)	Central West Catchment Broad Vegetation Type	Vegetation Class	Area of Vegetation in the Project Boundary (ha)	Area within Project Disturbance Boundary (ha)	Area retained within Project Boundary (ha)	CWCMA Extent (ha)	% removed within CW Catchment	Extent of vegetation within NSW (ha)	% Removed within NSW
Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest	Mountain Gum – Peppermint Forest at High Altitudes	Southern Tableland Dry Sclerophyll Forest	51.70	18.87	32.84	28,651.11	0.066%	650,000-1,250,000	0.0029%
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland	n/a	n/a	12.84	12.43	0.41	n/a	n/a	n/a	n/a
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland	n/a	n/a	2.79	0.85	1.94	n/a	n/a	650,000-1,250,000	0.0001%
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest	Mountain Gum – Peppermint Forest at High Altitudes	Tableland Clay Grassy Woodland	0.90	0.00	0.90	28,651.11	0.000%	160,000-250,000	0.0000%
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland	n/a	n/a	23.35	0.00	23.35	n/a	n/a	n/a	n/a
Pagoda Rock Sparse Shrubland	no match	Sydney Montane	32.87	0.05	32.83	no match	n/a	60,000-100,000	0.0001%

Table 4.2 Summary of Percentage Loss of Vegetation within Project Boundary, CW Catchment and NSW

Vegetation Community (DEC 2006)	Central West Catchment Broad Vegetation Type	Vegetation Class	Area of Vegetation in the Project Boundary (ha)	Area within Project Disturbance Boundary (ha)	Area retained within Project Boundary (ha)	CWCMA Extent (ha)	% removed within CW Catchment	Extent of vegetation within NSW (ha)	% Removed within NSW
		Heath				available			
Cox's Permian Red Stringybark - Brittle Gum Woodland	Mountain Gum – Peppermint Forest at High Altitudes	Southern Tableland Dry Sclerophyll Forest	92.02	23.71	68.31	81,070.92	0.029%	650,000-1,250,000	0.0036%
Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	Sydney Sandstone Woodland	Sydney Montane Dry Sclerophyll Forest	679.11	370.43	308.68	65,131.33	0.569%	180,000-240,000	0.2058%
TOTAL			**1951.88**	**957.98**	**993.90**	**452,144.65**	**0.212%**	**1,690,000**	**0.0588%**
TOTAL (all forest and woodland)			**1951.88**	**834.62**	**787.08**	**5,950,301.85**	**0.014%**	**21,017,500**	**0.004%**

**The lowest extent of remaining vegetation supplied in Keith's estimates has been used for calculations. For- example, 180,000 ha of Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Forest was used, not 240,000 ha. Grasslands were not included in this calculation as Keith's estimates covers forest and woodland, not secondary grasslands.*

4.2.3 Project Impacts on Ecological Communities

i. Assessing Impacts to Threatened Biodiversity

There is no legal requirement to prepare an Assessment of Significance (also called the "Seven-part Test") when preparing an Environmental Assessment under Part 3A of the EP&A Act. However, a number of "Seven-part Tests" have been prepared as a risk assessment tool to determine which threatened flora and fauna listed under the TSC Act are most at risk from the Project (**Appendix I**). These tests examine threatened ecological communities, populations and species that are known or have a high potential to occur within the study area, as assessed in a Likelihood of Occurrence Table (**Appendices E & F**).

The Assessments of Significance indicate that without mitigation or compensation measures, the Project will have a significant impact upon Box Gum Woodland, *Eucalyptus cannonii* and TSC Act listed threatened fauna (**Appendix I**). Without mitigation or compensatory measures, the Project will result in a net loss of forest and woodland habitat (approximately 835 ha) for threatened species, exacerbate key threatening processes, such as native vegetation removal and tree hollow loss and degrading remaining habitat by increasing the degree of isolation between existing patches of habitat.

In consideration of this, the Project includes ameliorative measures to mitigate the potential impacts on biodiversity. Rehabilitation and ongoing management of vegetation will take place within the Project Boundary to reduce the net loss of habitat for threatened species in the long-term. A Biodiversity Offset Strategy is proposed for the Project to compensate for the loss of vegetation and Threatened Ecological Communities (TECs) and will focus on re-establishing local and regional habitat links to provide an effective biodiversity corridor for the long term.

Chapter 5 presents a summary of recommended mitigation and compensation measures to minimise adverse impacts resulting from the Project.

ii. Impacts to Threatened Ecological Communities

The Project will result in a reduction in the local and regional abundance and distribution of various vegetation communities, including one TEC. Assessments of Significance (**Appendix I**) have been prepared to assess the impact of the Project on this community and the estimated areas of direct impact are presented in **Table 4.1**.

a. Box Gum Woodland and Derived Native Grassland

Capertee Rough-barked Apple Red Gum Yellow Box Woodland constitutes Box Gum Woodland and Derived Native Grassland listed as a Critically Endangered Ecological Community under the EPBC Act and an Endangered Ecological Community under the TSC Act.

The definition of EPBC Act Box Gum Woodland and Derived Native Grassland overlaps with that of the TSC Act. However, the former pertains to higher quality remnants and is defined more precisely according to the composition of the native understorey and ground stratum. All CEEC Box Gum Woodland and Derived Native Grassland listed under the EPBC Act is therefore also covered by the TSC Act. However, some of the lower condition woodland or grassland that is covered by the TSC Act definition of Box Gum Woodland and Derived Native Grassland does not meet the appropriate condition for consideration under the EPBC Act. This is further explained below.

EPBC Act/TSC Act vegetation: Vegetation conforming to CEEC Box Gum Woodland listed under the EPBC Act has native canopy, understorey and ground stratum. The canopy is dominated or co-dominated by Blakely's Red Gum and/or Yellow Box trees and has a predominantly native understorey. Within a sampling area of 0.1 ha at least 12 non-grassy understorey species (such as forbs, shrubs, ferns, sedges and monocots other than grasses) were recorded. In areas mapped as CEEC Box Gum Woodland Derived Native Grassland, evidence from adjacent vegetation and landform suggest that Blakely's Red Gum and/or Yellow Box would originally have occurred. As per the CEEC Box Gum Woodland, areas of grasslands are dominated by native species and contain at least 12 non-grassy understorey species within a 0.1 ha sample area.

TSC Act vegetation: The lower quality vegetation conforming solely to the TSC Act does not currently have an overstorey of Blakely's Red Gum and/or Yellow Box, though these species are predicted to have once occurred before historic clearing took place. Though no mature trees are present, there is evidence of natural regeneration of the canopy as a small numbers of Blakely's Red Gum saplings were recorded. The understorey is predominantly native and would respond to assisted natural regeneration. However ground stratum diversity is relatively low, with less than the requisite 12 non-grassy Box Gum species per sampling area of 0.1 ha that is required for consideration of Box Gum Woodland and Derived Native Grassland under the EPBC Act.

Box Gum Woodland is geographically widespread but is now highly fragmented and is found along the slopes and tablelands of Queensland and NSW and throughout the ACT to Victoria (DECCW (NSW) 2010a). Prior to European settlement the community formed an almost continuous band comprising of several million hectares (DECCW (NSW) 2010a). It has been used and continues to be used extensively for agriculture, such as for livestock grazing and cropping. It is under represented in the reserve system and the main remnants of it are under ongoing threat from agricultural usage. According to DEC (2006) Stringybark – Box – Gum Woodland covers 224,242 ha within the catchment. Within NSW, Keith (2004) estimates Western Slopes Grassy Woodland covers between 500,000 and 900,000 ha (0.6-01.1%).

Since the CEEC remains poorly represented in the national conservation reserve system (being situated largely on fertile, arable land) the conservation of remaining remnants are critical to the recovery of the CEEC and thus the Key Threatening Processes "*Clearing of native vegetation*" (TSC Act) and "*Land Clearance*" (EPBC Act) have been named as the most prevalent threats to this community (DECCW (NSW) 2010a).

As a result of the Project, there will be the progressive removal of woodland. Clearing of vegetation may increase edge effects on the retained portion of Box Gum Woodland and as a result, the community may be impacted by altered microclimates, weed invasion and soil erosion. Some of the remaining areas of Box Gum Woodland within the Project Boundary will be subject to highwall mining, and impacts are expected to be minimal.

Within the Project Boundary, Box Gum Woodland occurs largely as mostly Condition C. This transpires within quadrat data recorded within the community, as low counts of weed species were recorded (see **Appendix A**). However, there is evidence of past clearing within Project Boundary as the majority of gully vegetation contains re-growth size trees. Approximately 46.48 ha of Capertee Rough-barked Apple – Red Gum – Yellow Box Woodland and Derived Native Grassland occur in the Project Boundary.

Under the mine plan proposed for the Project, approximately 16.21 ha of Box Gum Woodland (Condition C) and 0.27 ha of Derived Native Grassland (Condition B) conforming to the EPBC Act will be removed. The Project will also remove 1.96 ha of Box Gum Woodland Derived Native Grassland conforming to only the TSC Act, totalling 18.44 ha of Box Gum Woodland and Derived Native Grassland. Overall this accounts for 35% of Capertee Rough-barked Apple – Red Gum – Yellow Box Woodland within the Project Boundary, 0.02% Stringybark – Box – Gum Woodland within CW Catchment and 0.003% within NSW. This has been summarised in a Table 4.2.

In the short-term and without appropriate mitigation and amelioration measures, the removal of approximately 18.44 ha of Box-Gum Woodland and Derived Native Grassland would have a significant impact on a local scale. However, the total area proposed to be cleared is not significant in the region as thousands of hectares (224,242 ha) remain. The key issue for this vegetation in the region is the relative lack of reservation of such vegetation. The proponent has arranged for substantial avoidance, mitigation and offsetting of this vegetation type and this will add to the area reserved in the region. The proponent has redesigned the mine plan, thus avoiding 30 ha or 65% of this vegetation within the Project Boundary to maintain genetic diversity. In the long-term the Project will rehabilitate 16.48 ha of CEEC Box Gum Woodland and Derived Native Grassland (listed under the EPBC Act and TSC Act), 1.96 ha of EEC Box Gum Woodland and Derived Native Grassland (listed under the TSC Act) and recover and conserve 221.7 ha of CEEC Box Gum Woodland and Derived Native Grassland (listed under the EPBC Act) within offsets (refer to **Table 6.2**). Box Gum Woodland and Dervied Native Grassland listed under the EPBC Act are also covered by the TSC Act.

Rehabilitation of the ecological community can be expected to directly benefit the recovery of threatened species reliant on Box Gum Woodland (DECCW (NSW) 2010a).

An Assessment of Significance without considering mitigation or compensatory measures is provided in (**Appendix I)**.

4.2.4 Reduction in the Availability of Important Habitat Features

The distribution and abundance of flora and fauna varies on temporal and spatial scales and in relation to the ability of each species to exploit a set of environmental resources to maintain a viable population. Habitat selection and the value of a site are generally based on a bio-geographic range in which critical resources can be acquired. These include sufficient territory for a home range, macro and micro-physical habitat features and the availability of food, water, nest and/or den sites (Bookhout 1996).

Within these vegetation communities, a range of habitat features provide forage, shelter and breeding opportunities for fauna, the quality of which is dependent upon location and past land use. Remnant woodland patches support a higher diversity and abundance of habitat features, than regrowth areas which generally lack many habitat features. This is mainly because features such as ground debris and hollows have not had the opportunity to form because the trees are still young, or because they occur in areas that were, until recently, regularly cleared of ground habitat.

Important fauna habitat features that will be removed by the Project are:

- Structural diversity – as more vegetation layers support more niche habitats for various animals to shelter, forage and nest;

- Understorey vegetation – shelter and foraging habitat for amphibians, reptiles, small birds and terrestrial mammals;
- Fallen logs, woody debris and leaf litter – shelter habitat for amphibians, reptiles and terrestrial mammals, and forage habitat for woodland bird species;
- Hollow-bearing living trees and stags – essential habitat resources for range of fauna species which may rely on them for shelter, breeding or roosting. Loss of mature remnant hollow-bearing trees will have important implications for threatened species such as reptiles, birds, arboreal mammals and microbats;
- Nectar-producing trees and shrubs – foraging habitat for insects, blossom-dependant birds, arboreal mammals and megachiropteran bats (flying-foxes);
- Feed trees, shrubs and grasses for a range of species – food for a range of passerine birds and herbivorous mammals;
- Ecotonal (edge) communities – foraging habitat for many species, particularly birds such as raptors;
- Ephemeral drainage lines - foraging, shelter and breeding habitat for amphibians, aquatic reptiles, wetland birds and aquatic mammals;
- Constructed farm dams with aquatic vegetation - foraging and breeding habitat for amphibians, aquatic reptiles and wetland birds; and
- The impact of mining on habitat results in the clearance of vegetation and removal of fauna habitat features.

The impact of mining on fauna habitat results in the clearance of vegetation and removal of fauna habitat features. This process results in numerous actions considered to be Key Threatening Processes by OEH such as the Clearing of Native Vegetation (NSW Scientific Committee, 2004c), Loss of Hollow-bearing Trees (NSW Scientific Committee, 2006a), Removal of Dead Wood and Dead Trees (NSW Scientific Committee, 2004i) and Bushrock Removal (NSW Scientific Committee, 2004b).

i. Loss of Tree Hollows

Tree hollows are an essential resource for a number of fauna species that rely on them for refuge and nesting (Cockle et al., 2010, Newton, 1994, Heinsohn et al., 2003, Gibbons and Lindenmayer, 2002). Tree hollows have been shown to be a key limiting resource for hollow-dependent fauna (Lindenmayer et al., 1990, Newton, 1994, Heinsohn et al., 2003, Gibbons and Lindenmayer, 2002, Brawn and Balda, 1988, Cameron, 2006, Gibbons et al., 2002), especially considering the processes of natural decay and primary excavation that produce hollows are time-consuming and energy costly (Aitken and Martin, 2007, Aitken and Martin, 2008, Marsden and Pilgrim, 2003, Murphy and Legge, 2007). Furthermore, many hollow-dependent species such as the Swift Parrot (*Lathamus discolor*) are hollow specialists (as opposed to hollow generalists) and will only occupy hollows with specific hollow characteristics (Gibbons et al., 2002); this means that many of the available number of hollows in an area of habitat are unlikely to be usable or 'functional', which increases the demand on the remaining suitable hollows.

In spite of the history of logging and gathering of timber for firewood within Ben Bullen State Forest, many trees remaining within the forest have hollows; particularly within the gully and slopes vegetation communities. Of these, it is possible that only a small proportion of available hollows are likely to be functional (Cockle et al., 2008) and so the importance of this limited resource in the Project Boundary is likely to be high.

Hollow formation generally develops as a tree ages and is exposed for longer, and eventually becomes vulnerable to natural decay and weakening processes (Gibbons and Lindenmayer 2002). The likelihood of a tree being hollow-bearing is strongly associated with trunk diameter at breast height (DBH) and as a result of age and habit of the tree species (Gibbons and Lindenmayer 2002, Harper et al. 2004). In box-ironbark communities, this corresponds to old trees with a DBH of at least 60 cm, which is generally equivalent to at least 120-150 years old, or pre-European settlement ages (ECC 2001, Gibbons et al. 2008).

Over 300 Australian fauna species are reliant on hollows, and at least 40 species are commonly found within a given geographical region (Gibbons et al. 2002). As such, hollows are a resource in disproportionately high demand compared to the availability of suitable cavities (Lindenmayer et al. 1990, Newton 1994, Gibbons and Lindenmayer 2002, Heinsohn et al. 2003); a consequence of the low occurrence of remnant trees, age requirements, and the prolonged and energy intensive processes of natural decay and primary excavation that produce hollows (Aitken and Martin 2007, Murphy and Legge 2007, Aitken and Martin 2008). The distribution, diversity and abundance of hollow-dependent fauna is constrained by hollow density and specific characteristics of cavities (Remm et al. 2008). Many available hollows in an area are unlikely to be usable or 'functional' for many species, which increases the demand on remaining suitable hollows (Newton 1994, Cockle et al. 2010).

Much of this resource will be lost in the short term and medium term from within the Project Disturbance Boundary. Furthermore, fragmentation and edge effects will have consequences for the integrity of the remaining hollow-bearing forest (e.g. susceptibility to windblow). The loss of tree hollows will have important implications for threatened species such as bats, owls and some diurnal birds, as discussed below.

The recommended mitigation measures to minimise adverse impacts on tree hollows resulting from the mining process are described in detail in **Chapter 5**.

4.3 Impacts on Remaining Vegetation/Habitat

The direct impacts of the Project on flora, fauna and vegetation communities are mostly related to the removal of native vegetation which provides direct habitat for a wide diversity of species (see preceding sections). However, the Project will also have indirect impacts on the ecological values of the Project Boundary, including fragmentation, noise, dust, and erosion. These indirect impacts of the Project are considered in more detail below.

4.3.1 Habitat Fragmentation and Patch Size

The Project is likely to lead to habitat fragmentation by removing an extensive area of forest and woodland habitat of the Project Boundary.

Impacts of habitat loss can be exacerbated by fragmentation of vegetation that is not cleared (Lindenmayer et al. 1999). Fragmentation is the process whereby once continuous areas of habitat are divided into multiple smaller and discrete patches usually isolated from each other by significantly different environment. This is typically non-woodland or forest land such as grass or agricultural land, or artificial infrastructure (Primack 1993, Fahrig 2003, Manning et al. 2006). No remnant fragments are the same; they vary in size, shape, isolation age, forest type, age and type of surrounding vegetation, topography, level of disturbance, level of connectivity, etc (Lindenmayer et al. 1999, Peake 2006), which then influences flora and fauna assemblages.

In many cases, fragmentation and the resulting patch sizes can result in similar biodiversity outcomes to direct habitat removal (Bennett 1990, Reid 1999). Habitat connectivity and the extent and magnitude of impacts of isolation depend on the movement and dispersal capabilities of specific species. Patch size also determines the number of species and density of individuals or populations within an area. Within a cleared agricultural landscape, small patches of remnant woodland and forest can be very valuable for biodiversity conservation (ECC 2001, Fischer and Lindenmayer 2002b). However, for many woodland birds, the minimum area of habitat required to support and maintain viable populations of a species and prevent population declines is approximately 100 ha (Higgins and Peter 2002). This will also rely on the availability of suitable habitat features and associated forage, breeding or nesting resources, and the structural complexity of remaining habitat.

Indirectly, fragmentation can put stress on native flora and fauna by increasing intraspecific and interspecific competition for space and resources in areas of remaining habitat. Plants and other sessile organisms are usually directly destroyed, while mobile animals (especially birds and mammals) retreat into remnant patches of habitat (Fischer and Lindenmayer 2007). This can lead to crowding and increased competition between individuals and species.

Habitat isolation and barrier effects can also adversely impact on daily movements of species, particularly if they are unable or unwilling to move between suitable areas of fragmented habitat; disrupt the successful dispersal of juveniles (Cooper and Walters 2002); and in extreme circumstances, affect large-scale migratory patterns (Lindenmayer et al. 1999, Fischer and Lindenmayer 2002b). Species most vulnerable to barrier effects include smaller ground-dwelling species, species with low mobility and rare species as they are vulnerable to even a small reduction in movements as it can reduce genetic continuity within a population. Speckled Warblers and Brown Treecreepers are threatened woodland bird species found within the Project Boundary, and are particularly susceptible to fragmentation, a reduction in habitat size and distance between habitat patches which impacts on their dispersal capabilities. These impacts are discussed in greater detail in **Section 4.4** below.

Genetic isolation can lead to inbreeding and genetic drift problems for populations isolated within a fragment and reduce the effective population size (Primack, 1993). Species least vulnerable to barrier effects tend to be those that are highly mobile (e.g. birds and bats), although even these species can vary in their response to barriers (Bennett 1990).

The severity of impacts caused from isolation will vary from location to location and depend on a number of factors. At first glance some areas within the Project Boundary look likely to become isolated during mining. However, there will be staged vegetation clearance and staged rehabilitation of each mining block over 21 years, with the result that forest will be rehabilitated around the retained pagodas and cliffs so that vegetation on these areas becomes re-connected to other undisturbed vegetation in time. Impacts to flora diversity will be mitigated by seed collection which will aim to maintain genetic diversity in the Project Boundary. Impacts will vary between fauna groups and will depend on their mobility and willingness to move through the modified landscape. As found in the results of surveys the largest fauna group is birds, which are relatively mobile and will not be directly impacted by isolation of habitats. Highwall island impacts are likely to be reduced as areas of undisturbed habitat shall remain connected.

4.3.2 Reduction or Loss of Habitat Connectivity

Habitat connectivity refers to the connectedness between patches of suitable habitat (Franklin 1993, Taylor et al. 1993, Keitt et al. 1997). As previously explained, the determination of 'suitable' habitat can vary significantly between individual species and is highly dependent on the landscape (Beier and Noss 1998, Lindenmayer et al. 1999, Fahrig 2003).

The habitat within the Project Boundary would facilitate fauna movements, particularly as Ben Bullen State Forest is heavily forested and connected to extensive areas of contiguous remnant vegetation (Gardens on Stone National Park, Newnes State Forest, which are connected to Wollemi National Park). On a local scale, the removal of habitat within the Project Disturbance Boundary will fragment some areas within the Project Boundary. The sequence of mining and rehabilitation over the 21 years will help to reduce these impacts. The impacts to surrounding habitats outside the Project Boundary will be low for the reason that the Project is positioned on the western edge of Ben Bullen State Forest. To the west of the Project Boundary, large areas of farmland lie between the Project Boundary and Sunny Corner State Forest. Farmland and industrial land to the north of the Project Boundary also separates the Project Boundary from Gardens of Stone National Park; and the south is also fragmented by farmland. To the east, vast areas of similar habitat remain within areas of Ben Bullen State Forest and Newnes State Forest, the latter also connecting to the second largest park in NSW, Wollemi National Park, which covers 487,000 ha.

Notwithstanding the Project will greatly reduce an area of habitat for flora and fauna and the width of existing north-south corridors will not be greatly affected. That is affected not severed. Very large areas of connected sandstone habitat shall remain east of the Project. Due to farmland currently fragmenting habitats to the west, north and south, only highly mobile fauna species would overcome this current obstacle. This group would include mainly birds which would continue to travel through the landscape during Project mining.

On a regional scale the Project will remove 958 ha of habitat corridor situated on the western edge an even larger tract of protected national parks state forests covering more than 500,000 ha.

4.3.3 Edge Effects

The Project will result in habitat fragmentation which leads to "edge effects". This refers to changes in physical and biological conditions at an ecosystem boundary or interface between adjacent ecosystems (Fischer and Lindenmayer 2007), particularly between natural habitats such as forests and disturbed or developed land (Yahner 1988).

Edge effects can refer to abiotic microhabitat changes in light, temperature, moisture and nutrient levels; and biotic changes such as alterations in the composition and relationships between various flora and fauna species (Chen et al. 1990, Fischer and Lindenmayer 2007). The depth of penetration of edge effects within vegetation varies depending on the structural contrast between ecosystems, but can extend from between tens to hundreds of metres from the edge (Yahner 1988). These include microclimatic changes in light, temperature, humidity and wind, which can favour a suite of different species, including exotics, and therefore cause significant changes to the ecology of the patch (Lindenmayer and Fischer 2006). Impacts will occur at edges created between the Project Disturbance Boundary and areas of retained forest and woodland (Peake 2006). The measure of penetration is also correlated to slope, soil type and adjoining land use. For example, dry sclerophyll sandstone forest and other exposed habitats upslope of clearing will remain relatively intact. Conversely, edge effects of down slope habitats, particularly wetter environments are far more extensive if not managed.

The potential ecological impacts of the open cut could extend beyond the areas to be cleared and into areas of forest and woodland that are being retained. The edge effects could include changes in sunlight, humidity, water runoff and wind and erosion. There is a low potential for edge effects to occur in upslope or midslope areas as the highest risk of edge effects is from unmitigated erosion and surface water runoff. Therefore edge effects within the drier habitats are expected to be minimal and confined close to the edge of clearing. Such habitats include the following vegetation communities: Pagoda Rock Sparse Shrubland, Exposed Blue Mountains Sydney Peppermint Silvertop Ash Shrubby Woodland and Tableland Scribbly Gum Narrow-leaved Stringybark Shrubby Open Forest. Impacts down slope of clearing have the potential to be more widespread and penetrate significantly further from the cleared areas. For this reason Coalpac will implement best practice measures to control impacts from erosion, sedimentation and associated weed invasion.

As another example, the opportunistic Noisy Miner is a native edge specialist that favours disturbed habitats because they tend to have an open midstorey that does not support shrubs and trees of different ages classes (Clarke and Oldland 2007, Birds Australia 2011). The species tends to become dominant in remnant patches that are no longer structurally intact and aggressively, and successfully, excludes other native bird species from the area (Rawlings et al. 2010). They can penetrate up to 200 m into the interior of the fragment; hence why they are quick to colonise linear patches in particular.

As shown with the Noisy Miner, the size and shape of a remnant patch determines its susceptibility to further degradation as fragmentation increases the ratio of disturbed "edge" habitat to more intact "interior" habitat (Manu et al. 2007). Edges are typically warmer, drier and exposed to more wind than remnant interiors (Yahner 1988, Murcia 1995). Long, narrow, linear patches are most vulnerable to edge effects by increasing the area of exposure to invasion by exotic and invasive flora and fauna (Bryson and Carter 2004), fire, erosion (Pimentel and Kounang 1998), loss of structural diversity, increased nutrient loading and pollution (Yahner 1988, Fischer and Lindenmayer 2007).

Small fragments are therefore unfavourable for species such as the Black-chinned Honeyeater which require interior habitat, and several small, isolated forest patches will be able to maintain fewer species than a single intact forest of the same total area.

4.3.4 Subsidence

Subsidence can occur when the coal seam is removed and the rock strata overlying the mined section fracture and deform. The total subsidence of a surface point consists of two components, active and residual. In most cases active subsidence forms around 90% of the total subsidence, and usually occurs rapidly following mining. Residual subsidence is time-dependent and is due to readjustment and compaction within the goaf (area of fractured and fallen strata left after coal extraction). The degree of subsidence resulting from a particular mining activity depends on a number of site specific factors including: the mining method and design of the mine (percentage extraction), the strength and thickness of the coal seam being extracted, the ratio of the depth of overburden, the nature of the overlying strata and the depth of the seam and topography (NSW Scientific Committee , 2005). In extreme circumstances horizontal displacement can extend for more than one kilometre from mine workings (NSW Scientific Committee , 2005). These circumstances can occur from both longwall and bord and pillar underground mining methods.

Cracks in the surface due to mine subsidence can dramatically change surface and groundwater hydrology. Subsidence affects water dependant ecosystems and can dramatically alter functioning ecosystems including riparian habitats, hanging swamps and wetlands. Significant subsidence can also cause decreased stability of slopes and escarpments, contamination of groundwater by acid drainage, increased sedimentation, bank instability and loss, creation or alteration of riffle and pool sequences, changes to flood behaviour, increased rates of erosion with associated turbidity impacts, and deterioration of water quality due to a reduction in dissolved oxygen and to increased salinity, iron oxides, manganese, and electrical conductivity (NSW Scientific Committee , 2005).

Highwall mining is a low subsidence mining method that relies upon the stability of the overlying strata for success and so is designed to operate this way. Longwall extraction relies on the opposite effect and requires strata failure (and subsidence) for stress relief at depth to permit mining to proceed. Stability and subsidence impacts from the highwall mining component of the Project are estimated to be less than 20 mm (Geonet 2011) and would therefore be minimal (as defined by DMR, 2003). Monitoring of subsidence will be covered in the Biodiversity Management Plan (BMP) and Monitoring Program.

4.4 Impacts to Ben Bullen State Forest and Gardens of Stone Stage 2 State Conservation Area Proposal

4.4.1 Impacts to Ben Bullen State Forest

Ben Bullen State Forest covers approximately 6,783 ha. The Project is largely located within the State Forest, with approximately 1,442 ha of the Project Boundary (58%) lying within it. Of this, approximately 752 ha consist of the Project Disturbance Boundary and will be impacted. Therefore the Project will result in the progressive removal of 11% of Ben Bullen State Forest over 21 years, at an average rate of 36 ha per annum. The removal of forest and woodland will occur on the western edge of Ben Bullen State Forest.

Short term impacts to parts of Ben Bullen State Forest are expected to be high; however the progressive removal and subsequent rehabilitation will cause the long-term impacts to Ben Bullen State Forest to be low. Further, Coalpac are committed to continue high quality rehabilitation of Ben Bullen State Forest (see **Section 5.3.3**).

4.4.2 Impacts to Gardens of Stone Stage 2 State Conservation Area

The Colong Foundation for Wilderness has a proposal to expand the Gardens of Stone conservation area. The proposal, known as the Gardens of Stone Stage 2 (GOS2) covers an area approximately 39, 888 ha and consists of six divisions that are proposed to extend the Blue Mountains National Park and Gardens of Stone National Park by creation of two new conservation areas: Gardens of Stone State Conservation Area and Western Escarpment State Conservation Area. The division that the Project lies within is the Baal Bone and Long Swamp Division (BBLSD). The BBLSD has been nominated by the Colong Foundation for inclusion into GOS2 for its "massed pagoda 'villages' that stand above the diverse swampy plains".

Although the Project is located within the GOS2, it constitutes 1.3% of the proposed conservation area and the clearing of this vegetation is to be rehabilitated in stages. Moreover the proposed biodiversity offset areas will add to and complement some of the objectives of GOS2. The Project will not clear significant geological formations. It will not remove any pagoda villages or cliff lines within the Project Boundary. Of the 958 ha proposed to be disturbed by the Project, approximately 528 ha are located within the BBLSD. This constitutes approximately 6.8% of the total area of BBLSD. This value (528 ha) is lower because areas of Ben Bullen State Forest west of the Castlereagh Highway have not been included in the BBLSD of GOS2. Long-term impacts to GOS2 are likely to be low. Coalpac are committed to continuing high quality rehabilitation of Ben Bullen State Forest (see **Section 5.3.3**).

A Project offset property, Hyrock Hartley is located within the western escarpment division in an area proposed as an extension to the Blue Mountains National Park. The western escarpment division covers 4,000 ha. The Hyrock Hartley property covers approximately 236 ha of intact native sandstone vegetation and constitutes 5.9% of the western escarpment division and 0.6% of the GOS2.

For information relating to how the Project will benefit the GOS2 please refer to **Section 6.3.1**.

The table below lists the six divisions of GOS2 and their values according to Muir (2005).

Table 4.3 Proposed Areas of GOS2

Division	Area (ha)	Summary of Principal Values
Genowlan Mountain	1,688 ha of Crown Land	The Mountain rises more than 500 metres from the valley floor. Time and weather have carved a masterpiece in sandstone: home to 'Three Hundred Sisters'. A biodiversity hotspot, Mount Genowlan has more than of 340 plants and 75 mammals and birds.
Airly Mountain*	2,020 ha of Crown Land	The Mountain contains some of the State's best preserved oil shale ruins. They are located in a spectacular setting with dramatic valley views, surrounded by cliffs of pagoda scenery. The ruins are a ghost town lost in time.

Table 4.3 Proposed Areas of GOS2

Division	Area (ha)	Summary of Principal Values
Wollangambe Wilderness	2,380 ha of State Forest	The Wollangambe Wilderness is a popular destination with bushwalkers and canyoners. It is a spectacular landscape that features Goochs Crater, wild headwater streams, wet sclerophyll forests, and nationally endangered and scientifically important spring-fed swamps. For protection as State Conservation Area
Newnes Plateau	22,000 ha of State Forest	Newnes Plateau contains ancient windswept montane heathlands, nationally endangered upland swamps, and unique snowgum-snowgrass high plateau woodlands that make a biodiverse garden when combined with an unmatched mix of sandstone features. The woodlands and swamps on Newnes Plateau also represent the coldest and highest development of native vegetation in the Sydney Basin. For protection as State Conservation Area
Baal Bone and Long Swamp	7,800 ha of State Forest	Baal Bone and Long Swamp embrace massed pagoda 'villages' and stand above the diverse swampy plains. Collectively they form an evocative landscape of broken stone, reminiscent of Cambodia's forest temples, while the precious indigenous rock art bordering caves betokens other ancient shrines.
Western Escarpment	4,000 ha of Crown Land	The Western Escarpment is renowned for its outstanding ochre-coloured cliffs. Above them are rare plant communities, and below, fringing the escarpment, the dramatic valley scenery is enhanced by wonderful forests. The area has great potential for quiet or indeed energetic family-based recreation, and has untapped tourist potential. For protection as State Conservation Area & National Park Extension

** Notes: Source:Muir, (2005)*
Airly Mountain Division is now within the Mugii Murum-ban SCA declared in March 2011

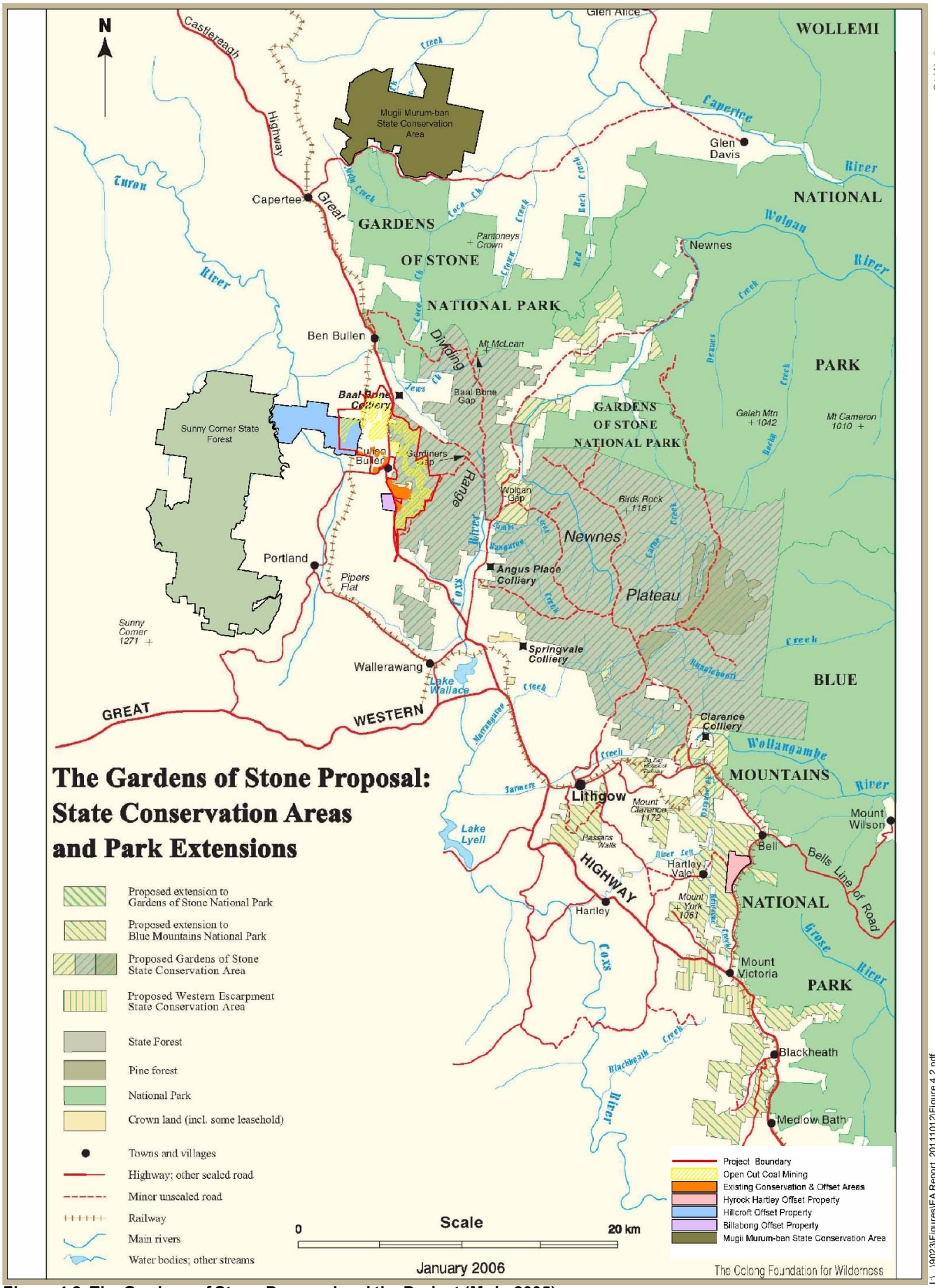


Figure 4.2. The Gardens of Stone Proposal and the Project (Muir, 2005)

4.5 Project Impacts on Flora Species

The potential impacts upon threatened species are discussed below, and focus upon flora and fauna that are known to occur in the Project Boundary. It does not include species discussed in **Chapter 3** that have not been verified on site, albeit regarded as having potential to occur on site.

4.5.1 EPBC Act and TSC Act Listed Species

i. Eucalyptus cannonii

Eucalyptus cannonii (listed as Vulnerable under the EPBC and TSC Acts) has been found in substantial numbers throughout the Project Boundary (see **Figure 3.2**). Approximately 908.7 ha of potential and known habitat estimated to support 37,602 specimens of *Eucalyptus cannonii* occur within the Project Boundary. The Project will remove approximately 278 ha of potential and known habitat, estimated to support 19,219 individuals.

The Project proposes to retain and avoid 630 ha of potential and known *Eucalyptus cannonii* habitat, estimated to support 18,382 individuals. Approximately 66 records of the *Eucalyptus cannonii* occur in the Lithgow LGA. In addition to the area of potential habitat conserved within the Project Boundary, a range of mitigation measures are proposed to be implemented, including protecting and conserving large areas of known and suitable habitat for this species via offset properties Hillcroft and Hillview/Billabong and rehabilitating impacted land progressively within the Project Boundary.

Although a substantial amount of habitat for *E. cannonii* will be removed by the Project, the proposed areas of retention and rehabilitation for the species within the Project Boundary, in combination with the proposed offset areas supporting habitat for *E. cannonii*, (see **Section 5.4.2**) will ensure positive outcomes as a whole on a local and regional basis.

ii. Persoonia marginata

Persoonia marginata is listed as Vulnerable under the EPBC Act and TSC Act. Within the Lithgow LGA, there are 21 records of the species that presumably belong to the Wollemi National Park and Ben Bullen State Forest populations. The three subpopulations recorded by this study (**Figure 3.2** and **Figure G.2** of **Appendix G**) collectively represent a new population for the species and comprise approximately 21,088 individuals occupying 49.77 ha of habitat within the Project Boundary and the neighbouring Ben Bullen State Forest. Of this significant population, approximately 16.27 ha occur within the Project Boundary (**Table 3.2**).

Table 4.4 *Persoonia marginata* Impacts from the Project

Sub-population	Cullen Valley Mine Subpopulation	Cullen Valley Mine Habitat Compensatory Area 5 Subpopulation	North-eastern Subpopulation	Total
Total Area of Habitat (ha)	38.08	3.93	7.76	49.77
Total Area of Habitat outside Project Boundary (ha)	33.58	0	0	33.58
Area of habitat retained within Project Boundary (ha)	4.5	3.93	4.48*	13.1
Area of habitat removed within Project Boundary (ha)	0	0	3.09	3.09
Area of habitat predicted to be indirectly impacted within Project Boundary (ha)	0	0	0.19	0.19
Total area IMPACTED within Project Boundary (ha)	0	0	3.28	3.28

** This area does not include the 0.19 ha of indirectly impacted habitat*

The Project proposes to impact upon 3.28 ha of the southern portion of the North-eastern subpopulation that lies largely within the Project Disturbance Boundary (**Table 4.4**). This will include the removal of approximately 3.09 ha of habitat that will be directly impacted and a further 0.19 ha of habitat that is expected to be indirectly affected by secondary impacts of habitat removal such as edge effects. The additional area of 0.19 hectares has been calculated assuming a 20 m wide indirect impact zone from the edge of the Project Disturbance Boundary (see **Figure G.2** in **Appendix G**). Furthermore, the recorded density of *Persoonia marginata* within the Project Disturbance Boundary is approximately 98 plants per hectare, a far lower density compared to the remaining subpopulations for which an average of 240 plants/ha has been recorded (see **Chapter 3**).

The Project proposes to retain and avoid clearance of 8.98 ha of known *Persoonia marginata* habitat within the Project Boundary. This area to be avoided includes habitat within both the Cullen Valley Mine and northern portion of the North-eastern subpopulations. The Habitat Compensation Area no. 5 subpopulation is not located within the proposed Project Disturbance Boundary and will not be disturbed by the Project or the existing Coalpac operations. In addition to this, there are an additional 33.58 ha of *Persoonia marginata* habitat within the Cullen Valley Mine subpopulation located outside of the Project Boundary in the Ben Bullen State Forest that will not be disturbed by the Project.

Provisions exist for the management of the remaining areas of the populations and their habitat within the Project Boundary (see Chapter 5). The subpopulations found within the Project Boundary will be retained and managed for the life of the Project.

In addition to this, mitigation measures are proposed to be implemented as per Coalpac's Species Management Plan and include rehabilitating impacted habitat progressively, and propagation of the species for use in the rehabilitation of the 3.28 ha of habitat to be impacted by the Project.

Further, known habitat are protected and conserved in large areas of Hillcroft offset property (**Section 6.4.1**). The proposed areas of retention through avoidance of known habitat within the Project Boundary and rehabilitation of removed habitat within the Project Disturbance Boundary, in combination with the proposed mitigation measures and compensatory measures will ensure positive outcomes as a whole on a local and regional basis and no significant impact is expected to occur to the *Persoonia marginata* species.

Other areas of suitable habitat may occur in dry sclerophyll forest and woodland communities within the Project Boundary; however no additional occurrences were detected during the targeted searches undertaken for the Project or from previous surveys in the local area.

4.5.2 TSC Act Listed Species

a. *Eucalyptus aggregata*

Eucalyptus aggregata was found within the Project Boundary and outside the Project Disturbance Boundary within an existing offset acquired by Invincible Colliery in 2008. Due to *E. aggregata* preferring naturally grassy and relatively arable land there are very few stands of *E. aggregata* in conservation reserves (NSW Scientific Commitee 2010). This offset area is proposed for conservation and help to maintain the species in the area and add species numbers within conservation tenure.

No impact is expected to occur to *Eucalyptus aggregata* by the Project.

4.6 Project Impacts on Fauna Species

4.6.1 EPBC Act and TSC Act Listed Species

i. Invertebrates

The Bathurst Copper Butterfly is listed as Vulnerable under the EPBC Act and Endangered under the TSC Act. This species has quite a specific set of habitat requirements, which renders large areas of the Project Boundary unsuitable. According to NSW Atlas of Wildlife records, the closest records to the Project Boundary occur at Pinedale Mine, Blackmans Flat, approximately 5km away.

No sites containing suitable habitat were recorded during past or current surveys. Due to a lack of suitable habitat recorded in the Project Boundary and the fact that no individuals were recorded, the Project is not expected to significantly impact the Bathurst Copper Butterfly.

ii. Amphibians

A total of eight amphibian species recorded within the Project Boundary during the current and previous surveys. None of these amphibians are listed as threatened under Commonwealth or State legislation.

iii. Reptiles

One Federally listed threatened reptile, the Broad headed Snake has potential to occur on the Project Boundary.

The Broad-headed Snake is listed as Vulnerable under the EPBC Act and Endangered under the TSC Act. The Broad-headed Snake occurs from the coast to ranges of south-eastern Australia, where it is largely confined within an area approximately 250 km of Sydney where Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, occur. This nocturnal species inhabits rock crevices and shelters under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. During summer the species typically migrates about 200m from the sandstone escarpments to hollows in large trees. Preferred prey species (geckos and small skinks) were recorded during current and previous surveys of the Project Boundary. There are very few records of the Broad-headed Snake in the Lithgow LGA. All of the seven records are located east of the Project area within large areas of protected high quality habitat within the Wollemi National Park and Blue Mountains National Park. The Broad-headed Snake was not recorded during the field surveys; however suitable habitat for this species occurs in the Project Boundary. These habitats exist within the Project Boundary as rocky escarpments and pagoda landscapes (winter habitat) as well as valley forests directly beneath these winter habitats.

It is highly possible that at least one of the seven known individuals utilise habitats within the Project Boundary from time to time; however there are vast areas of suitable habitat within the remaining areas of Ben Bullen State Forest, Newnes State Forest and nearby Wollemi National Park and the Blue Mountains National Park that would adequately support the small population known to occur in the LGA. The action will remove approximately three-quarters of its documented summer habitat; however more summer habitat will remain beyond the Project Disturbance Boundary (within Ben Bullen State Forest etc). Large areas of suitable winter habitat in the Project Boundary will not be directly impacted by the Project. The Project proposes to retain large areas of Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest/Woodland, Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Woodland and Pagoda Shrubland along the plateaus, ridges and upper slopes, which contain the sandstone outcropping and the pagoda landscapes suitable for the Broad-headed Snake. In addition, a range of mitigation measures are proposed to be implemented, as well as protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary.

iv. Birds

a. Blossom-dependant birds

The Regent Honeyeater (*Xanthomyza phrygiai)* (Critically Endangered under the TSC Act and Endangered under the EPBC Act) has potential to occur in the treed habitats of the Project Boundary.

This blossom dependant birds relies heavily on nectar and pollen from mistletoes and trees from the Myrtaceae family in particular the *Eucalyptus sp., Corymbia sp* and *Melaleuca sp.* The Project will remove approximately 835 ha of suitable foraging, shelter and breeding habitat for these threatened species which occurs in the woodlands and open forests of the Project Boundary. Despite this, large areas of suitable habitat will remain in the Project Boundary (787 ha of treed habitat) and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

A suite of mitigation measures will be implemented to compensate for the removal of suitable habitat for the Project including protecting and conserving large areas of suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary, which are outlined in **Chapter 5**.

b. Migratory birds

Two threatened migratory birds occur or have potential to occur in the forest and woodland communities of the Project Boundary. These include:

- Swift Parrot (*Lathamus discolor*) (Endangered under the TSC Act and the EPBC Act); and
- Satin Fly-catcher (*Myiagra cyanoleuca*) (Migratory under the EPBC Act).

The Project will remove approximately 835 ha of suitable foraging, shelter and breeding habitat for these threatened species which occurs in the woodlands and open forests of the Project Boundary. Despite this, large areas of suitable habitat will remain in the Project Boundary (787 ha of forest and woodland) and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented for the Project including protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary.

v. Mammals

a. Terrestrial Mammals

The Spotted-tailed Quoll is listed as Endangered under the EPBC Act and Vulnerable under the TSC Act. The Spotted-tailed Quoll was not detected during current or previous surveys, however it is considered to potentially occur within the Project Boundary due to the presence of suitable habitat and known records in the LGA. There are 29 records of the Spotted-tailed Quoll in the Lithgow LGA. It is possible that this species may utilise habitats within the Project Boundary from time to time. The Project will remove approximately 835 ha of suitable forage, den and breeding habitat. Despite this, large areas of suitable habitat will remain in the Project Boundary (787 ha of forest and woodland) and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented including protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary.

The Brush-tailed Rock-wallaby is listed as Vulnerable under the EPBC Act and Endangered under the TSC Act. The Brush-tailed Rock-wallaby was not detected during current or previous surveys, however it is considered to potentially occur within the Project Boundary due to the presence of suitable habitat and known records in the LGA. There are 15 records of the Brush-tailed Rock-wallaby within the Lithgow LGA. Their distribution within the LGA occurs east of and north of the Project Boundary within protected high quality remnants of the Wollemi National Park and Gardens of Stone National Park. It is possible that this species may utilise habitats within the Project Boundary from time to time. The Project will not directly impact the plateaus, ridges and upper slopes, which contain

the sandstone outcropping and the pagoda landscapes suitable for the Brush-tailed Rock-wallaby. Despite this, large areas of suitable habitat will remain in the Project Boundary and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented including protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary.

b. Microbats

Large-eared Pied Bat (*Chalinolobus dwyeri)* (listed as Vulnerable under the TSC Act and EPBC Act) is a cave dependant microbat. The Project will not remove rocky escarpments and pagoda country which provides critical habitat features for these species. Further, the Project proposes a minimum 50 m setback of open cut operations from these rocky escarpments and replacement with highwall mining, to further reduce impacts. This will include the retention of vegetation between open cut mining operations and the rocky escarpment habitats in the Project Boundary. Substantial areas of suitable roost habitat will remain in other areas of the Project Boundary and also within the nearby protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented including protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary.

4.6.2 TSC Act Listed Species

i. Reptiles

Rosenberg's Goanna is listed as Vulnerable under the TSC Act. No individuals were detected during current or previous surveys in the Project Boundary; however suitable forage, shelter and breeding habitat within the Project Boundary were observed during habitat assessment. There are very few OEH records within the Lithgow LGA, which occur predominately in the Wollemi National Park. The species requires large tracts of habitat in which termite mounds are critical for the species' life cycle. For this reason it is possible that the four known records within the Lithgow LGA may utilise habitat within the Project Boundary from time to time as records occur within the goanna's large home range. The habitat likely used would include the woodland of the mid to upper slopes and heath within the ridgelines and rocky escarpments more so than the taller gully forests.

The Project proposes to retain large areas of Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest/Woodland, Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Woodland and Pagoda Shrubland along the plateaus, ridges and upper slopes. In addition, a range of mitigation measures are proposed to be implemented including protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary.

ii. Birds

a. Blossom-dependant birds

A suite of threatened blossom-dependent birds occur or have potential to occur in the treed habitats of the Project Boundary. These include:

- Little Lorikeet (*Glossopsitta pusilla*) (Vulnerable under the TSC Act);
- Painted Honeyeater (*Grantiella picta*) (Vulnerable under the TSC Act); and
- Black-chinned Honeyeater (*Melithreptus gularis gularis*) (Vulnerable under the TSC Act).

These blossom dependant birds rely heavily on nectar and pollen from mistletoes and trees from the Myrtaceae family in particular the *Eucalyptus sp., Corymbia sp* and *Melaleuca sp.* The Project will remove approximately 835 ha of suitable foraging, shelter and breeding habitat for these threatened species which occurs in the woodlands and open forests of the Project Boundary. Despite this, large areas of suitable habitat will remain in the Project Boundary (787 ha of forest and woodland) and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

A suite of mitigation measures will be implemented to compensate for the removal of suitable habitat for the Project including protecting and conserving large areas of suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary, which are outlined in **Chapter 5**.

b. Woodland Birds

The following threatened woodland birds are known or have potential to occur in the Project Boundary. These include:

- Varied Sittella; (*Daphoenositta chrysoptera*) (listed as Vulnerable under the TSC Act);
- Speckled Warbler (*Pyrrholaemus saggitatus*) (listed as Vulnerable under the TSC Act);
- Brown Treecreeper (*Climacteris picumnus victoriae*) (listed as Vulnerable under the TSC Act);
- Scarlet Robin (*Petroica boodang*) (listed as Vulnerable under the TSC Act);
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) (listed as Vulnerable under the TSC Act);
- Turquoise parrot (*Neophema pulchella*) (listed as Vulnerable under the TSC Act);
- Hooded Robin (*Melanodryas cucullata cucullata*) (listed as Vulnerable under the TSC Act);
- Flame Robin (*Petroica phoenicea*) (listed as Vulnerable under the TSC Act); and
- Diamond Firetail (*Stagonopleura guttata*) (listed as Vulnerable under the TSC Act).

The Project will remove approximately 835 ha of suitable foraging, shelter and breeding habitat for these threatened species which occur in the woodlands and open forests of the Project Boundary. Despite this, large areas of suitable habitat will remain in the Project Boundary (787 ha of forest and woodland) and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented including protecting and conserving suitable habitat for this species via offset properties, and rehabilitating impacted land to a high quality progressively within the Project Boundary.

c. Cockatoos, Raptors and Large Forest Owls

The following threatened Cockatoos and Raptors occur or have potential to occur in the Project Boundary. These include:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*) (Listed Vulnerable under the TSC Act);
- Glossy Black Cockatoo (*Calyptorhynchus lathami*) (listed as Vulnerable under the TSC Act); and
- Square-tailed Kite (*Lophoictinia isura*) (listed as Vulnerable under the TSC Act).

The Gang-gang Cockatoo was frequently recorded from the Project Boundary during current and previous surveys, and there are a large number of records from the Lithgow LGA. The Project will result in the removal of 835 ha of breeding and foraging habitat. Despite this, large areas of suitable habitat will remain in the Project Boundary (787 ha of forest and woodland) and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented including protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary.

The Glossy Black Cockatoo was not recorded in the Project Boundary during current or previous surveys, although numerous NSW Atlas records indicate that it occurs nearby. The Project will remove 835 ha of suitable nesting habitat for this species in the form of tall hollow bearing trees. A critical habitat feature, *Allocasuarina sp* was recorded during habitat assessment which indicates that some foraging habitat for the Glossy Black Cockatoo is present in the Project Boundary. . Despite this, large areas of suitable habitat will remain in the Project Boundary (787 ha of forest and woodland) and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented including protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary.

The Square-tailed Kite (*Lophoictinia isura*) was recorded in the Project Boundary and is known in the wider locality. The species requires a large hunting range of forest/woodland habitat, particularly containing timbered watercourses where is prefers to nest. The Square-tailed Kite was observed foraging within the Project Boundary. It is likely that the species utilises the Project Boundary as a component of a much larger home range. No nests or suitable breeding habitat was observed during surveys. Therefore the Project will remove 835 ha of foraging habitat. Despite this, large areas of

suitable habitat will remain in the Project Boundary (787 ha of forest and woodland) and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented including protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary.

The following large forest owls occur or have potential to occur in the Project Boundary. These include:

- Masked Owl (*Tyto novaehollandiae*) (listed as Vulnerable under the TSC Act);
- Barking Owl (*Ninox connivens*) (listed as Vulnerable under the TSC Act); and
- Powerful Owl (*Ninox strenua*) (listed as Vulnerable under the TSC Act).

The owl species mentioned above also have a requirement for nesting in large trees with hollows, some of which will be lost from the Project Boundary. It is possible that these species, particularly Powerful Owl but also the Barking Owl and Masked Owl could lose actual or potential nest sites within the Project Boundary, though no nest sites have been identified in this area to date. The Project will remove 835 ha of foraging, roosting and nesting habitat as part of the Project. Despite this, large areas of suitable habitat will remain in the Project Boundary (787 ha of forest and woodland) and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented including protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary.

iii. Mammals

a. Arboreal Mammals

The Squirrel Glider is listed as Vulnerable under the TSC Act. This species was detected within the East Tyldesley portion of the Project Boundary during current surveys. There are also numerous nearby NSW Atlas records of this species. The Project will remove known habitat of the Squirrel Glider. Despite this, large areas of suitable habitat will remain in the Project Boundary (787 ha of forest and woodland) and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented, including protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary.

The Yellow-bellied Glider is listed as Vulnerable under the TSC Act. No individuals were recorded during surveys (current or previous), albeit numerous records occur in the LGA. This species prefers tall mature eucalypt forest, which occurs within the gullies of the Project Boundary. NSW Atlas records occur within areas of the Wollemi National Park which may suggest the National Park provides

primary habitat for the species and that the species may utilise the Project Boundary from time to time. The Project will remove suitable habitat for the Yellow-bellied Glider.

The Eastern Pygmy Possum is listed as Vulnerable under the TSC Act. No individuals were recorded during current and previous surveys of the Project Boundary. The majority of records occur in the Newnes State Forest, south-east of the Project Boundary. The Project will remove suitable habitat for the Eastern Pygmy Possum. With the implementation of mitigation measures outlined in **Chapter 5,** no significant impact is likely to occur to the Eastern Pygmy Possum.

The Koala is listed as Vulnerable under the TSC Act. No Koalas were detected during current or previous surveys. Habitat assessment indicated that some portions of the Project Boundary support primary and secondary food trees (*Eucalyptus viminalis* and *Eucalyptus punctata*) for the Koala. NSW Atlas records indicate that their distribution within the Lithgow LGA is scattered and restricted to Newnes State Forest and Wollemi National Park. The closest record occurs at Wolgan State Forest, around 8 km north-east of the Project Boundary. The Project will clear primary and secondary habitat which may be used by a small population of this species from time to time. Despite this, large areas of suitable habitat will remain in the Project Boundary (787 ha of forest and woodland) and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented including protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary. No significant impact is expected to occur to the Koala as a result of the Project.

b. Microbats

A suite of microbats occur or have the potential to occur in the Project Boundary. These include:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) (listed as Vulnerable under the TSC Act);
- Eastern Freetail-bat (*Mormopterus norfolkensis*) (listed as Vulnerable under the TSC Act);
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) (listed as Vulnerable under the TSC Act);
- Greater Broad-nosed Bat *(Scoteanax rueppellii*) (listed as Vulnerable under the TSC Act); and
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) (listed as Vulnerable under the TSC Act).

The above list of microbats have been separated and discussed with respect to their roosting requirements.

The Eastern False Pipistrelle, Eastern Freetail-bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat are hollow dependant species which rely on tree hollows to roost and breed. The Project will remove 835 ha of roosting habitat and foraging habitat. Despite this, large areas of suitable habitat will remain in the Project Boundary (787 ha of forest and woodland) and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan

State Forest and some parts of Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented for the project, including protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary.

The Eastern Bent-wing Bat is cave dependant microbats. The Project is likely to remove 835 ha of foraging habitat. The Project will not remove rocky escarpments and pagoda country which provide critical habitat features for this species. Further, the Project proposes a minimum 50 m setback of the Project Disturbance Boundary from these rocky escarpments. This will include the retention of buffer vegetation between open cut mining operations and the rocky escarpment habitats in the Project Boundary. Substantial areas of suitable roost habitat will remain in other areas of the Project Boundary and also within the nearby protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented including protecting and conserving suitable habitat for this species via offset properties and rehabilitating impacted land progressively within the Project Boundary.

4.6.3 Impacts to Common Species

i. Invertebrates

Stygofauna are macroinvertebrates that live in underground water across a diverse range of habitats including caves, aquifers and springs. According to AGE (2011) the Project will not produce any further significant impact on the groundwater regime or adversely impact regional groundwater quality. There is however potential for spills and contamination by metals and hydrocarbons, waste disposal and fuel storage areas; however adequate bunding and immediate clean-up of spills, standard practice and/or a legislated requirement should prevent contamination of shallow strata and subsequent leakage to the groundwater system. Furthermore there are no known springs or significant permanent water courses within the Project Boundary that are fed by groundwater around which groundwater dependent ecosystems have developed (AGE 2011). Notwithstanding Coxs River Swamp and Jews Creek Swamp which are located outside the Project Boundary and have not been impacted by the Baal Bone Colliery, and therefore will not be affected by the Project. Therefore the Project is not expected to impact upon Stygofauna.

ii. Amphibians

All amphibian habitats described as occurring within the Project Boundary are also commonly represented in the wider locality, including nearby protected areas. Numerous surveys have been conducted within the Project Boundary. The Project will result in the removal of foraging and breeding habitat for common amphibians.

iii. Reptiles

A total of 13 common reptile species have been recorded within the Project Boundary. All reptile habitats described as occurring within the Project Boundary are also commonly represented in the wider locality, including nearby protected areas. As with amphibians, the Project will result in the removal of foraging and breeding habitat for common reptiles.

iv. Birds

A large number of bird species have been recorded within the Project Boundary during surveys conducted since 1996. This includes a number of birds that are listed as threatened under both the EPBC Act and TSC Act.

The Project will result in the removal of approximately 835 ha of foraging and/or breeding habitat for birds. Given the extent of woodland habitat to be removed, it is likely that this will result in impacts on common woodland-dependant birds that currently occupy the Project Boundary. Areas of woodland habitat also remain in the wider locality.

v. Mammals

A number of mammal species have been recorded from within the Project Boundary during current and previous surveys conducted since 1996. The Project will result in the removal of up to 1006 ha of foraging, breeding and shelter habitat for common mammals. A few of the common mammals occurring within the Project Boundary are woodland-dependant species. It is likely that this will result in impacts on common woodland-dependant mammals that currently occupy the Project Boundary. Areas of woodland habitat also remain in the wider locality.

4.7 Indirect Impacts

The Project will have indirect impacts (Dale et al. 2001) on the ecological values of the Project Boundary and surrounds, which are discussed in detail below. Many of these are forms of environmental pollution (Spellerberg 1998, Rabin et al. 2003, Driussi and Jansz 2006) or the opening up of habitat to invasive species.

4.7.1 Habitat Degradation

Habitat loss rarely occurs in isolation from other threats (Fischer and Lindenmayer 2007). While the Project will directly remove large areas of vegetation, a range of other indirect threatening processes will result from the clearance which will further increase the loss of habitat for a range of flora and fauna.

Habitat degradation refers to the gradual deterioration of habitat quality over various spatial and temporal scales (Fischer and Lindenmayer 2002a, Maron et al. 2011). In some instances it can be difficult to detect due to a long manifestation time. The woodland areas to be cleared predominantly consist of trees that have been cleared and have since regrown, although remnant trees are scattered across the Project Boundary. Portions of forest and woodland within the Project Boundary are made up of relatively young trees with low DBHs that are not of hollow-bearing age. Notwithstanding the importance of these trees in providing hollows once matured, the removal of these trees will significantly reduce the short to mid-term availability of hollow habitat for native fauna.

The main consequences of habitat degradation are the decline or complete loss of a species from a geographic area. The loss of critical habitat features may force some mobile species to emigrate, however species unable to relocate to other habitat will be vulnerable to genetic isolation and an inability to breed or a slow life cycle which may result in low population density and potentially local extinction (refer to **Figure 4.2**).

4.7.2 Competition for Resources

Removal of habitat and forced emigration from the Project Boundary will impact on the successful relocation of a range of fauna. Dispersal into new areas of habitat can significantly increase con-specific competition and alter population dynamics with existing occupants (Dickman 1991, Rappole and McDonald 1994, Amarasekare 2002, Maron et al. 2011).

Overcrowding has the potential to create conflict over territoriality, viable home ranges and overlap of structural niches (Lawlor 1980); restrict accessibility to limiting forage, roosting and breeding resources; alter predator-prey interactions; potentially increase the incidence and spread of diseases; and affect the availability of mates (Nelson et al. 1960). Competition for such resources may lead to injury and death for various fauna, or push those unable to settle out of suitable habitat.

4.7.3 Noise

Fauna species are sensitive to elevated levels of noise in their environment, which generally result from anthropogenic sources (Fletcher and Busnel 1978). Persistent noise can affect an animal's physiology by impacting on its hearing and energy budget, interrupting foraging and reducing reproductive success and long-term survival. Behavioural impacts include habitat loss through avoidance and a retreat away from favourable habitats (AMEC Americas Limited 2005). While some species will habituate and become accustomed to periodic noise disturbance (Fletcher and Busnel 1978), other species may be forced to relocate, which again will be restricted by habitat degradation.

Anthropogenic noise can adversely impact an individual or species' reproductive success and mortality (AMEC Americas Limited 2005) by affecting signal production, deployment, perception and response. Interference can distort or mask social, warning, mating or territorial calls and how they are heard and interpreted by other animals (Chan et al. 2010). It can indirectly change population dynamics by disrupting navigation, impacting on predator-prey interactions, changing habitat use and affecting courtship and parental care (Owings and Morton 1998, Rabin et al. 2003, Chan et al. 2010).

The Project will generate noise during the construction of infrastructure and through routine mining operations, particularly as the mine will operate for 24 hours a day in some areas. . Traffic, particularly from large mining trucks and excavation machinery; blasting during the mining phase; and noise from generators and machinery will elevate noise levels in the environment and potentially impact on various fauna species and affect the value of the habitats that remain (AMEC Americas Limited 2005).

Noise will diminish within areas that are progressively rehabilitated and, in the long term, noise levels should return to normal following rehabilitation of the total mined area and cessation of mining.

4.7.4 Light

The Project has the potential to increase the level of artificial light in the natural environment. Increased light levels may adversely impact wildlife by direct glare, chronic or periodic increased illumination and temporary unexpected fluctuations in light levels (Longcore and Rich 2004, Saleh 2007, Longcore and Rich 2010).

Research into impacts from altered lighting indicates that prolonged exposure can trigger behavioural and physiological responses that include but are not limited to:

- Disorientation and/or temporary blindness;
- Changes in foraging behaviour, such as when diurnal species extend foraging into the night-time (Longcore and Rich 2010);
- A disruption of seasonal day length cues which trigger critical behaviours (Longcore and Rich 2004, Saleh 2007, Longcore and Rich 2010);
- Suppression of the immune function (Bedrosian et al. 2011);
- Alteration in the timing of reproduction which can decrease successful breeding and reduce fitness (Bedrosian et al. 2011); and
- Interference with predator-prey relationships.

While the construction and operational phases of the Project will have some effect on the surrounding forest and woodland environment, the impacts from light pollution are likely to remain close to the immediate Project Disturbance Boundary of the operational open cut pit, with only limited glare into the surrounding natural vegetation. It is likely that most fauna species would habituate to the periodic disturbance and that light pollution from the mine is unlikely to have a significant or long-term impact on any fauna species.

Artificial light will diminish within areas that are progressively rehabilitated and, in the long term, light levels will return to normal following rehabilitation of the total mined area and cessation of mining.

4.7.5 Dust

The Project will generate dust during the removal of vegetation, construction and mining phases. As with the impacts caused by anthropogenic noise, dust pollution can lead to a decrease in habitat quality by affecting the health of trees and leading to altered community structure, reducing the overall amount of available habitat. It also has the potential to extend the area of impact beyond the mine footprint.

Plants will be most affected by dust, as it can settle and accumulate on leaf surfaces and impair essential physiological processes including photosynthesis, respiration, and transpiration by shading or clogging stomata and reducing light penetration through leaves (Spencer and Tinnin 1997, Ministry for the Environment (NZ) 2001). Dust can also abrade the leaf surface and cuticle, increasing the plant's susceptibility to pathogens, fungal disease, and toxic gaseous pollutants (Farmer 1993). These impacts increase mortality and decrease productivity which can result in changes in vegetation and community structure (Farmer 1993).

The effect of dust deposition could affect animals that rely on plants, either as a source of food or habitat. Physiological impacts may result in a reduction in the size and abundance of fruits and sugar levels, while dust on the foliage and fruit may affect palatability to animals (Ministry for the Environment (NZ) 2001).

Dust will diminish within areas that are progressively rehabilitated and, in the long term, dust levels should return to normal following rehabilitation of the total mined area and cessation of mining.

4.7.6 Erosion

The Project will increase the current extent of erosion in the Project Boundary, impacting on the landscape and key areas of habitat. Soil erosion typically results in a loss of water, organic matter, nutrients and biota important for the health and productivity of soil landscapes (Pimentel and Kounang 1998). Disregarding the direct, large-scale clearance of vegetation and soil in the mine footprint, erosion will predominantly result from the construction and use of hard-surfaces such as roads, tracks, and infrastructure for general mining operations.

Erosion most relevant to the Project Boundary includes water erosion of soil; sheet, rill, gully, and tunnel (Harpstead et al. 2001). Sheet erosion is the uniform removal of soil without the development of visible water channels and is the least apparent of the four erosion types. Rill erosion is soil removal through the cutting of many small, but conspicuous, channels. Gully erosion is the consequence of water that cuts down into the soil along the line of flow and this type of erosion develops more quickly in places like tracks and animal trails. Tunnel erosion may occur in soils with sub layers that have a greater tendency to transport flowing water than does the surface layer.

The effects of erosion can already be seen within the Project Boundary, particularly gully erosion along access roads and banks of dry creek lines. The soils of the Project Boundary have a moderate soil erosion and dispersion potential (EcoBiological 2011). Once these soils are disturbed, the potential for erosion is increased (EcoBiological 2011). As indicated, this characteristic of soil is worsened by the removal of ground vegetation that would otherwise stabilise the banks.

Sheet and rill erosion are likely to occur where large areas are cleared, particularly on hillsides. Where there is no obvious existing channel for the water to follow, it will form rills or flow overland. This kind of erosion is likely to be exacerbated by any kind of clearance for the mine and infrastructure.

4.7.7 Vehicle Strike

Vegetation clearance and increased traffic associated with the Project may impact fauna through increased vehicle strike, injury and mortality. The Project will result in the construction of additional roads and tracks which means an increased length of road for animals to cross and negotiate, as well as an increase in the number of vehicles operating in the Project Boundary. Vehicle strike can pose a significant risk to some wildlife, particularly (but not exclusively) ground dwelling species (Taylor and Goldingay 2010). While some mobile species, such as birds, have the potential to move away from the path of clearing, other species that are less mobile, or those that are nocturnal and restricted to tree hollows, may have difficulty moving over relatively large distances. Pre-clearance surveys however, are likely to reduce the risk of mortality during clearing.

This is likely to be most significant during the construction phase, when vegetation and habitats are being cleared. This may also occur during the operation of the mine as a result of collision with vehicles entering and leaving the pit as well as during the normal daily movements of workers and vehicles throughout the site.

Although some mortality of animals as a result of vehicle strike is likely, it is not expected to be significant. The majority of the roads within the Project Boundary would not be able to be traversed at high speed due to the terrain, and animals are expected to be able to avoid vehicles.

Site induction that entails instructions to be aware of fauna on haul roads will decrease the risk. The risk of vehicle strike will diminish as areas that are progressively rehabilitated will return to current levels following rehabilitation of the total mined area and cessation of mining.

4.7.8 Weeds, Feral Animals and Overabundant Native Species

Alterations to habitat conditions often favour introduced and/or hardy native plant and animal species that can proliferate in disturbed conditions. Habitat fragmentation and associated edge effects reduce the availability and quality of refugia for native fauna and increase feral access to resources, thus increasing the risk of predation and competition for resources for local native fauna (Dickman 1996, Doak 2002, Fitzgerald and Wilkinson 2009). It can also increase native flora susceptibility to infection from pathogens (Dale et al. 2001, Garkaklis et al. 2004) such as the fungus *Phytophthora cinnamon* which causes dieback (NSW Scientific Committee 2004e).

Invasive weed and feral animal infestation are already evident within the Project Boundary and are threats whose impacts are well established in the Hunter region (West and Saunders 2007, Gong et al. 2009). Invasive species compete with natives for resources and can aggressively invade areas, displacing native plants and animals. Feral animals such as rabbits, hares, pigs, goats, wild dogs, cats, foxes, aggressive birds such as mynas, and feral honey bees (Oldroyd et al. 1997) pose a major threat to many native and threatened species (West and Saunders 2007, Fitzgerald and Wilkinson 2009). They compete for food and nest or roost sites; breed in more open areas following clearance of forest and woodland; prey on adults, juveniles and eggs; and damage and degrade natural habitats and breeding sites.

As previously mentioned, the presence of the feral fox may be a key factor in the low numbers and diversity of ground-dwelling fauna in the Project Boundary and surrounds as they have long been recognised to be a major contributor to the decline of ground-nesting birds, small to medium mammals and reptiles (DECC (NSW) 2007, SEWPaC 2010).

Generally, the proportion of exotic plants found within the Project Boundary is highest around the lower slopes and valley floors where the land has been used for more intensive agriculture and livestock can facilitate weed dispersal. The upland areas tend to have a more intact understorey that has fewer serious weeds. The control of weeds can help recover threatened species (West and Saunders 2007, Fitzgerald and Wilkinson 2009, Hunter-Central Rivers Catchment Management Authority 2010).

These processes are well established in the Project Boundary and region by Forests NSW, and the Project is not considered likely to exacerbate them. A weed and feral animals control program will be prepared for implementation by Coalpac as part of the Biodiversity Offset Management Plan (BOMP). With the implementation of this plan, the Project is not likely to increase the presence of effects of feral species.

4.8 Impacts to Groundwater Dependant Ecosystems

No groundwater dependant ecosystems (GDEs) have been identified to occur within the Project Boundary during vegetation mapping by Cumberland Ecology or during groundwater impact assessments by AGE (2011). Furthermore there are no known springs or significant permanent water courses within the Project Boundary that are fed by groundwater around which GDEs have developed (AGE 2011). Notwithstanding the proximity of Coxs River Swamp and Jews Creek Swamp which are likely to constitute GDEs (AGE 2011), these GDEs are located 2 km and 3.5 km away from the Project Boundary, respectively.

Baal Bone Colliery has six bores which monitor the rise and fall of groundwater in Coxs River Swamp. Water collected by the Baal Bone Colliery within the underground workings is discharged into Jews Creek and is considered minor (AGE 2011). The findings of Connell Wagner (2006) indicated that there has been no impact on groundwater in either the Coxs River Swamp or the Jews Creek Swamp by Baal Bone Colliery. An assessment of the rise and fall of the groundwater level within the Baal Bone monitoring bores is outside the scope of this report; however the variation is unlikely to be the result of existing mining activities at the Invincible Colliery or Cullen Valley Mine or those proposed for the Project (AGE 2011).

4.9 Cumulative Impacts

4.9.1 Local Scale

Cumulative impacts result when many small-scale alterations to the environment combine to cause an overall greater level of impact. Cumulative impacts can arise from either persistent losses of one resource, or the compounding effects of two or more impacts (Lindenmayer, 2006). Impacts that may be insignificant on their own may be significant when considered together with other actions being undertaken as part of the same project.

Extensive vegetation clearing has already occurred in the locality as a result of historical farming, agriculture, forestry, transport and other mining projects. These processes are still occurring and impacting the area, and the broad scale vegetation clearance that will occur as a result of the Project will exacerbate these existing ecological impacts. If no mitigation or compensatory measures are provided, this will result in cumulative impacts on flora and fauna as habitats are further reduced and fragmented.

Coal mining and other industrial activity has and is currently taking place in other portions of Ben Bullen State Forest and nearby areas. Other operations nearby to the Project include:

- Baal Bone Colliery;
- Mount Piper Power Station Extension;
- Ivanhoe North Colliery; and
- Pine Dale Coal Mine – Yarraboldy Extension.

On current information publically available the surrounding projects are not seeking approval to clear large areas of vegetation. Baal Bone Colliery proposes to continue underground mining in the northern parts of Ben Bullen State Forest. Mining has now concluded in Longwalls 28-31 and has not directly impacted vegetation through clearing. The Mount Piper Power Station Extension proposes to avoid direct impacts to remnant native vegetation by restricting construction to pre-cleared areas containing regrowth and planted gardens. Ivanhoe North Colliery will result in the clearance of approximately 12.3 ha of relatively undisturbed native vegetation. The Yarraboldy Extension of Pine Dale Coal Mine will remove 27 ha of vegetation, 14 ha being native vegetation. Collectively, the Project makes up a large proportion of the cumulative impacts. As such, areas of the Ben Bullen State Forest will be subject to open cut, highwall and underground mining within the next two to three decades, beyond which, no further disturbance is likely to occur as a result of mining. The coal being mined by the Project is the last remaining coal to be mined in the Cullen Bullen area, and as such the cumulative impacts are finite and known.

The cumulative impacts of mining and other industrial development on the GOS2 are not expected to increase dramatically. This is because the surrounding developments consist of either smaller surface impacts or subsurface (underground mine) operations. Excluding underground mines, Pine Dale Mine's Yarraboldy Extension is the only development seeking to remove 20 ha of vegetation located in BBLSD.

Cumulative impacts are also likely to occur from a combination of all the pressures caused by the Project. This includes the direct impacts of habitat removal, potential impacts from underground subsidence and the subsequent impacts of dust, lighting, noise and erosion. These cumulative impacts are likely to be most strongly felt in the patches remaining after clearing, and are likely to extend beyond the footprint of the mine.

Notwithstanding this, all of the mines in the region propose to rehabilitate mined areas and return them to their original forest and woodland state. The mined landscaped will be progressively returned as flora and fauna habitat in the medium to long term. Where offsets are acquired these will collectively and significantly increase the total areas of native vegetation that exist in the locality in the future and will significantly increase the total area of native vegetation within conservation reserves in the locality and the region. Further details about the collective benefits of offsetting by mines in the locality are provided in **Chapter 6**.

Despite these collective impacts, the Project is unlikely to directly threaten the occurrence of these vegetation communities within the Project Boundary or the region. Large areas of such vegetation will remain both within the Project Boundary (787 ha of forest and woodland) and outside of it, including other areas of Ben Bullen State Forest, Newnes State Forest, Gardens of Stone National Park and Wollemi National Park. Some vegetation communities to be impacted, particularly the CEEC Box Gum Woodland and Derived Grasslands, are not well represented within secure tenures, particularly within conservation reserves.

However, this situation is likely to change within the region and subregion in the near future as offsetting proposes to establish permanent biodiversity offsets containing impacted vegetation for possible additions to National Parks. The offsetting arrangements will both protect existing forest and woodland communities and restore vegetation on farmland, with the net result being an increase in total woodland vegetation and an increase in such vegetation under conservation tenures. The offset strategy for the Project is described in further detail in **Chapter 6**.

4.9.2 Regional Scale

There are no regional statistics available to provide quantitative commentary on the cumulative impacts of the mining industry on a regional scale. As with the locality around Cullen Bullen and Ben Bullen State Forest, it is obvious that the wider region has also experienced large-scale vegetation clearing resulting from decades of agriculture, forestry and mining.

Although severely cleared in the past, many contemporary mining projects are capable of compensating current and future threatened species and ecological community impacts via offsetting, particularly when considered collectively.

Current assessments and offsetting projects now place a high focus on replacing and supplementing ecological communities, which can be considered as surrogates or "flagship items" for a suite of threatened species that rely on them for habitat.

It is also important to recognise that whilst CEECs like Box Gum Woodland and Derived Native Grassland are worthy of consideration in their own right, the emphasis on making secure provisions for CEECs also makes significant contributions to the conservation of a suite of threatened species such as the Regent Honeyeater and Swift Parrot.

4.10 Duration and Timing of Impacts

The duration and timing of the impacts of the Project has important effects on the magnitude of the overall impacts on the ecology of the Project Boundary at any given time.

Ben Bullen State Forest is 6,783 ha in size and of this, 835 ha of forest and woodland will be progressively cleared by the Project. However, land within the Project Boundary will also be progressively rehabilitated with the primary aim of returning it to forest and woodland for the life of the mine. Thus the *net loss* of vegetation at a given stage of the Project time will be minimised through the progressive clearance and concurrent rehabilitation of the land within the Project Boundary. Therefore, areas of habitat that occur in parts of the Project Boundary that will be developed later will continue to provide biodiversity services until they are removed. In the final years of mining some of the rehabilitation will be 20 years old and already providing some habitat to replace that which will be removed.

This means that for the life of the mine (21 years) parts of the Project Disturbance Boundary will be vegetated, although areas recently mined by open cut operations will have young, rehabilitated vegetation. These young rehabilitated areas will still represent habitat for some fauna species, including woodland birds, and play an important role in maintaining habitat areas and connectivity as the Project progresses.

Table 5.3 provides a conceptual breakdown of the progressive rehabilitation of the three areas of mining in the Project Disturbance Boundary projected for the current year and Years 2, 8, 14 and 20 of the Project.

In addition to this, not all areas will be permanently cleared and disturbed. Areas to be used for buildings and other mine infrastructure will be returned to forest and woodland in the long term once use of the facilities has ceased. Moreover, all of the mined areas will be revegetated to forest and

woodland in accordance with a Biodiversity Management Plan (BMP; see **Chapter 5**) and added to the BOMP (see **Chapter 6**).

4.11 Permanence and Reversibility of Impacts

Although extensive impacts will occur on a local scale, not all of these are irreversible, and with appropriate management and the implementation of mitigation measures, the impact of these can be considerably reduced.

Apart from the large components of the mine that will alter the topography of the site, other aspects of the development are likely to have reversible impacts, and flora and fauna are likely to recover well with appropriate rehabilitation measures. Not all areas will be permanently cleared and disturbed. Areas to be used for buildings and other mine infrastructure will be returned to forest and woodland in the long term once mining has ceased. Moreover, all of the mined areas other than the final void will be revegetated to forest and woodland using local provenance species in the long term.

If appropriate effort is put into the subsequent rehabilitation of building and infrastructure areas, it is likely to be possible to recreate the communities that previously existed in these areas. Rehabilitation and regeneration of forest and woodland is possible on degraded areas and has the potential to reduce the impacts of habitat removal on threatened species. The planting of threatened plant species which are known to occur in the Disturbance Boundary would reduce impacts on these species and enable recovery of populations in the Project Boundary.

4.12 Summary of Impacts

The major impact of the Project will be from the clearance of broad areas of forest and woodland, directly removing biodiverse habitats for many species and important habitat resources such as tree hollows. Without substantial mitigation and compensation measures, the Project would add significantly to ecological impacts within the locality – denuding it of native vegetation and habitat for many native species. For this reason, substantial ameliorative measures, including avoidance, mitigation and compensation, are an integral part of the Project. These are discussed in detail in **Chapter 5** and **Chapter 6**.

Chapter 5

Impact Mitigation Measures

5.1 Introduction

The purpose of this chapter is to outline the mitigation measures proposed to ameliorate the impacts of the Project on flora and fauna. As demonstrated in previous chapters, the Project Boundary is biodiverse and provides habitat for a wide range of flora and fauna, including species listed under State and Commonwealth threatened species legislation. Accordingly a suite of substantial mitigation measures has been prepared to mitigate these impacts.

The considerations for reducing the ecological impacts follow the Part 3A Draft Guidelines for Threatened Species Assessment (DEC and DPI , 2005) which include a hierarchy of principles:

- Avoid – to the extent possible, developments should be designed to avoid or minimise ecological impacts;
- Mitigate – where certain impacts are unavoidable through design changes, mitigation measures should be introduced to ameliorate the ecological impacts of the Project; and
- Compensate – the residual impacts of the Project, following the implementation of mitigation measures, should be compensated to offset what would otherwise be a net loss of habitat.

Further to these considerations, it is essential to monitor the ongoing status and health of flora and fauna communities that will be retained within the Project Boundary in order to assess the success of the mitigation and compensation measures. This will be achieved through the establishment of an ecological monitoring program for the Project.

A BMP will be prepared to guide the implementation of the mitigation strategy incorporating detailed specifications for the implementation of all the impact mitigation measures described below for the existing offsets and the Project. The BMP will be the key document to ensure that the conservation objectives of the Project are met and that impacts to biodiversity are adequately managed for the life of the Project. This is explained further in **Section 5.2**.

The BMP will also include a BOMP that will include existing offsets of the Project and provide specifications for the restoration and management of biodiversity offset areas and will be finalised prior to the commencement of Project mining operations. This is explained in further detail in **Chapter 6**.

5.2 Measures to Avoid Impacts

Open cut mining operations cannot readily avoid impacts where mineral resources are beneath flora and fauna habitats. However, avoidance can be achieved to varying degrees by modification of the design and location of mine associated infrastructure away from natural habitats, where feasible. Wherever possible, risks of environmental impacts have been avoided through the overall Project design itself. Some local scale avoidance measures are discussed below.

Avoiding environmental impacts has been considered throughout the Project planning and design phases. The Project mine plan has been devised through the consideration of a number of alternatives which were developed to reduce the potential for adverse impacts to the environment, including specific impacts on threatened ecological communities and species. Significant modification to the design of the Project has led to improved biodiversity outcomes, particularly in the northern portions of the Project Boundary for Cullen Valley area and the East Tyldesley area.

The Project mine plan has been devised through the consideration of a number of alternatives which were developed to reduce the potential for adverse impacts to the environment, including reduction in amenity impacts to near neighbours and specific impacts on Matters of National Environmental Significance. These measures include preferential adoption of highwall mining to reduce impacts of habitat fragmentation and clearing of areas initially proposed for open cut or completely sterilising areas from any form of coal extraction. More specifically, these avoidance measures have excluded 994 hectares of vegetation, forming 787 ha hectares of forest and woodland habitat from disturbance by mining within the Project Boundary over the life of the mine (21 years).

Altering disturbance footprints for the Project through mine plan design also avoided:

- 63 ha of potential *Eucalyptus cannonii* habitat;
- Pagoda habitat by implementing highwall mining to avoid open cut impacts and establishing a minimum buffer of 50 m from the extent of open cut areas;
- Excessive clearing of native vegetation to make way for the conveyor easement;
- A collective 8.98 ha of *Persoonia marginata* habitat occurring within the Cullen Valley Mine subpopulation and the northern portion of the north-eastern subpopulation; and
- Approximately 30 ha of Box Gum Woodland habitat.

These avoidance measures are explained in more detail below.

The Project's avoidance of *Eucalyptus cannonii* is greatly challenged by the scattered distribution and local abundance of the species within the Project Boundary. Due to the distribution of the species within the Project Boundary, complete avoidance of this species would not be viable as it would sterilise over one-third of the Project Disturbance Boundary. Less effective techniques with lower mining recoveries such as highwall mining have been implemented where possible to avoid direct impacts to 630 ha of potential *Eucalyptus cannonii* and 30 ha of Box Gum Woodland. Impacts to *E. cannonii* are therefore considered unavoidable and Coalpac will implement a suite of mitigation measures and compensatory measures to reduce and offset Project impacts to *Eucalyptus cannonii*.

The implementation of highwall mining under the rocky outcrops, and thus set back from pagoda habitats will also reduce impacts on potential Brush-tailed Rock-wallaby, Broad-headed Snake, Large-eared Pied Bat and Eastern Bent-wing Bat habitat occurring within the sandstone plateaus, rocky outcrops and pagoda landscapes. Coalpac has further reduced the open cut footprint, specifically at the bases of retained rocky outcrops and pagodas habitats. This area will now be highwall mined. Essentially, this has set back the open cut footprint by 20 m below small isolated rocky outcrops and 50 m from pagodas or escarpments. This will further reduce potential impacts of subsidence and create a buffer between these habitats and open cut mining operations.

The alignment of the Mount Piper Power Station conveyor has also been located largely within an existing powerline infrastructure alignment to reduce further vegetation clearing and is within the defined Project Disturbance Boundary.

Coalpac's commitment to avoiding impacts on threatened species has resulted in the redesign of the existing Cullen Valley Mine approval to avoid the entire *Persoonia marginata* subpopulation located within the northern extent of the existing Approved Mining area (see **Figure 3.2**). Coalpac has also revised the Project mine plans to implement highwall mining to avoid disturbance to 30 ha of Box Gum Woodland.

Further avoidance, where practical will be a key aim during detailed design for the Project.

Substantive mitigation and compensation measures are proposed to offset the impacts of the Project on flora and fauna as described below.

5.3 Measures to Mitigate Impacts

Where the design of the Project is implemented on the ground, measures can be established to mitigate some of the direct and indirect impacts of the construction and operation of the Project. This section summarises the recommended mitigation measures.

5.3.1 Minimising Vegetation Clearance and Habitat Loss

Disturbance to areas of native vegetation and habitat will be unavoidable during the construction process. However, in order to minimise clearing impacts and avoid unnecessary disturbance, the limits of clearing will be clearly identified on plans and on the ground (using flagging and signage) during the construction process.

Native vegetation beyond the identified clearing areas will not be disturbed. Ancillary facilities such as stockpile sites, site compounds and construction zones will not be located beyond the limits of clearing. During the detailed design stage, opportunities to further minimise vegetation disturbance will be considered.

5.3.2 Pre-clearance Surveys

Pre-clearance surveys of forest and woodland areas to be removed will be conducted to identify any threatened flora and fauna species or habitat within areas of impact. These will provide an opportunity to avoid impacts to flora and fauna of conservation significance during clearing.

Where clearing of vegetation and fauna habitats will take place, clearing protocols will be put in place, including checking trees for the presence of arboreal fauna prior to felling. Animals found to be occupying trees will be safely removed before the clearing of trees and relocated into nearby forest that will not be disturbed.

Where feasible, transportable habitat features such as large logs and boulders will be placed in adjacent retained areas to allow their continuation as potential fauna refuge sites. Seed collection from mother trees and propagation of seed will take place to be used in later regeneration of disturbed areas.

Coalpac will implement a Land Disturbance Protocol for the Project, to be included in the BMP. This Land Disturbance Protocol requires the Environmental Manager (or delegate) to carry out an inspection of proposed disturbance areas prior to any disturbance activities occurring. This Protocol also provides a process to ensure compliance with the relevant licences and approvals, that sensitive ecological features are not impacted upon directly, and that appropriate mitigation is put in place prior to any disturbance.

5.3.3 Mine Rehabilitation

One of the key mitigation strategies for the proposal is the rehabilitation of mining areas to maximise conservation values and biodiversity. This includes maximising the biodiversity and connectivity within the landscape, through management of existing rehabilitation sites and the establishment of new rehabilitation sites.

i. Existing Mine Rehabilitation

There are signs of rehabilitation failure through the heating of old underground workings in some areas of Cullen Valley Mine's rehabilitation area. Coalpac is working to remediate the impacts through clay capping and flooding as per the report *Remediation of Subsurface Heating in Established Rehabilitation – Cullen Valley Mine.*

Aside from this inherited issue of underground heating damaging existing rehabilitation, Coalpac's rehabilitation of mined areas are progressing well and are within target levels (EcoBiological 2010), which provides confidence that future rehabilitation of newly mined areas will follow suit and be of high quality providing habitat for flora and fauna.

An analysis of recent rehabilitation data is provided in more detail below.

The table below shows that each rehabilitation block varies in its diversity. Surprisingly, the oldest block (2002) has the poorest species diversity. It appears from the photographic records of block 2002 provided in EcoBiological (2010) that the area has been affected by the heating of old underground workings. This would explain the poor diversity of species recorded.

Keeping in the mind the poor diversity of block 2002, the average number of species recorded over the rehabilitation is 55 species (including weeds). The highest diversity (71 species) was recorded in block 2003; block 2002 has the poorest diversity at 21 species. An average of 34% of species found in the reference site is also found in the nearby rehabilitation blocks. Approximately 50% of species found within Cumberland Ecology surveys of Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest occur across the rehabilitation blocks. The rehabilitation block with the highest proportion of native species occurring within the reference site and Cumberland Ecology's

surveys is block 2003 with approximately 47% and 31% respectively. Weed foliage cover on all rehabilitation blocks is low and the highest weed cover recorded on block 2008 (EcoBiological 2010). Rehabilitation of *Eucalyptus cannonii* cannot be measured at this current stage due the Stringybark trees not being at reproductive maturity and the reliance on reproductive material to distinguish the Vulnerable *Eucalyptus cannonii* from the common *Eucalyptus macrorhyncha.*

EcoBiological's rehabilitation assessment report of Coalpac's existing rehabilitation has been provided in **Appendix J**. The report provides further quantitative analysis against target levels and photograph records of each rehabilitation block.

Table 5.1 provides a complete list of species recorded by EcoBiological (2010) in each rehabilitation block (2002, 2003, 2004 and 2008) in the Project Boundary. A total of 60 quadrats (2m x 2m) were sampled over the four rehabilitation blocks. The total number of species recorded in each block has been aligned against a complete list of species recorded in nearby native undisturbed vegetation by EcoBiological (2010) and a list of species recorded by Cumberland Ecology in Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest.

Table 5.1 Analysis of Existing Rehabilitation of Mine Areas

Family	Scientific Name	Common Name	Rehabilitation Blocks				EcoBiological Reference Site	Cumberland Ecology
			2002	2003	2004	2008		
Acanthaceae	*Brunoniella australis*							X
Adiantaceae	*Cheilanthes sieberi subsp. sieberi*	Poison Rock Fern					X	X
Anthericaceae	*Arthropodium sp.*						X	
Anthericaceae	*Thysanotus tuberosus subsp. tuberosus*	Common Fringe-lily					X	
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort	X	X			X	X
Apiaceae	*Hydrocotyle tripartita*	Pennywort				X		X
Apiaceae	*Platysace ericoides*			X			X	
Asteraceae	*Brachyscome spathulata*							X
Asteraceae	*Cassinia aculeata*	Dolly Bush		X	X	X	X	
Asteraceae	*Cassinia quinquefaria*				X			
Asteraceae	*Chrysocephalum apiculatum*	Yellow Buttons		X		X	X	
Asteraceae	*Coronidium scorpioides*	Button Everlasting					X	
Asteraceae	*Cirsium vulgare**	Spear Thistle			X	X		
Asteraceae	*Conyza sp.**					X		
Asteraceae	*Euchiton gymnocephalus*				X			
Asteraceae	*Euchiton involucratus*	Star Cudweed					X	
Asteraceae	*Gamochaeta americana**	Cudweed				X		
Asteraceae	*Gnaphalium sp.**				X			

Table 5.1 Analysis of Existing Rehabilitation of Mine Areas

Family	Scientific Name	Common Name	Rehabilitation Blocks				EcoBiological Reference Site	Cumberland Ecology
			2002	2003	2004	2008		
Asteraceae	*Helichrysum scorpiodes*							X
Asteraceae	*Hypochaeris radicata**	Catsear	X	X	X	X	X	
Asteraceae	*Lagenifera stipitata*	Blue Bottle-daisy						X
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood		X		X	X	X
Asteraceae	*Senecio linearifolius*	Fireweed Groundsel			X			
Asteraceae	*Senecio madagascariensis**	Fireweed				X		
Asteraceae	*Senecio mrenanthoides*							
Asteraceae	*Senecio quadridentatus*	Cotton Fireweed		X	X		X	
Asteraceae	*Senecio sp.*				X			
Asteraceae	*Sonchus oleraceus**	Common Sowthistle			X			
Asteraceae	*Vittadinia cuneata*							X
Boraginaceae	*Cynoglossum australe*				X		X	X
Boraginaceae	*Echium vulgare**	Vipers Bugloss				X		
Brassicaceae	*Arabidella ssp.*							
Brassicaceae	*Capsella bursa-pastoris**	Shepherd's Purse				X		
Campanulaceae	*Wahlenbergia communis*						X	
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell			X			X
Campanulaceae	*Wahlenbergia stricta subsp. stricta*	Tall Bluebell		X	X	X	x	

Table 5.1 Analysis of Existing Rehabilitation of Mine Areas

Family	Scientific Name	Common Name	Rehabilitation Blocks				EcoBiological Reference Site	Cumberland Ecology
			2002	2003	2004	2008		
Caryophyllaceae	*Stellaria pungens*	Prickly Starwort		X	X	X		X
Casuarinaceae	*Allocasuarina distyla*	Scrub She-oak		X	X	X		
Chenopodiaceae	*Einadia hastata*	Berry Saltbush			X	X		
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush		X	X	X		
Clusiaceae	*Hypericum gramineum*	Small St. John's Wort		X			X	
Clusiaceae	*Hypericum perforatum**	St John's Wort			X	X		
Convolvulaceae	*Convolvulus erubescens*	Blushing Bindweed			X			
Convolvulaceae	*Dichondra repens*	Kidney Weed						X
Cyperaceae	*Carex inversa*					X		
Cyperaceae	*Schoenus apogon*	Common Bog-rush				X		
Dennstaedtiaceae	*Pteridium esculatum*	Bracken Fern						
Dilleniaceae	*Hibbertia obtusifolia*	Hoary Guinea Flower			X		X	X
Ericaceae - Styphelioideae	*Brachyloma daphnoides*	Daphne Heath					X	X
Ericaceae - Styphelioideae	*Lissanthe strigosa subsp. subulata*	Peach Heath					X	
Ericaceae - Styphelioideae	*Leucpogon lanceolatus*							X
Ericaceae -	*Leucpogon muticus*							X

Table 5.1 Analysis of Existing Rehabilitation of Mine Areas

Family	Scientific Name	Common Name	Rehabilitation Blocks				EcoBiological Reference Site	Cumberland Ecology
			2002	2003	2004	2008		
Styphelioideae								
Ericaceae - Styphelioideae	*Monotoca scoparia*			X			X	
Ericaceae - Styphelioideae	*Styphelia tubiflora*							X
Fabaceae - Faboideae	*Bossiaea sp.*			X	X			
Fabaceae - Faboideae	*Cytisus scoparius**	Scotch Broom			X			
Fabaceae - Faboideae	*Glycine sp.*			X	X			
Fabaceae - Faboideae	*Glycine clandestina*							
Fabaceae - Faboideae	*Glycine tabacina*				X			
Fabaceae - Faboideae	*Hardenbergia violacea*	Purple Coral Pea		X	X	X	X	X
Fabaceae - Faboideae	*Hovea heterophylla*						X	
Fabaceae - Faboideae	*Hovea linearis*							X

Table 5.1 Analysis of Existing Rehabilitation of Mine Areas

Family	Scientific Name	Common Name	Rehabilitation Blocks				EcoBiological Reference Site	Cumberland Ecology
			2002	2003	2004	2008		
Fabaceae - Faboideae	*Indigofera australis*	Australian Indigo		X	X			X
Fabaceae - Faboideae	*Podolobium ilicifolium*	Prickly Shaggy Pea		X				X
Fabaceae - Faboideae	*Trifolium repens**	White Clover				X		
Fabaceae - Faboideae	*Acacia brownii*							X
Fabaceae - Mimosoideae	*Acacia buxifolia subsp. buxifolia*	Box-leaf Wattle	X	X	X	X	X	X
Fabaceae - Mimosoideae	*Acacia dealbata subsp. dealbata*	Silver Wattle	X	X	X	X	X	X
Fabaceae - Mimosoideae	*Acacia decurrens*	Black Wattle	X	X	X	X		
Fabaceae - Mimosoideae	*Acacia falciformis*	Broad-leaved Hickory		X	X	X		X
Fabaceae - Mimosoideae	*Acacia gunnii*	Ploughshare Wattle					X	
Fabaceae - Mimosoideae	*Acacia implexa*	Hickory Wattle		X	X		X	

Table 5.1 Analysis of Existing Rehabilitation of Mine Areas

Family	Scientific Name	Common Name	Rehabilitation Blocks				EcoBiological Reference Site	Cumberland Ecology
			2002	2003	2004	2008		
Fabaceae - Mimosoideae	*Acacia myrtifolia*	Red-stemmed Wattle		X	X			
Fabaceae - Mimosoideae	*Acacia obtusifolia*		X				X	X
Fabaceae - Mimosoideae	*Acacia rubida*	Red-stemmed Wattle	X	X	X	X		
Fabaceae - Mimosoideae	*Acacia sp.*				X	X		
Fabaceae - Mimosoideae	*Acacia spectabilis*	Mudgee Wattle	X	X	X	X		
Fabaceae - Mimosoideae	*Acacia terminalis*	Sunshine Wattle	X	X	X	X		X
Fabaceae - Mimosoideae	*Acacia ulicifolia*	Prickly Moses			X			X
Gentianaceae	*Centaurium erythraea**	Common Centaury			X	X		
Geraniaceae	*Geranium solanderi*	Native Geranium		X	X			
Goodeniaceae	*Goodenia bellidifolia*	Daisy-leaved Goodenia					X	
Goodeniaceae	*Goodenia hederacea subsp. hederacea*	Forest Goodenia				X	X	X
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort		X	X	X	X	
Haloragaceae	*Haloragis heterophylla*	Rough Raspwort				X		

Table 5.1 Analysis of Existing Rehabilitation of Mine Areas

Family	Scientific Name	Common Name	Rehabilitation Blocks				EcoBiological Reference Site	Cumberland Ecology
			2002	2003	2004	2008		
Iridaceae	*Patersonia sericea*	Silky Purple-Flag		X			X	
Juncaceae	*Juncus australis*					X		
Juncaceae	*Juncus flavidus*							
Juncaceae	*Juncus vaginatus*		X					
Lamiaceae	*Mentha satureioides*	Creeping Mint				X		
Lauraceae	*Cassytha pubescens*	Devil's Twine					X	
Lobelieaceae	*Pratia purpurascens*							X
Lomandraceae	*Lomandra filiformis*	Wattle Mat-rush			X		X	X
Lomandraceae	*Lomandra glauca*	Pale Mat-rush					X	
Lomandraceae	*Lomadra longifolia*							X
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush		X	X		X	X
Loranthaceae	*Amyema pendulum subsp. pendulum*						X	
Malaceae	*Cotoneaster sp.**				X			
Myrsinaceae	*Anagallis arvensis**	Scarlet Pimpernel	X	X	X	X		
Myrtaceae	*Eucalyptus albens*	White Box		X		X		
Myrtaceae	*Eucalyptus bicostata*	Southern Blue Gum		X	X			
Myrtaceae	*Eucalyptus bridgesiana*	Apple Box	X	X	X			
Myrtaceae	*Eucalyptus dalrympleana subsp. dalrympleana*	Mountain Gum		X	X	X		X

Table 5.1 Analysis of Existing Rehabilitation of Mine Areas

Family	Scientific Name	Common Name	Rehabilitation Blocks				EcoBiological Reference Site	Cumberland Ecology
			2002	2003	2004	2008		
Myrtaceae	*Eucalyptus cannonii#*	Capertee Stringybark					X	X
Myrtaceae	*Eucalyptus dives*	Broad-leaved Peppermint		X				X
Myrtaceae	*Eucalyptus globoidea*	White Stringybark	X	X		X		
Myrtaceae	*Eucalyptus macrorhyncha/cannonii*	Red Stringybark	X	X	X			
Myrtaceae	*Eucalyptus macrorhyncha*	Red Stringybark					X	
Myrtaceae	*Eucalyptus mannifera*	Brittle Gum					X	X
Myrtaceae	*Eucalyptus melliodora*	Yellow Box			X			
Myrtaceae	*Eucalyptus obliqua*	Messmate		X	X	X		
Myrtaceae	*Eucalyptus pauciflora*	Snow Gum		X	X	X		
Myrtaceae	*Eucalyptus punctata*	Grey Gum	X			X		
Myrtaceae	*Eucalyptus radiata subsp. radiata*	Narrow-leaved Peppermint		X		X		
Myrtaceae	*Eucalyptus rossii*	Inland Scribbly Gum		X	X	X	X	X
Myrtaceae	*Eucalyptus rubida*	Candlebark	X	X				
Myrtaceae	*Eucalyptus sieberi*	Silvertop Ash		X	X			
Myrtaceae	*Eucalyptus sp.*			X				
Myrtaceae	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark			X			X
Myrtaceae	*Eucalyptus tereticornis/blakelyi*	Forest Red Gum		X	X			
Myrtaceae	*Eucalyptus viminalis*	Ribbon Gum		X				X

Table 5.1 Analysis of Existing Rehabilitation of Mine Areas

Family	Scientific Name	Common Name	Rehabilitation Blocks				EcoBiological Reference Site	Cumberland Ecology
			2002	2003	2004	2008		
Nyctaginaceae	*Boerhavia dominii*	Tarvine		X				
Oleaceae	*Notelaea microcarpa*	Native Olive		X				
Orchidaceae	*Acianthus sp.*							X
Orchidaceae	*Calochilus sp.*						X	
Orchidaceae	*Corysanthes hispida*	Bristly Helmet Orchid						
Orchidaceae	*Dipodium roseum*						X	
Orchidaceae	*Diuris maculata*							X
Orchidaceae	*Diuris sp.*						X	
Orchidaceae	*Pterostylis sp.*							X
Oxalidaceae	*Oxalis perennans*			X	X	X	X	X
Phormiaceae	*Dianella revoluta var. revoluta*	Blue Flax-Lily					X	X
Phyllanthaceae	*Poranthera microphylla*		X	X	X	X	X	X
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		X			X	X
Pittosporaceae	*Plantago debilis*							X
Plantaginaceae	*Plantago lanceolata**	Lamb's Tongues				X		
Poaceae	*Austrodanthonia penicillata*							X
Poaceae	*Austrodanthonia racemosa var. racemosa*			X	X		X	
Poaceae	*Austrodathonia sp.*			X				

Table 5.1 Analysis of Existing Rehabilitation of Mine Areas

Family	Scientific Name	Common Name	Rehabilitation Blocks				EcoBiological Reference Site	Cumberland Ecology
			2002	2003	2004	2008		
Poaceae	*Austrostipa scabra*				X	X	X	X
Poaceae	*Austrostipa sp.*			X	X		X	
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass	X	X	X	X	X	
Poaceae	*Entolasia stricta*	Wiry Panic					X	
Poaceae	*Echinopogon caespitosus*							X
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass		X				
Poaceae	*Entolasia stricta*	Wiry Panic		X				
Poaceae	*Holcus mollis**	Creeping Fog				X		
Poaceae	*Joycea pallida*	Redanther Wallaby Grass	X	X			X	X
Poaceae	*Lachnagrostis aemula*	Blowngrass				X		
Poaceae	*Lolium sp.*					X		
Poaceae	*Microlaena stipoides var. stipoides*	Weeping Grass	X	X			X	X
Poaceae	*Panicum effusum*							X
Poaceae	*Panicum simile*	Two-colour Panic		X				
Poaceae	*Phalaris aquatica**	Phalaris			X	X		
Poaceae	*Poa sieberiana*		X	X	X	X	X	X
Poaceae	*Poaceae sp.*					X		
Poaceae	*Themeda australis*							X

Table 5.1 Analysis of Existing Rehabilitation of Mine Areas

Family	Scientific Name	Common Name	Rehabilitation Blocks				EcoBiological Reference Site	Cumberland Ecology
			2002	2003	2004	2008		
Polygonaceae	*Rumex sp.**	Dock				X		
Proteaceae	*Lomatia myricoides*							
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung			X	X		X
Proteaceae	*Persoonia myrtilloides*							X
Ranunculaceae	*Clematis aristata*	Old Man's Beard		X				
Rosaceae	*Acaena novae-zelandiae*	Bidgee-widgee				X		
Rosaceae	*Rubus fruticosus**	Blackberry			X	X	X	
Rubiaceae	*Asperula conferta*							X
Rubiaceae	*Galium binifolium*			X	X			
Rubiaceae	*Galium gaudichaudii*	Rough Bedstraw		X	X			
Rubiaceae	*Galium propinquum*							X
Rubiaceae	*Opercularia aspera*	Coarse Stinkweed		X				X
Rubiaceae	*Pomax umbellata*							X
Santalaceae	*Exocarpos cupressiformis*	Native Cherry		X				X
Santalaceae	*Leptomeria acida*							X
Scrophulariaceae	*Veronica calycina*							X
Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell		X	X	X	X	
Solanaceae	*Solanum sp.*				X			

Table 5.1 Analysis of Existing Rehabilitation of Mine Areas

Family	Scientific Name	Common Name	Rehabilitation Blocks				EcoBiological Reference Site	Cumberland Ecology
			2002	2003	2004	2008		
Stackhousiaceae	*Stackhousia monogyna*							X
Stylidiaceae	*Stylidium graminifolium*	Grass Trigger-plant					X	
Violaceae	*Viola betonicifolia*	Native Violet		X				X
Violaceae	*Viola hederacea*	Ivy-leaved Violet		X				
Species Diversity			**21**	**71**	**69**	**60**	**58**	**67**
Diversity found in reference sites			**8/58**	**27/58**	**22/58**	**19/58**		
Percentage found in reference sites			**14**	**47**	**28**	**33**	**100**	
Diversity found in Cumberland Ecology surveys of Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest			**9/67**	**21/67**	**18/67**	**15/67**		
Percentage found in CE surveys			**13**	**31**	**26**	**22**		

ii. Project Rehabilitation

Mine rehabilitation has an important role to play in mitigating impacts and restoring biodiversity, particularly when rehabilitation will have added strategic benefits. The Strategic benefits of successful rehabilitation for the Project are listed below:

- The Project lies within Ben Bullen State Forest, which is also proposed to form part of the Gardens of Stone State Conservation Area;
- Poor rehabilitation of mined areas will affect the value of offsets, particularly the value that the Hillcroft offset would add between linking Sunny Corner State Forest to Ben Bullen State Forest; and
- The Project will rehabilitate valley floor habitats which are crucial to maintaining wildlife corridors and connecting pagoda and ridgeline habitats.

For these reasons high quality mine rehabilitation for this Project is paramount. Based on recent precedents of other projects, it has been assumed that high quality mine rehabilitation of forest and woodland in the long term can be equivalent to ratios accredited to offsets. This is driven by the strategic benefits associated with restoring mined areas of Ben Bullen State Forest. Coalpac is committed to continuing their existing high quality rehabilitation and will rehabilitate 818 ha back to forest and woodland.

The proponent also commits to rehabilitating approximately 18.44 ha Capertee Rough-barked Apple Red Gum Yellow Box Grassy Woodland and Derived Native Grassland, 278 ha of potential and known *Eucalyptus cannonii* habitat, 3.28 ha of impacted *Persoonia marginata* habitat and the remaining 818 ha of non listed native vegetation. These areas will be rehabilitated to a similar standard as that of the undisturbed vegetation.

Table 5.2 below provides targets for the rehabilitation of threatened flora habitat. Targets have been derived from population estimates described in **Section 3**.

Table 5.2 Rehabilitation Targets (over 21 years) for Threatened Plants and Threatened Ecological Community Habitat Recorded in the Project Disturbance Boundary

	Area of known Habitat to be Cleared and Rehabilitated (ha)	Target Density per Hectare	Target Number of Individuals in Rehabilitation of Known Habitat
Eucalyptus cannonii	278^	See Table 3.1	19,219
Persoonia marginata	3.28	98	321
Capertee Rough-barked Apple Red Gum Yellow Box Woodland and Derived Native Grassland EPBC Act	16.48	n/a	n/a
Capertee Rough-barked Apple Red Gum Yellow Box Woodland and Derived Native Grassland TSC Act	1.96	n/a	n/a
Non-listed native vegetation	818.71		

Notes: ^ This figure does not include areas of grassland within the Hillcroft property still within the Project Disturbance Boundary that will be rehabilitated to include E. cannonii.

Rehabilitation of threatened plant habitats will aim to achieve similar densities of *Eucalyptus cannonii* and *Persoonia marginata* recorded during population estimates as indicated in the table above. Rehabilitation of *Eucalyptus cannonii* habitat is not expected to be difficult as seed viability appears to be high as the species can be easily propagated from seed (NSW NPWS 2000). The ease of propagating this species is sanctioned by the prevalence of nurseries supplying tubestocks within its natural range. The species is apparently already in existing rehabilitation which will continue for the Project.

Mt Annan Royal Botanic Gardens have also successfully propagated *Persoonia marginata*. Propagation trials of *Persoonia marginata* will be undertaken by Coalpac to ensure successful rehabilitation of the 3.28 ha of habitat to be impacted. The density of planted *Persoonia marginata* within rehabilitation will aim to achieve a survival rate of pre-clearance densities, which has been recorded at 98 plants per hectare. Where practical, topsoil will be translocated from proposed mining areas, particularly habitat of the *Eucalyptus cannonii* and *Persoonia marginata*, with minimal stockpiling or spread across areas ready for rehabilitation works, in an attempt to maximise the viability of the native seed bank of local ecological communities. Mitigation measures for avoiding soil-borne pathogens are explained below.

All areas disturbed by mining activities will be progressively rehabilitated over the life of the mine through consolidated Rehabilitation and Landscape Management Plan. Replanting of mine rehabilitation areas will use local native plant species. Seed collection programs will be undertaken to ensure adequate seed is collected from all species to ensure species diversity is maintained.

Table 5.3 below provides a summary of each mining impact area and subsequent rehabilitation area of the Project for years 2, 8, 14 and 20.

Table 5.3 Conceptual Rehabilitation of Project Mining Areas

	Hillcroft	Cullen Valley	East Tyldesley	Invincible	Total
Year 2	73.3	181.3	0.0	136.3	**390.9**
Year 8	80.6	181.3	50.2	259.1	**571.2**
Year 14	80.6	284.7	151.4	343.7	**860.4**
Year 20	80.6	358.7	191.8	442.0	**1073.1**
Total	**80.6**	**358.7**	**191.8**	**442.0**	

Notes: the existing rehabilitation in each mining area has been considered in the calculations. The total area is therefore greater than the project disturbance boundary at the conclusion of the Project.

In order to measure the effectiveness of the rehabilitation and its effect on Matters of NES, a monitoring strategy will be developed and implemented. This will comprise detailed and replicated flora and fauna surveys in rehabilitated areas to quantify the change in species diversity over time. Further details of the monitoring strategy to be implemented in areas of rehabilitation are provided in the **Section 5.3.10**.

In addition, a consolidated Rehabilitation and Landscape Management Plan will be developed for this Project that prescribes the progressive rehabilitation of all mine disturbed areas. The key objectives of this plan are to restore, where possible, the pre-mining biodiversity within a safe and stable landform.

A consolidated Mine Closure Plan will also be developed for the Project at the relevant time to specify how lands within the Project Boundary will be finally closed to mining and returned to other land uses.

Below are a series of recent photographs of the rehabilitation at Cullen Valley Mine.



Photograph 5.1 **Existing Mine Rehabilitation at Cullen Valley Mine**



Photograph 5.2 **Existing Mine Rehabilitation at Cullen Valley Mine**



Photograph 5.3 Existing Mine Rehabilitation at Cullen Valley Mine

Baal Bone Colliery, Pine Dale Mine and Ivanhoe North Colliery also propose to rehabilitate mined areas in the subregion and return the lands within their mining authorities to pre-disturbed forest and woodland communities. The mined landscaped in the region will be progressively returned as flora and fauna habitat in the medium to long term. The combined rehabilitation of these three large mines, together with the rehabilitation of the Project Boundary will create large areas of native vegetation in the vicinity that will be managed for conservation in the long term.

5.3.4 Soil-borne Pathogen Control – Phytophthora cinamomi

Phytophthora cinnamomi is a root or collar rot fungus that causes dieback in native plants (Environment Australia 2001). Serious epidemics of *P. cinnamomi* have occurred in areas of Australia south of 30° latitude. The root damage caused by *Phytophthora* renders plants vulnerable to disturbance, drought stress, dieback and death (Environment Australia 2001) Infection of native plants by *P. cinnamomi* is listed as a Key Threatening Process under the NSW *Threatened Species Conservation Act 1995* (TSC Act)[13] and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

P. cinnamomi has been particularly successful in areas of Australia with a Mediterranean climate (Botanic Gardens Trust 2008). Disease epidemiology of *P. cinnamomi* induced dieback is complex and dependent on a number of biotic and abiotic factors including climate, soil characteristics, soil microbes and host physiology and susceptibility (Botanic Gardens Trust 2008). Therefore it is not possible to measure the susceptibility of the Project to *Phytophora cinamomi.*

No accounts of die back have been recorded in the Project Boundary or in the area to date. The closest known record occurs in Wollemi National Park, Newnes, approximately 10 km north-east of the Project Boundary (Therese Suddaby 2008).

Phytophora cinamomi can spread via wind dispersal or through the transportation of infected vegetation. As it is not known from the site, the likelihood of spreading the fungus throughout the Project from site topsoil is low. All vehicles involved in vegetation clearance that are new or been used outside the Project Boundary will be cleaned prior to entering the site to ensure that they are free from soil / vegetation prior to clearing.

Monitoring and management of *Phytophora cinnamomi* within rehabilitation areas will form part of the BMP.

5.3.5 Weeds and Feral Animal Control

A weed and feral animal control program will be implemented to control feral animals and weeds. These will focus on those species that have the capacity to significantly impact on the habitat value of the retained native vegetation and native fauna populations. Some exotic plant species pose serious threats to native vegetation communities. These introduced species typically invade, out compete and eventually modify ecosystems so that native plants species cannot survive. Priority will be given to the removal of such species. Weed control methods include hand weeding, foliar spraying, cut-and-paste, and stem injection.

Feral animals that have the capacity to impact on the environment include the European Red Fox that can impact on the Spotted-tailed Quoll through predation, and the European Rabbit, that can affect vegetation communities through grazing. These will be controlled through appropriate management strategies.

5.3.6 Dust Minimisation Measures

A suite of dust minimisation measures will be implemented during construction and operation of the Project. These measures would comprise a monitoring network and management procedures to proactively manage the day-to–day generation of dust and fine particles due to the Project.

The management of dust generation from the Project will focus on key identified areas of construction and operational activities. These activities are listed below and will be implemented to minimise dust impacts on-site and off-site:

- Disturbed areas – mitigation measures are targeted at design measures as well as operational techniques in order to minimise dust generation, such as the design and reshaping of overburden dump areas and the regular watering of trafficked surfaces;
- Handling of materials – mitigation measures are focused on materials being handled (i.e. ROM, overburden, topsoil) to minimise dust generation, as well as an awareness of adverse weather and relocating/rescheduling activities in periods of high wind where dust impacts can be expected;
- Haul roads – mitigation measures are targeted at minimising the volume of trucks where practical and minimising dry exposed surfaces as well as the type of surface of the haul roads themselves; and

- Blasting – mitigation measures such as the consideration of weather conditions and sensitive features will be incorporated into the design of the blasts for the Project.

A key component of dust minimisation for on-site and off-site impacts is the monitoring of adverse weather conditions. Adverse dispersion conditions may include prolonged periods of calm or strong wind speeds and a range of conditions in between. Under light winds and stable conditions the dispersion potential of the atmosphere is limited and emissions sources, such as dozers, excavators, draglines and trucks are likely to be the largest contributor to impacts and should be managed accordingly. Conversely, wind erosion and wind dependent sources are likely to contribute most significantly when strong winds are experienced.

The implementation of the above mitigation measures are expected to provide sufficient management of dust generation to minimise the on-site and off-site impacts.

5.3.7 Noise Minimisation Measures

Noise generation from the Project will be managed through the targeting the mine plan design, noise mitigation of the plant and equipment fleet (such as attenuating haul trucks or cladding of the Invincible Coal Handling Processing Plant (CHPP)), and prescribing protocols and procedures for construction and operational activities. In addition to these measures, predictive modelling has been utilised during the development of the Project in order to develop a series of mining scenarios that would limit any adverse noise impacts.

The implementation of the above mitigation measures are expected to provide sufficient management of noise generation to minimise the on-site and off-site impacts.

5.3.8 Management of Surface Water, Erosion and Sedimentation

The construction and operation of the Project will manage the potential on-site and off-site impacts from surface water and erosion and sedimentation through the implementation of a range of prescribed mitigation measures. These measures will target the design of both construction and operational activities where practical. Key aspects include:

- Maintaining flows in receiving waters – where practical, diverting runoff from undisturbed areas into natural drainage network via diversion drains and banks;
- Maintaining receiving water quality – directing groundwater flows and stormwater runoff from disturbed areas to the water management system;
- Minimising on-site erosion – temporary erosion and sediment control measures to include silt fences, hay bales, jute mesh, cross banks, contour banks, armouring and straw mulching; and
- Developing an integrated Water Management System for the Project, including a range of water management storages and infrastructure.

The implementation of the above mitigation measures are expected to provide sufficient management of water on-site to minimise the potential direct and indirect impacts from water through erosion and sedimentation.

5.3.9 Reference Sites

To inform the rehabilitation strategy, it will be important to determine what the key characteristics of the ecological community are that will need to be identified and assessed to determine if successful rehabilitation has been accomplished. These will be obtained through the process of establishing baseline data from undisturbed areas of representative communities, commonly referred to as reference sites. These sites will be monitored simultaneously throughout the life of the Project and fundamental aspects such as species composition and weed levels will be assessed and compared to the rehabilitation areas to determine if rehabilitation is progressing in a satisfactory way, or enable unsatisfactory aspects to be detected at an early stage of the Project. The positioning of reference sites will include undisturbed and non impacted *Persona marginate* habitat. As part of the rehabilitation strategy for the Project, a series of reference sites will be established and included in the BMP using a quantitative methodology which will also be used to develop completion criteria.

i. Existing Reference Sites

Two reference sites have been located in remnant native vegetation within the Project Boundary for rehabilitation of mined areas (see **Figure 2.1**). One 20 m x 20 m quadrat is located in remnant vegetation surrounding the Invincible Mine CHPP and another in remnant forest directly south of the Cullen Valley open cut mine haul road (EcoBiological 2010). At each reference site five 2 m x 2 m quadrats are randomly placed and the following parameters are recorded:

- Species diversity;
- Plant density;
- Stratum proportions – ground, shrub, midstorey and overstorey;
- Height; and
- Foliage cover.

More reference sites are to be established as more impacted areas are rehabilitated, especially if new vegetation communities and habitats are introduced into the rehabilitation program that have not already been included. This way, as the rehabilitation program becomes more diverse, the reference sites will follow suit and provide useful benchmarks. Reference sites should be appropriately replicated for each vegetation community to capture a full range of variables including catastrophic events such as wildfire.

5.3.10 Ecological Monitoring

This section provides a proposed methodology for the ecological monitoring program that will be implemented within the offset properties and areas of remnant vegetation and mine rehabilitation within the Project Boundary. The monitoring program aims to incorporate a range of methodologies that will provide various levels of information about the existing flora and fauna species and their habitats and quantify ecological changes occurring within these populations and habitats as a result of improved management, habitat re-establishment and enhancement and rehabilitation programs being implemented throughout the life of the Project.

The monitoring program will include:

- Undertaking baseline flora and fauna surveys in the Biodiversity Offset Properties to determine the flora and flora species present, estimate the population sizes and distribution of species of NES (National Environmental Significance) and determine areas and quality of potential habitat;
- Establishing permanent monitoring quadrats and photo-points in various habitat types and in various health conditions in the Biodiversity Offset Properties and remnant vegetation within the Project Boundary;
- Undertaking on-going ecological monitoring in these areas for the duration of the Project to assess changes occurring within these communities as a result of improved management or habitat enhancement programs;
- Undertaking annual ecological monitoring of Project rehabilitation, habitat re-establishment and active management areas within the Project Boundary for the duration of the action to measure changes in ecological function and sustainability and ensure these areas are comparable with a range of reference sites or trending in the right direction;
- Undertake monitoring of MNES, particularly the *Persoonia marginata* subpopulations and their habitat adjacent to the Project Disturbance Boundary for the duration of the Project to measure changes in habitat quality, potential threatening processes and overall population health;
- Identifying and addressing key threatening processes, such as limited recruitment, weed or feral animal invasion or poor rehabilitation progress based on the data, which can be used as a guide for adaptive management strategies; and
- Demonstrating that the monitoring methodology is sufficient to satisfy regulatory reporting requirements and assist and guide management intervention required to complete the desired objectives.

i. Baseline Ecological Surveys

Detailed baseline and pilot flora and fauna surveys will be undertaken across the various woodland and grassland communities within the Project Boundary and Biodiversity Offset Properties to provide environmental data for the relevant Matters of National Environmental Significance (MNES) including areas of habitat or potential habitat for native species. These surveys will add to the data collected during previous extensive surveys undertaken in the Project Boundary.

ii. Flora Surveys

Baseline flora surveys will be undertaken to identify the species occurring, estimate the population sizes and distribution of flora species and ecological populations of NES and determine areas of potential habitat. The flora assemblages will be recorded by quadrat sampling, random meander surveys and targeted searches for flora species listed as MNES. This includes but is not limited to *Eucalyptus cannonii* and *Persoonia marginata*.

All vascular plants recorded or collected will be identified using keys and nomenclature provided in Harden (1990-1993). Any specimens are not readily identifiable will be lodged for identification with the National Herbarium of NSW at the Royal Botanic Gardens, Sydney.

iii. Fauna Surveys

Detailed baseline fauna surveys will be undertaken focussing on the relevant species of NES, including but not limited to the Spotted-tailed Quoll, the Regent Honeyeater, the Swift Parrot, the Large-eared Pied Bat, Brush-tailed Rock-wallaby and Broad-headed Snake. This will involve establishing survey locations and conducting targeted surveys including cage trapping, harp trapping and bird surveys. The survey locations established in the baseline fauna surveys will be utilised in the subsequent Flora and Fauna Management Plan for the Project to enable comparisons in faunal composition to be made over time. This will enable a more comprehensive management plan to be developed, which addresses more specific management requirements for individual species as required.

a. Reptile Surveys

Purpose: to survey for the Broad-headed Snake

To survey for the Broad-headed Snake, a combination of active searches in winter and spotlighting of suitable tree hollows in the warmer summer months will be employed.

Being a cold blooded species, the Broad-headed Snake switches between habitats depending on the season. In warmer summer months, the species prefers to nest in tree hollows while in the winter months the species can be found in exfoliating sandstone outcrops and rock crevices. Survey will employ both active searches in summer and spotlighting of tree hollows in winter.

b. Mammal surveys

Purpose: to survey for the Spotted-tailed Quoll

To survey for the Spotted-tailed Quoll, Infra-red camera will be utilised at each monitoring location.

These traps use animal movement to trigger the camera to take a still photograph, and as they use infra-red technology, they can be used at night. Two camera traps will be positioned approximately 60 cm from the ground in potential habitat and will be left for a minimum of two weeks at each location. Bait will be placed within the field of view of the camera. Infra-red camera traps are useful because they are left in place for long time periods, and shy animals such as the Spotted-tailed Quoll can become habituated to them. These traps have been proven to detect Quolls in other parts of NSW.

Purpose: to survey for the Brush-tailed Rock-wallaby

To survey for the Brush-tailed Rock-wallaby, Infra-red camera will be utilised at each monitoring location.

These traps use animal movement to trigger the camera to take a still photograph, and as they use infra-red technology, they can be used at night. Two camera traps will be positioned in potential habitat including but not limited to shelter habitat or high transient areas, optimally where Brush-tailed Rock-wallaby scats are found.

The cameras will be left for a minimum of two weeks at each location. Infra-red camera traps are useful because they are left in place for long time periods, and shy animals such as the Brush-tailed Rock-wallaby can become habituated to them.

iv. Bat Surveys

Purpose: to survey for the Large-eared Pied Bat

To survey for the Large-eared Pied Bat, harp traps will be employed at several locations to trap microbats at night along suitable flyways. Harp traps will be left a minimum of two nights at each survey location. Bats will be collected from harp traps at dawn and the bat species subsequently identified.

v. Migratory Bird Surveys

Purpose: to survey for the Regent Honeyeater & Swift Parrot

Surveys for the Regent Honeyeater and Swift Parrot will be undertaken annually at a time when these species have potential to occur. The best time is likely to be between July and October, when both species are known to occur in the area.

Visual observation and call identification will be carried out in each monitoring location. Dawn and dusk surveys will be conducted at each monitoring location and diurnal birds will be also identified and recorded as they are during the survey periods. GPS readings will be taken near sightings of any threatened bird species.

vi. Habitat Assessment

In the baseline ecological surveys, the habitat assessment would focus on the availability of suitable habitat for the relevant species of NES; however the suitability of habitat for other species would also be recorded. Fauna habitat assessments will also include consideration of important indicators of habitat condition and complexity including the occurrence of microhabitats such as tree hollows, fallen logs, bush rock and wetland areas such as creeks and soaks. An assessment of the structural complexity of vegetation and habitat features such as tree hollows, bush rock and fallen trees, and signs of fauna usage such as scats, diggings, footprints, scratches, nests, burrows, paths and runways are recorded. The nature and extent of human disturbance at each monitoring location will also be recorded.

The establishment of permanent monitoring quadrats and ecological methodology monitoring used to assess habitat condition will be part of the on-going ecological monitoring program and is described in more detail below.

5.3.11 Summary of Mitigation Measures

A suite of environmental control measures will be implemented for the Project which will have indirect benefits that will help to minimise impacts to ecology.

Table 5.4 provides a summary of the specific ecological mitigation measures to be implemented. Since the Project represents a consolidation of two existing Coalpac mines, some of the following measures are currently being undertaken in which case existing management systems will be amalgamated and updated to cover the Project.

Table 5.4 Summary of Specific Ecological Mitigation Measures

Impact	Mitigation
Vegetation and habitat loss	Mine associated infrastructure will be located in existing cleared areas where possible to minimise the loss of habitat. Disturbance of vegetation will be limited to the minimum necessary for each stage of the pre strip clearing. Limits of clearing will be marked and fencing installed where appropriate around the construction footprint area prior to construction activities commencing to avoid unnecessary vegetation and habitat removal. A pre-clearing Land Disturbance protocol will be extended and refined for all vegetation clearing to minimise impacts to threatened flora and fauna and resident fauna. A consolidated flora and fauna management plan will be developed as part of the BMP. Clearing of vegetation will be scheduled where possible to optimise seed collection. Transportable habitat features such as large logs and boulders will be retained post-clearing and placed in available rehabilitation areas, where feasible, to allow their continuation as potential fauna refuge sites. Native seed will be collected and propagated for use in rehabilitation areas and other disturbed areas including Eucalyptus cannonii. Persoonia marginata cuttings will be used in rehabilitation. Eucalyptus aggregata rehabilitation in Invincible Colliery's existing offset 8 should also occur. Appropriate regeneration methodologies and strategies will be developed for the Project. As part of these methodologies, there will be a focus on optimising revegetation efforts and offsetting areas for threatened species. Mining areas will be progressively revegetated. Retained vegetation and revegetated/regenerated vegetation will be managed for conservation including access restrictions, weed control, and feral animal management. A substantial external offset strategy will be developed and implemented (see Section 6). A terrestrial ecology monitoring program for the Project will be extended and refined to better understand impacts and guide rehabilitation actions for flora and fauna throughout the Project Boundary. Threatened species monitoring will be undertaken.

Table 5.4 Summary of Specific Ecological Mitigation Measures

Impact	Mitigation
	Monitoring will be undertaken for exotic weeds and feral animals to determine management actions required.
	Reference sites will be established and monitored for the life of the Project (see Section 5.3.9).
Habitat fragmentation	Linkages and or crossing zones between isolated vegetation remnant patches will be maintained where feasible.
	Vegetation will be rehabilitated to link existing patches of habitat and create corridors where feasible.
Weed and feral animal invasion	Detailed management strategies will be contained in the BMP.
Vehicle strike and direct mortality	Vehicle driving policies will be implemented with speed restrictions to minimise the risk to fauna.
	Signs will be erected to remind drivers to be alert at known fauna crossings.

Chapter 6

Biodiversity Offset Strategy

6.1 Introduction

In a regional context, it is recognised that the Project will take place on land classified as Zone No 1 (f) Rural (Forestry) which permits the development of extractive industries (mining). Notwithstanding, Coalpac has developed a BOS with the objective of offsetting the residual impacts on biodiversity, particularly on threatened ecological communities and habitat for threatened species. The Offset Strategy has been devised to comply with the current principles for offsetting set out by SEWPaC (DEWR, 2007) and by OEH (DECC (NSW), 2008a).

The Project will require the provision of a Biodiversity Offsets Package to compensate for the predicted ecological impacts of the proposed open cut mine and associated infrastructure. The Offset Package is the combination of offsets used to compensate the outstanding residual impacts of the Project that will result after various avoidance and mitigation measures have been implemented.

The Offset Package addresses the impacts of the Project in a strategic and meaningful way that will deliver a real biodiversity outcome. It will ensure that the Project is not conducted at the cost biodiversity conservation. A “maintain or improve” approach is to be undertaken that retains the ecological condition of the landscape within the locality by conserving, where practically possible, and increasing representative woodland and forest communities within designated areas.

Maintain or improve is defined as increasing the net area and condition of ecological communities within the locality of the proposed development in the medium to long term by permanently conserving and improving the condition of representative examples of vegetation communities and habitats for threatened species that are to be impacted by the proposed development. This definition has been based upon the key principles of offsetting, and particularly that:

- Offsets should be targeted to the ecological communities and threatened species that will be impacted by the Project;
- Offsets should be commensurate with the magnitude of the impacts; that is, there should be a net increase in the size and condition of the community types, populations or habitat types that will be impacted by the Project; and
- Offsets should be lasting; that is, there should be a level of legal protection for offset areas.

The Biodiversity Offsets Package consists of three priorities that together will ensure the best compensatory outcomes are achieved for the predicted ecological impacts of the Project. The Offsets Package has been designed to meet State and Commonwealth offset requirements and protect and improve biodiversity within the locality with the most efficient utilisation of resources.

6.2 Legal Requirements

The provision of Biodiversity Offsets to compensate for Project impacts is not currently a formal legal requirement. Notwithstanding this, offset policy documents exist for both Commonwealth and State Agencies (DEWR 2007, DECCW 2010). Proponents generally must demonstrate that their Project can address the principles outlined in these policy documents in order for their Project to be considered compliant with the objectives of the relevant environmental legislation (i.e. the Commonwealth EPBC Act and State EP&A and TSC Act).

6.3 Project Approach to Biodiversity Offsetting

The Biodiversity Offset Strategy entails acquisition of offset properties for permanent conservation of native flora and fauna, including threatened flora and fauna predicted to be impacted by the Project, supported by ongoing land management to improve the biodiversity values of the offsets. In addition to the principles set out by SEWPAC and OEH, the development of the Biodiversity Offset Strategy has been guided by the following key design concepts (adapted from Business and Biodiversity Offsets Programme (BBOP), 2009):

- Secure land for permanent conservation;
- Increase the area of forest and woodland under conservation above what will be lost through the Project;
- Improve the biodiversity values of the offset properties through changing land use (i.e. deliver conservation gains to offset properties that would otherwise not have taken place under current use);
- Improve the biodiversity values of the offset properties through the implementation of positive management interventions to actively stop degradation and to increase the area of native vegetation and habitat for native flora and fauna; and
- Time the offsets to minimise the lags between the Project's impacts and the offset achieving its objectives.

Consideration of the local and regional context of the Project and the offsets can help to enhance the land in the vicinity of the Project and to provide longer term community benefits. The surrounding land, including the GOS2 (State Conservation Area) Proposal; existing corridors (e.g. creeks, rivers); and partial or incomplete links (Sunny Corner State Forest and Ben Bullen State Forest) have played a significant role in shaping the Biodiversity Offset Strategy. Thus, the development of the offsets was also influenced by the following design concepts:

- Locate potential offsets available in the locality of the Project;
- Enhance existing conservation reserves by;
    - Adding to the patch size of a reserve by locating offsets nearby or adjacent to the reserve,
    - Adding additional land to the reserve system,

- Connecting an existing reserve to other areas of habitat by building corridors, and
- Buffering the reserve from surrounding land use.

➢ Build upon natural corridors like creeks and rivers to mitigate broad scale habitat fragmentation; and

➢ Build onto other nearby biodiversity offsets, which will add value by effectively increasing the net area of established offset areas in the locality.

Research has highlighted the importance of maintaining treed habitats in the intervening disturbed landscape, as these patches or corridors are important for fauna movement and seed dispersal (Cooper *et al.*, 2002; Fischer and Lindenmayer, 2002; DSE (VIC), 2008; Goldingay and Taylor, 2009). Remnant patches also serve as stepping stone corridors that facilitate the movement of fauna in the landscape (DSE (VIC), 2008). Stepping stones have been shown to be important in maintaining landscape connectivity and maintaining gene flow between separate populations because of the movement of pollen and seed vectors such as animals and insects (Lindenmayer, 2006).

Figure 6.1 presents the overview concept for the Biodiversity Offset Strategy. As mentioned above, a key design in the Biodiversity Offset Strategy for the Project is to build onto existing and future conservation lands and natural corridors to enhance the overall package of conservation lands in the locality of the Project.

Typically low diversity native grasslands consist of hardy native grasses and to lesser extent native herbs that persist, albeit grazed by cattle. These areas have not been ploughed nor been improved with pasture grasses. Low diversity native grasslands derived from non-listed communities within the Project Disturbance Boundary have not been included in impacts and will not be offset as these provide very limited ecological value in their current state (i.e. grassland); however areas of low diversity native grassland occurring within offset properties have been included within offset calculation as these areas, once rehabilitated, will form good quality woodland and forest habitats capable of supporting flora and fauna species and therefore exhibit higher ecological value.

6.3.1 Benefits of Biodiversity Offset Package to Ben Bullen State Forest (including GOS 2 BBLSD SCA)

The establishment of an offset package that is capable of connecting large areas of conservation is a major feature of the Biodiversity Offset Strategy for this Project. The Biodiversity Offset Strategy will add value to the existing reserve system in the area. The key concept underpinning this is to provide connectivity between these remnants and rehabilitation areas is to increase the patch size to enhance the contributions of each offset or reserve land.

The Project's biodiversity offset package has taken due consideration of Ben Bullen State Forest and the GOS2. As for both Ben Bullen State Forest and GOS2, the inclusion of Hillcroft will provide a missing link between two currently disconnected tracts of large remnant vegetation; this being the lack of connection between Ben Bullen State Forest and Sunny Corner State Forest (**Figure 6.1**).

The following objectives from Muir (2005) that are applicable and have been adopted by the Project are described below.

The establishment of an offset package that is capable of connecting large areas of conservation is a major feature of the Biodiversity Offset Strategy for this Project. The Biodiversity Offset Strategy will add value to the existing reserve system in the area. The key concept underpinning this is to provide connectivity between these remnants and rehabilitation areas and to increase the patch size to enhance the contributions of each offset or reserve land.

The Project's biodiversity offset package has taken due consideration of Ben Bullen State Forest and the GOS2. Notwithstanding that some areas of Hillcroft will be mined and rehabilitated. The inclusion of Hillcroft will provide a missing link between two large and currently disconnected tracts of native forest vegetation: Ben Bullen State Forest and Sunny Corner State Forest (**Figure 6.1**).

The following objectives from the GOS2 proposal are addressed by the Project, as explained below:

> Objective 1: *Protection of the most outstanding pagoda landscapes in Australia – these include some of the best scenery in Australia, such as dramatically coloured escarpments, narrow canyons, cave overhangs, rock arches, lonely sandstone peninsulas and wind-formed but now well vegetated sand dunes that are remnants of an ancient paleo-landscape*.

The Project will avoid all pagoda landscapes and Coalpac has committed to a 50 m buffer between mining operations and all pagodas or sandstone escarpments, and a 20 m buffer from any other significant rock exposure (outcrop) that does not fall into the above category.

> Objective 2: *Reservation of ancient windswept montane heathlands, nationally endangered upland swamps, a unique subspecies of snowgum and other grassy high plateau woodlands, including poorly conserved grassy white box woodlands, and moist forest gullies between these woodland*.

Collectively, the offset package will conserve all these attributes. The Hyrock Hartley property is located adjacent to the proposed Western Escarpment Division of GOS2. This property contains Blue Mountains Swamps, likely to constitute areas as described in the GOS2 as "nationally endangered upland swamps". The Hillcroft property supports intact high plateau grassy Scribbly Gum woodland and Gully Snow Gum – Ribbon Gum Forest. The Yarran View and Hillview/Billabong properties will contribute to poorly conserved grassy white box woodland and other CEEC variants local to the area. Further, the rehabilitation of grassland areas on Hillcroft aim to resemble pre-cleared forest which include moist gully forests. The acquisition of Hillcroft will conserve land that connects the rocky pagoda landscapes in the east to the wider drier rolling hills in the west. Once rehabilitated, Hillcroft will create direct connection between a large tracts of remnant habitat consisting of Winburndale Nature Reserve and Sunny Corner State Forest to even larger tracts of remnant habitat proposed to be GOS2 (Ben Bullen State Forest, Newnes State Forest and Gardens of Stone National Park) and further (Wollemi National Park and Blue Mountains National Park) (see Figure 4.2).

> Objective 3: *Protection of the area with the highest density of rare plants anywhere in the Blue Mountains.*

Hillcroft property and Hillview/Billabong have known populations of two nationally listed threatened plants; *Eucalyptus cannonii* and *Persoonia marginata.* The Booroolong Frog has also been recorded in a creek, which abuts Hillcroft.

The strategic benefits of the Project's biodiversity offset package has been summarised in **Section 6.4.7**.

6.3.2 Existing Biodiversity Offset Properties

Coalpac are currently managing land totalling approximately 166ha of forest, woodland and grassland, which will be managed as long-term compensatory conservation areas (see **Figure 1.2**). These properties will provide additional habitat for resident fauna and threatened flora species during the implementation of the Project. Approximately 115 ha of the existing Coalpac offsets are external to and abut the GOS2 proposal.

A breakdown of these properties has been provided below.

- Lot 1, DP 180294 ("Renown Farm"), an 18ha property containing approximately 5ha, of degraded woodland vegetation, and 13ha of degraded grassland and water storage. *Eucalyptus cannonii* tubestocks have been planted as part of rehabilitation (R.W. Corkery & Co 2008a);
- Lot 112, DP 877190, an 82ha property containing Tableland Gully Snow Gum, Ribbon Gum Grassy Forest vegetation community, Cox's Permian Red Stringybark Brittle Gum Woodland and Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest which is being rehabilitated and managed. This property also contains *Eucalyptus aggregata* and approximately 55 ha of suitable habitat. The species should be included in rehabilitation;
- Lot 113, DP 877190, which is linked to Ben Bullen State Forest and contains 14.5ha dominated by Tableland Gully Snow Gum – Ribbon Gum Grassy Forest vegetation community and grassland; and
- A collective area of approximately 51.43ha is being conserved as part of the Cullen Valley Mine Habitat Compensation Areas. These areas contain Sandstone Ridgetop Woodland, Tableland Sheltered Valley Forest, Tablelands Dry Woodland and approximately 3.93 ha of known *Persoonia marginata* habitat.

In addition to the existing offsets, Coalpac have developed a Biodiversity Offset Strategy with the objective of further offsetting the residual impacts from the Project on biodiversity, particularly on threatened ecological communities and habitat for threatened species.

6.4 Biodiversity Offset Properties

The Project has set aside native forests and woodlands for conservation in the Sydney Basin Bioregions, providing a regional approach to the protection of important conservation values and the aim of long-term sustainability of the region's important timber, gas and minerals.

As previously mentioned the rehabilitation of disturbed areas under existing Coalpac operations are progressing well and is of high quality. There is a relatively high degree of confidence that future rehabilitation will succeed and will be able to replant local native forest and woodland species on rehabilitated land. This has been considered when designing an offset program.

Most of the impacted habitats within the Project Boundary are within "sandstone landscapes" that are relatively well represented in National Parks and other conservation reserves within the locality. The offsetting measures for the Project (refer to **Table 6.1**) have been tailored to reflect this, the emphasis for the offsets being on conserving the more poorly represented Box Gum Woodland CEEC at an offset ratio of 13:1. However, considering the well conserved status of the sandstone vegetation and the quality of rehabilitation of mined areas, the proposed composite total offset ratio of 2:1 is considered adequate (refer to **Table 6.2**).

Eight different properties were investigated during the search for suitable offsets throughout 2011. Following this investigations of potential offsets the following offset properties have been included in the offset package:

- Hillcroft Offset: A property within and immediately to the west of the Project Boundary that will be acquired for conservation (**Figure 6.1**, **Figure 6.2 and 6.3**). This property is extensively vegetated over the western half, provides known habitat for the *Eucalyptus cannonii, Persoonia marginata* and abuts Booroolong Frog habitat (found in Williwa Creek, a tributary of the Turon River). Once rehabilitated will provide a link between Sunny Corner State Forest and Ben Bullen State Forest;

- Yarran View Offset: A property approximately 84 km north of the Project Boundary that will be acquired for conservation (**Figure 6.1** and **Figure 6.4**). This property contains both intact native vegetation and CEEC Box Gum Woodland and Derived Native Grassland;

- Hillview/Billabong Offset: A property west of the Castlereagh Highway adjacent the Project Boundary west of Invincible Colliery, owned by Coalpac. This property contains CEEC Capertee Rough-barked Apple Red Gum Yellow Box Woodland and Derived Native Grassland, *Eucalyptus cannonii* habitat and non-EEC vegetation similar to the Project Boundary (**Figure 6.1** and **Figure 6.5**); and

- Hyrock Hartley Offset: A property approximately 35 km south east of the Project Boundary will be acquired for conservation. The property contains sandstone habitats including escarpment and gully habitats similar to the Project Boundary (**Figure 6.1** and **Figure 6.7**) and recent OEH records of the Giant Dragonfly, Blue Mountains Water Skink and Spotted-tail Quoll. Provides a missing gap in the GOS2 Blue Mountains National Park extension.

Table 6.1 provides the areas of CEEC and non-C/EECs on each property for inclusion to offset impacts of the Project.

Table 6.1 Project Offset Strategy

Vegetation Type	Hillcroft (ha)	Yarran View (ha)	Billabong/ Hillview (ha)	Hyrock Hartley (ha)	Total (ha)
Box Gum Woodland and Derived Native Grassland C/EEC	-	186.8	34.9	-	221.7
Non C/EEC (native only)	989.5	256.3	48.5	236.09	1,530
Total	**989.5**	**443.1**	**83.4**	**236.09**	**1,752**

Table 6.2 provides the extent of CEEC and non-CEECs being disturbed within the Project Boundary and the amount of CEEC and non-EEC being conserved within offsets.

Table 6.2 Project Offset Package

Vegetation Type	Project Boundary Disturbance1 (ha)	Proposed Offset2 (ha)	Proposed Offset Ratio
CEEC	16.48	221.7	13.5
EEC^	1.96	221.7	113.1
Non C/EEC (native only)	818.71	1,530	1.9
Total	**837.15**	**1,752**	**2.1**

[1] does not include areas of low diversity native grassland and exotic grasslands

[2] includes areas of low diversity native grasslands

^ EEC Box Gum Woodland conforming under the TSC Act.

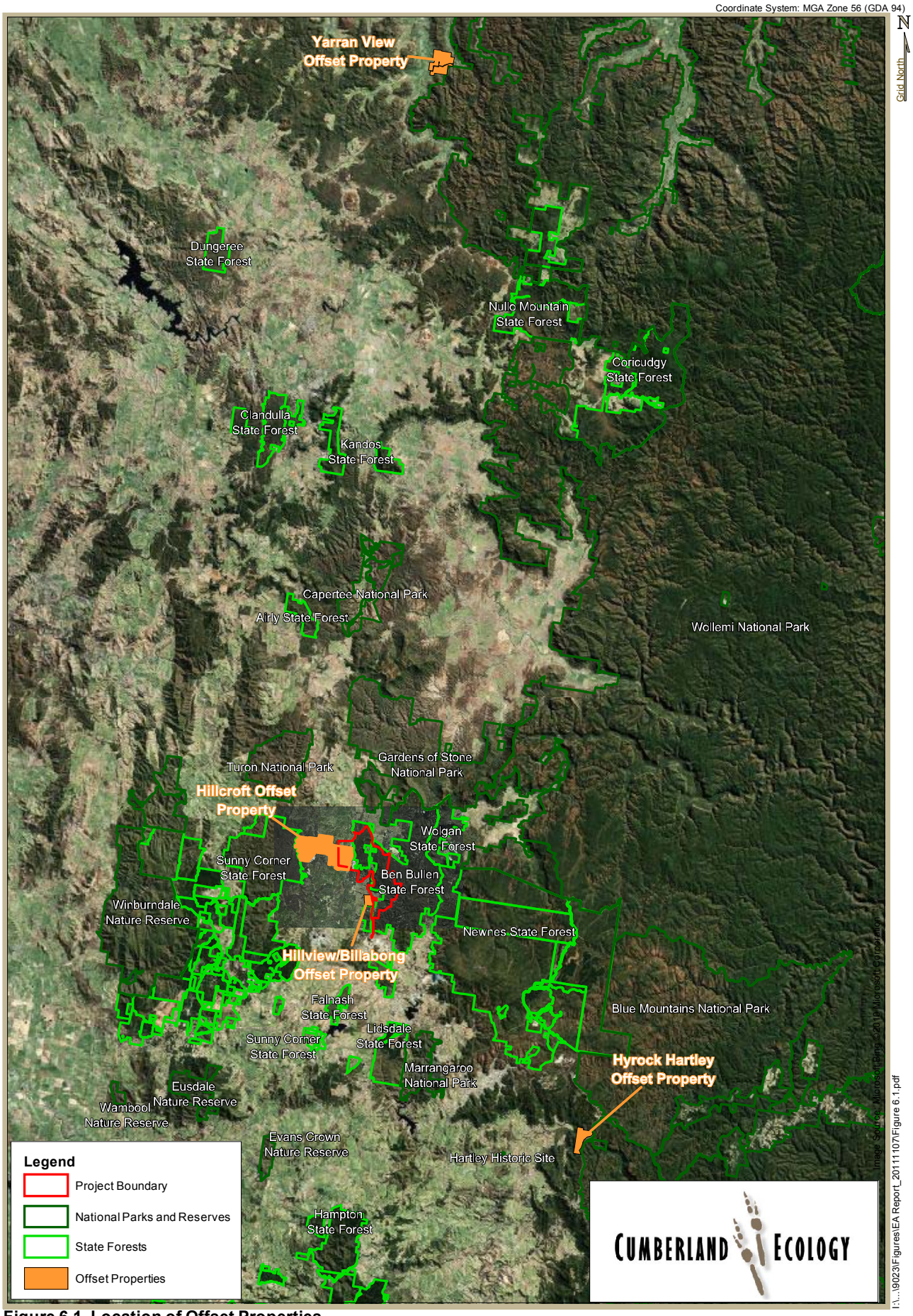


Figure 6.1. Location of Offset Properties

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6.4.1 Hillcroft Property

i. Purpose

The primary objective for acquiring Hillcroft is to create a substantial wildlife corridor between Ben Bullen State Forest and Sunny Corner State Forest to compliment GOS2, to conserve *Eucalyptus cannonii, Persoonia marginata* and Boroolong Frog habitat and rehabilitate similar vegetation to that within the Project Boundary, including suitable threatened species habitat being impacted by the Project. Notwithstanding 107 ha of Hillcroft is proposed for open cut mining as it occurs within the Project Disturbance Boundary.

Hillcroft provides 989 ha of non-C/EEC vegetation and contributes to OEH's requirement to offset non-C/EECs impacted by the Project. Hillcroft provides offsets for the loss of Scribbly Gum Woodland, *Eucalyptus cannonii* and *Persoonia marginata* habitat.

ii. Background

The Hillcroft property covers approximately 1,097 ha in total and lies directly west from the northern extent of the Project Boundary (**Figure 6.1**). The eastern portion (107 ha) is located within the Project Disturbance Boundary and will be subject to vegetation clearance and mining (see **Figure 1.2** and **Figure 6.2**). This property is also within the noise impacts Zone of Affectation (ZOA). The property is private freehold land. Grasslands are currently used for cattle grazing.

Anecdotal evidence from the landholder implies that there has been no application of fertiliser on Hillcroft for the last five years. Prior to this period some fertiliser was applied to the grazing paddocks, the relatively flat lands situated around the Homestead. No fertiliser has ever been applied to the "undulating" areas of the property.

iii. Vegetation

The property can be divided into two broad landscapes, farmed land in the eastern portion and good quality remnant native vegetation in the western half. The eastern portion is made up of Low Diversity Derived Native Grassland/Exotic derived from Tableland Broad-leaved Peppermint – Brittle Gum – Red Stringybark Grassy Open Forest, which has been grazed. On the upper slopes and plateaus small islands of remnant vegetation remain. The western portion supports good quality vegetation that is structurally intact and directly connected to Sunny Corner State Forest, which connects to Winburndale Nature Reserve (see **Figure 6.1**).

Eastern Hillcroft contains a mix of vegetation that extends from the east and west. The communities include Cox's Permain Red Stringybark Brittle Gum Woodland and *Eucalyptus cannonii* habitat, Tableland Scribbly Gum Narrow-leaved Stringybark Shrubby Open Forest surrounded by Tableland Broad-leaved Peppermint – Brittle Gum – Red Stringybark Grassy Open Forest and Low Diversity Derived Native Grassland/Exotic derived from the latter.

The ridge lines of western Hillcroft contain a Scribbly Gum Red Stringybark Grassy Woodland, in which *Persoonia marginata* was found. This woodland could not be assigned to DEC (2006) mapping, which may be related to distance west from DEC (2006) study area. The mid slopes support Tableland Broad-leaved Peppermint Brittle Gum Red Stringybark Open Forest and *Eucalyptus cannonii* habitat.

The creek line vegetation varied depending on elevation, aspect and geology. Tableland Gully Snow Gum Ribbon Gum Grassy Forest was recorded most consistently within true representations of this habitat. Generally, *Eucalyptus viminalis* (Ribbon Gum) was restricted to permanent flowing creeks and wider alluvial flats (Williwa and Dulhuntys Creek), while *E. pauciflora* (Snow Gum), *E.bridgesiana* (Apple Box) occupied permanent and ephemeral creeks. *Eucalyptus stellulata* (Black Sally) was also found in some localised areas i.e. frost hollows alongside *E. pauciflora*.

Although the property does not contain any CEEC Derived Native Grassland capable of enhancement to meet CEEC Box Gum Woodland, it does contain large areas of intact non CEEC native grassland showing signs of regeneration, large areas of remnant native vegetation and fauna habitat similar that are being removed by the Project. Furthermore, the condition of the grassland supports a suite of native grasses and some forbs capable of founding rehabilitation into woodland and forest.

Figure 6.2 provides a vegetation map of the Hillcroft property.



Photograph 6.1 **Hillcroft property facing west with derived native grasslands in the foreground, western Hillcroft and Sunny Corner State Forest in the distance.**



Photograph 6.2 **Scribbly Gum Red Stringybark Grassy Woodland on ridgelines of western Hillcroft. Note the presence of termite mounds**

Table 6.3 provides an approximation of each vegetation type on the Hillcroft property, including area of vegetation proposed as offset and areas of vegetation located within the Project Disturbance Boundary.

Table 6.3 Approximate Areas of Vegetation in the Hillcroft Offset Property

Vegetation Community	Area of Vegetation within the Offset Property (ha)	Area of Vegetation Removed (ha)	Area of Vegetation retained (ha)
Scribbly Gum - Red Stringybark Grassy Woodland	201.20	0.00	201.20
Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest	25.78	25.28	0.50
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Open Forest	270.70	13.02	257.68
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Open Forest Derived Native Grassland	88.79	0.00	88.79
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Open Forest Low Diversity Derived Native Grassland	367.01	42.73	324.27
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest	2.33	0.00	2.33

Table 6.3 Approximate Areas of Vegetation in the Hillcroft Offset Property

Vegetation Community	Area of Vegetation within the Offset Property (ha)	Area of Vegetation Removed (ha)	Area of Vegetation retained (ha)
Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest	2.08	0.001	2.08
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest	53.68	0.00	53.68
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Derived Native Grassland	42.25	0.00	42.25
Cox's Permian Red Stringybark - Brittle Gum Woodland	31.24	18.03	13.21
Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	11.86	8.39	3.47
TOTAL	**1,096.91**	**107.45**	**989.46**

Coalpac has committed to offsetting 989 ha of open forest, woodland and grassland within non impacted areas of the Hillcroft property. The large portion (western half) contains intact vegetation needing little management.

iv. Connectivity

This property holds important attributes, as western Hillcroft provides existing habitat for impacted fauna species in the short-term while the remaining areas are mined (within the Project Disturbance Boundary) and rehabilitated. In the medium and long-term the property will create a new link between two large tracts of disconnected native vegetation, Ben Bullen State Forest and Sunny Corner State Forest. This will facilitate fauna movement between these two State Forests and beyond as they connect to Winburndale Nature Reserve (further west) and Wollemi National Park, Newnes State Forest and Blue Mountains National Park (to the east).

The property also abuts Williwa Creek (a tributary of the Turon River), and encompasses a portion of Dulhuntys Creek (also a tributary of the Turon River). These are permanent watercourses and the protection of these habitats will provide important habitat values and facilitate fauna movements between landscapes.

v. Threatened Species Habitat

a. Flora

Eucalyptus cannonii

Several individuals of *Eucalyptus cannonii* were recorded on the Hillcroft property within Cox's Permian Red Stringybark – Brittle Gum Woodland and Tableland Broad-leaved Peppermint – Brittle Gum – Red Stringybark Open Forest (see **Figure 6.2** and **6.3**). Within eastern Hillcroft *E. cannonii* was observed along upper slopes. Contrast to this *E. cannonii* was not found along the

upper slopes of western Hillcroft within Scribbly Gum – Red Stringybark Grassy Woodland. This is not to say that the species does not occur as more survey effort may yield detection. From observations in western Hillcroft *Eucalyptus macrorhyncha* seemed to occupy the upper and mid slopes, whilst *E. cannonii* was found only along the mid slopes of Tableland Broad-leaved Peppermint – Brittle Gum – Red Stringybark Grassy Open Forest and seemed to drop out when the community changed to Scribbly Gum Red Stringybark Grassy Woodland.

Population estimated were calculated from various quadrats within the property and the Project Boundary (see **Figure 6.3 and Figure 2.1**). The results of quadrats and population estimates are provided below.

Table 6.4 ***Eucalyptus cannonii*** **Population Estimates for Removal, Retention and Rehabilitation on Hillcroft**

Vegetation Community	quadrat number	No of Eucalyptus cannonii recorded per quadrat	Average no of Eucalyptus cannonii in each vegetation community	Average Density per hectare	Area of Vegetation within the Offset Property (ha)	Estimated No of Individuals	Area of Vegetation Removed (ha)	Estimated No. of Individuals to be removed	Area of known habitat to be retained (ha)	Estimated No of Individuals remaining	Area of potential habitat for rehabilitation (ha)	Estimated nos. for rehabilitation of grasslands
Scribbly Gum - Red Stringybark Grassy Woodland	7	0	0	0	201.20	0	0.00	0	0.00	0	0.00	n/a
	9	0										
Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest	13	0	1	3	25.78	64	25.28	63	0.50	1	0.00	n/a
	17	1										
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Open Forest	6	5	3	13	270.70	3384	13.02	163	257.68	3221	0.00	n/a
	8	0										
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Open Forest Derived Native Grassland	n/a	n/a	n/a	0	88.79	0	0.00	0	0	0	88.79	1154
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Open Forest Low Diversity Derived Native Grassland	n/a	n/a	n/a	0	367.01	0	42.73	0	0	0	324.27	4216
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest	4	4	3	15	2.33	35	0.00	0	2.33	35	0.00	n/a
	14	6										
	18	0										

Table 6.4 *Eucalyptus cannonii* Population Estimates for Removal, Retention and Rehabilitation on Hillcroft

Vegetation Community	quadrat number	No of Eucalyptus cannonii recorded per quadrat	Average no of Eucalyptus cannonii in each vegetation community	Average Density per hectare	Area of Vegetation within the Offset Property (ha)	Estimated No of Individuals	Area of Vegetation Removed (ha)	Estimated No. of Individuals to be removed	Area of known habitat to be retained (ha)	Estimated No of Individuals remaining	Area of potential habitat for rehabilitation (ha)	Estimated nos. for rehabilitation of grasslands
Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest	12	9	9	45	2.08	94	0.001	0	2.08	94	0.00	n/a
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest^	0	0	0	0	53.68	0	0.00	0	0	0	0	n/a
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Derived Native Grassland*	n/a	n/a	n/a	0	42.25	0	0.00	0	0.00	0	0.00	n/a
Cox's Permian Red Stringybark - Brittle Gum Woodland	5	55	33	165	31.24	5154	18.03	2975	13.21	2179	0.00	n/a
	19	11										
Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	10	0	0	0	11.86	0	8.39	0	0.00	0	0.00	n/a
	16	0										
TOTAL					**1096.91**	**8731**	**107.45**	**3201**	**275.79**	**5530**	**413.06**	**5370**

Notes: *^ data obtained from Project Boundary surveys*

**Community is not known to support suitable habitat for E. cannonii.*

According to the Commonwealth's Conservation Advice (Threatened Species Scientific Committee , 2008a), the species occurs with *Eucalyptus macrorhyncha* (Red Stringybark), *E. rossii* (Scribbly Gum), *E. bridgesiana*, *E. dalrympleana* and *E. viminalis, E. mannifera* and *E. dives* on a variety of soil types and gradients. This has also been confirmed by the results of surveys within Hillcroft and the Project Boundary. It is highly likely that Hillcroft would have once supported the species throughout, particularly considering the local abundance of the species in the area over varying soil types. Therefore, currently the Hillcroft property provides approximately 275 ha of *Eucalyptus cannonii* habitat for 5,530 individuals. The property also provides vast areas of suitable habitat for rehabilitation. See rehabilitation section below.

Persoonia marginata

A new population of *Persoonia marginata* was found in western Hillcroft. This population was recorded along ridgelines and upper slopes, underlain by Shoalhaven geology supporting Scribbly Gum Red Stringybark Grassy Woodland. Unlike the population found in the Project Boundary, the western Hillcroft population was found to occur on both western and eastern aspects. From observations, the species seems to prefer Scribbly Gum Red Stringybark Grassy Woodland (except for one outlier found at the top of a creek bank in Tableland Broad-leaved Peppermint Brittle Gum Red Stringybark Grassy Open Forest).with an understorey dominated by *Joycea palida, Dianella revoluta,* and *Patersonia sericea.* In rocky sites of this community or areas with high proportions of *Lomandra filiformis Persoonia marginata* was not observed.



Photograph 6.3 Western Hillcroft *Persoonia marginata* Population

Results from preliminary surveys estimate an average density of 892 individuals per hectare was estimated from a total of 186 quadrats (20 m x 1 m). Approximately 85.96 ha of habitat have been mapped containing approximately 76,676 individuals.

The results of quadrat surveys and population estimates are provided below.

Table 6.5 *Persoonia marginata* Population Estimates and Estimated Area of Habitat in Western Hillcroft during Preliminary Surveys

Measured Parameters	Western Hillcroft Population
Average density per hectare (no. individuals/ha)	892
Estimated area of habitat (ha)	85.96
Estimated population size (no. of individuals)	76,676

b. Fauna

Western Hillcroft (approximately 470 ha) contains high quality remnant vegetation which supports a range of habitat requirements for the following threatened species known to occur within 5 km of the property.

Booroolong Frog

The Booroolong Frog was captured in a small section of suitable habitat along Williwa Creek during a diurnal targeted search (**Photo 6.4** and **Photo 6.5**). This creek runs along the western edge of the property. A nocturnal survey of the same site using call playback heard at least 3 individuals respond. For the location of the species sighting see **Figure 6.3.** Diurnal habitat assessment revealed only small sections of Williwa Creek contained suitable habitat, as large areas of the creek were degraded and contained vehicle tracks, steep earthen banks, deep pools and very little cobble stone sites. No frogs were detected in Dulhuntys Creek due to degraded habitat.



Photograph 6.4 **Williwa Creek, Western edge of Hillcroft where the Booroolong Frog was Found**



Photograph 6.5 **Booroolong Frog Recorded at Willwa Creek, West of Hillcroft.**

A number of threatened birds impacted by the Project have been recorded in the area of the property. Although the vegetation communities of western Hillcroft do not have a conspicuous shrub stratum, the crowded forest structure of the Snow Gums within the gullies, creek lines and lower slopes seemed to provide adequate cover for small woodland birds (see **Photo 6.5**).

A list of threatened birds recorded in the area with potential to occur in the forest and woodlands of western Hillcroft are listed below:

- Three records of the Little Eagle;
- Two records of the Gang-gang Cockatoo;
- One record of Regent Honeyeater;
- Four records of Varied Sittella;
- Two records of the Scarlet Robin;
- Six records of Little Lorikeet; and
- One record of the Powerful Owl.



Photograph 6.6 Tableland Snow Gum Ribbon Gum Grassy Forest

Three micro-bats, all of which will be impacted by the Project have also been recorded within 5 km of the Hillcroft property and include:

- One record of the Eastern Free-tail-bat;
- One record of Eastern False Pipestrelle; and
- Two records of Eastern Bent-wing Bat.

Although not recorded within 5 km of the property, suitable Spotted-tailed Quoll habitat exists not only due to an abundance of habitat features including trees with hollows, hollow logs on the ground, rocky outcrops, caves and rock crevices, food supply such as birds and other small animals, but also connection to other large remnants including Sunny Corner State Forest and Winburndale Nature Reserve, which currently do not have any records of the species to date. Notwithstanding large areas of contiguous forested land within its distribution would help to provide future stability for the species.

vi. Rehabilitation

The clearance of vegetation on eastern Hillcroft within the Project Disturbance Boundary is proposed to occur throughout Years 1 and 2. Mine rehabilitation is to occur shortly after in a progressive manner and finish by Year 4. This aims at giving the mine rehabilitation of eastern Hillcroft 18-19 years to mature and promote connections between the GOS2 and Sunny Corner State Forest. Moreover, rehabilitation of grasslands (not to be disturbed by Project mining operations) into forest and woodland should occur concurrently with mining of Hillcroft to give the maximum time for rehabilitation to mature and increase in value. This rehabilitation would also aid in providing links for fauna to disperse from the Project Boundary during clearing and mine operations.

Eucalyptus cannonii will be planted during woodland rehabilitation of the property in grasslands derived from Tableland Broad-leaved Peppermint – Brittle Gum – Red Stringybark Open Forest, where the species is known to grow naturally. Rehabilitation targets of *E. cannonii* will aim at re-introducing an average of 13 individuals per hectare (refer to **Table 3.1**). This equates to the re-introduction of approximately 5,370 individuals within 413 ha of suitable habit potential habitat (**Table 6.11**). **Figure 6.3** illustrates areas of known *E. cannonii* habitat and areas of potential habitat where *E. cannonii* can be replanted during rehabilitation.

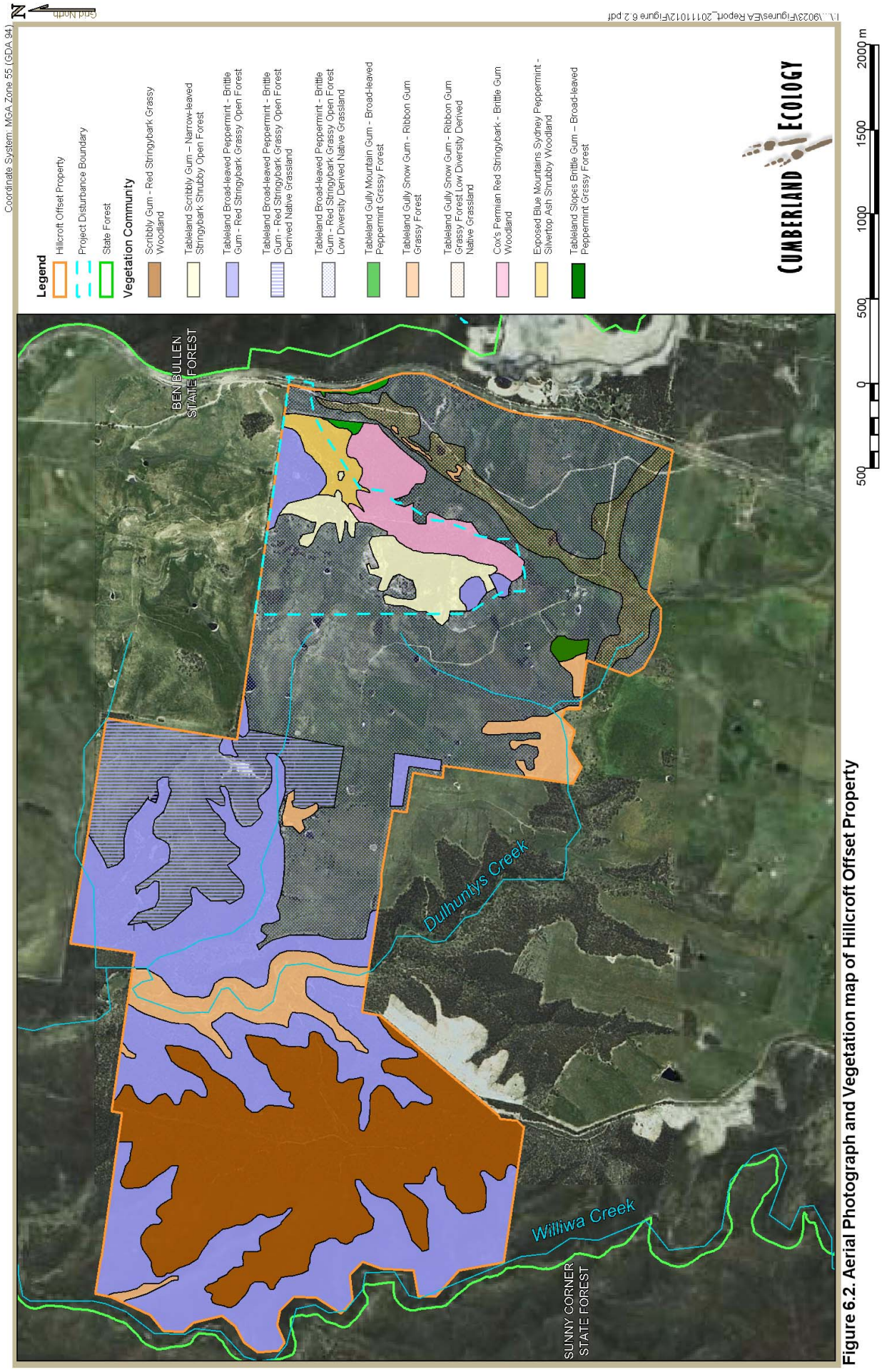


Figure 6.2. Aerial Photograph and Vegetation map of Hillcroft Offset Property

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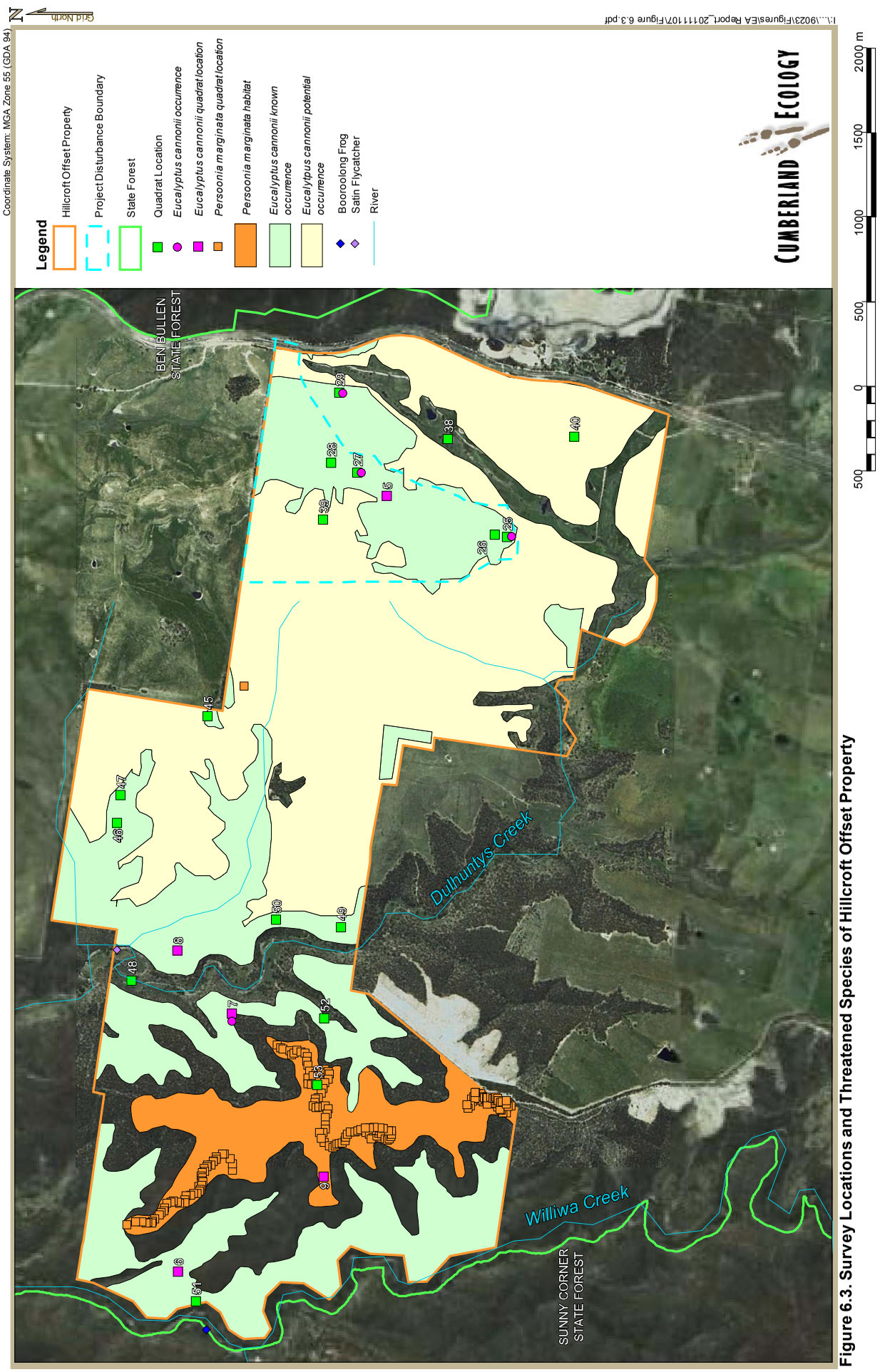


Figure 6.3. Survey Locations and Threatened Species of Hillcroft Offset Property

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6.4.2 Yarran View Property

i. Purpose

The primary objective for acquiring Yarran View is to conserve and rehabilitate Commonwealth listed Box Gum Woodland with possible inclusion to the adjacent Wollemi National Park. The property also provide suitable habitat for a number of threatened species predicted to be impacted by the Project. Yarran View provides 256 ha of non-EEC native vegetation and contributes to OEH's requirement to offset non-C/EEC vegetation impacted by the Project. The property also provides 186 ha of CEEC and contributes to SEWPaC and OEH's requirement to offset C/EEC impacted by the Project.

ii. Background

The Yarran View offset property covers an area of 450 ha and is private freehold land (approximate easting and northing 229759, 6392919). The property contains an array of different landscapes from rocky exposed ridge tops, steep shrubby slopes, cleared and semi cleared woodlands and grasslands on undulating lower slopes and a small creek (Lee Creek). Almost half of the property contains remnant vegetation in good condition. The location of this property in the wider region is provided in **Figure 6.1.**

Current land use of the property includes cattle grazing to grasslands. The property owner of Yarran View has advised that no fertiliser has been applied over the last 7 years. Prior to that, an organic nitrogen fertiliser was used in cleared areas.

iii. Vegetation

Vegetation on the property can be broadly described by two habitats, treed and grasslands. The higher country along the upper slopes, which contains a near homogenous tree canopy of *Eucalyptus albens* (White Box), probably a result of the quality of the soil which extends up high on the slopes. In rockier areas *Eucalyptus punctata* occurs. A dominant shrub layer of 40% or more discounts this vegetation unit as being Box Gum Grassy Woodland listed under the EPBC Act and TSC Act.

The lower slopes and valley floor of Yarran View has been cleared and partially cleared for grazing. This undulating terrain, on rich basalt soils contains scattered Box Gum Woodland and Derived Native Grasslands as described in the EPBC Act. In this lower country the drier slopes contain *Eucalyptus albens* and *Brachychiton populneum* (Kurrajong) with *Eucalyptus blakeyi* (Blakely's Red Gum) and *Angophora floribunda* (Rough-barked Apple) occurring on low lying wetter areas and creek line. The diversity of the native herbs and grasses in the grasslands, expect the valley floor, form a mosaic of low diversity and high diversity areas across this map unit. Note that some areas within quadrat surveys did not technically qualify for listing under the EPBC Act. This is due to a lack of native non grassy understorey species. Notwithstanding nearby areas where RCAs recorded the required species diversity for classification under the EPBC Act, and as such all areas except the valley floor were classified as CEEC Box Gum Woodland Derived Native Grassland. The diversity of groundcovers diminishes on the valley floor where more intense cattle grazing may have occurred. These areas did not qualify as CEEC under the EPBC Act or EEC under the TSC Act; however they contain enough native species capable of rehabilitation into quality woodland habitat. Refer to **Figure 6.4** for the distribution of vegetation on the property.

Natural regeneration of trees and some shrubs is evident throughout areas of the property. The quality of vegetation across the site varies from 20-60% weed cover in the grassy layer consisting of mainly annuals, *Carthamus lanatus* (Saffron Thistle) and *Conyza bonariensis* (Fleabane). *Hypericum perforatum* (St John's Wort) was also recorded in large densities in some areas across the site, which will require a more intensive management approach than areas where the ground layer is less weedy and/or containing a diversity of easier manageable weed species i.e. Saffron Thistle.



Photograph 6.7 **Yarran View, facing south overlooking large expanses of Box Gum Woodland Derived Native Grasslands and scattered White Box. Vegetated mountains of Wollemi National Park in the distance.**



Photograph 6.8 **Good quality Box Gum Woodland in south-western corner of Yarran View adjacent Wollemi National Park**



Photograph 6.9 **Shrubby White Box on Slopes of Yarran View**

Table 6.6 provides an approximation of each vegetation type on the Yarran View property.

Table 6.6 Approximate Areas of Vegetation in the Yarran View Offset Property

Vegetation Community	Area (ha)
Box Gum Woodland (CEEC)	43.01
Box Gum Woodland Derived Native Grassland (CEEC)	143.77
White Box Shrubby Woodland (non CEEC)*	219.75
Low Diversity Native Grassland/Exotic	36.52
Total	443.05

** This community does not conform to the EPBC Act description due to shrub density being more than 30%*

Yarran View contains approximately 186 ha of Commonwealth listed Box Gum Woodland and Derived Native Grassland and 256 ha of non EEC native vegetation.

iv. Connectivity

Yarran View adjoins Wollemi National Park along the southern and south-eastern boundary. The northern boundary does not adjoin protected land; however it does connect to a large tract of vegetation which covers an approximately 2,000 ha of intact mountainous habitat. The rehabilitation of Yarran View would provide a substantial link between these two habitats and additions of Box Gum Woodland in conservation tenure in the area.

v. Threatened Species Habitat

a. Flora

The property contains 233 ha of Box Gum Woodland habitat, of which 186 ha can be rehabilitated to CEEC Box Gum Woodland.

No threatened flora species were recorded during surveys or considered likely to occur. However, this may be a reflection of a lack of NSW Atlas records in the area.

b. Fauna

From observation in the field and indicated by the abundance of bird records, the property supports suitable habitat for a suite of woodland birds. This suitability of habitat is also supported with proximity to Wollemi National Park.

The majority of records occur along the edges of Wollemi National Park within 5 km of Yarran View. Records of impacted birds considered with potential to occur include:

- Nine records of the Speckled Warbler;
- Five records of Gang-gang Cockatoo in addition to five recorded during flora surveys;

- Eighteen records of Brown Treecreeper;
- Three records of Varied Sittella;
- Nine records of Diamond Firetail;
- Two records of Painted Honeyeater;
- Ten records of the Black-chinned Honeyeater;
- Three records of Hooded Robin;
- Seven records of Little Lorikeet; and
- Nine records of the Turquoise Parrot.

The property contains large areas of White Box Woodland (CEEC and non CEEC), critical habitat for the Regent Honeyeater and Swift Parrot. A number of Mistletoes were observed in abundance across the property, including one of the Regent Honeyeater's preferred food source, *Amyema miquelii*. Once the grasslands are rehabilitated to White Box Woodland, Yarran View will provide 443 ha of suitable habitat for woodland birds considered with potential to occur including the Swift Parrot and Regent Honeyeater.

The following threatened mammals also impacted by the Project have been recorded within 5 km of the property and are considered likely to occur. These include:

- Two records of Yellow-bellied Glider;
- Three records of Squirrel Glider;
- One record of Large-eared Pied Bat;
- One records of Eastern False Pipestrelle; and
- One record of Yellow-bellied Sheath-tail Bat.

Although not recorded within 5 km of the property, suitable Spotted-tailed Quoll habitat exists not only due to an abundance of habitat features including trees with hollows, hollow logs on the ground, rocky outcrops, caves and rock crevices, food supply such as birds and other small animals, but also connection to other large remnants including the Wollemi National park. Notwithstanding large areas of contiguous forested land within its distribution, Yarran View would help to provide future stability for the species.

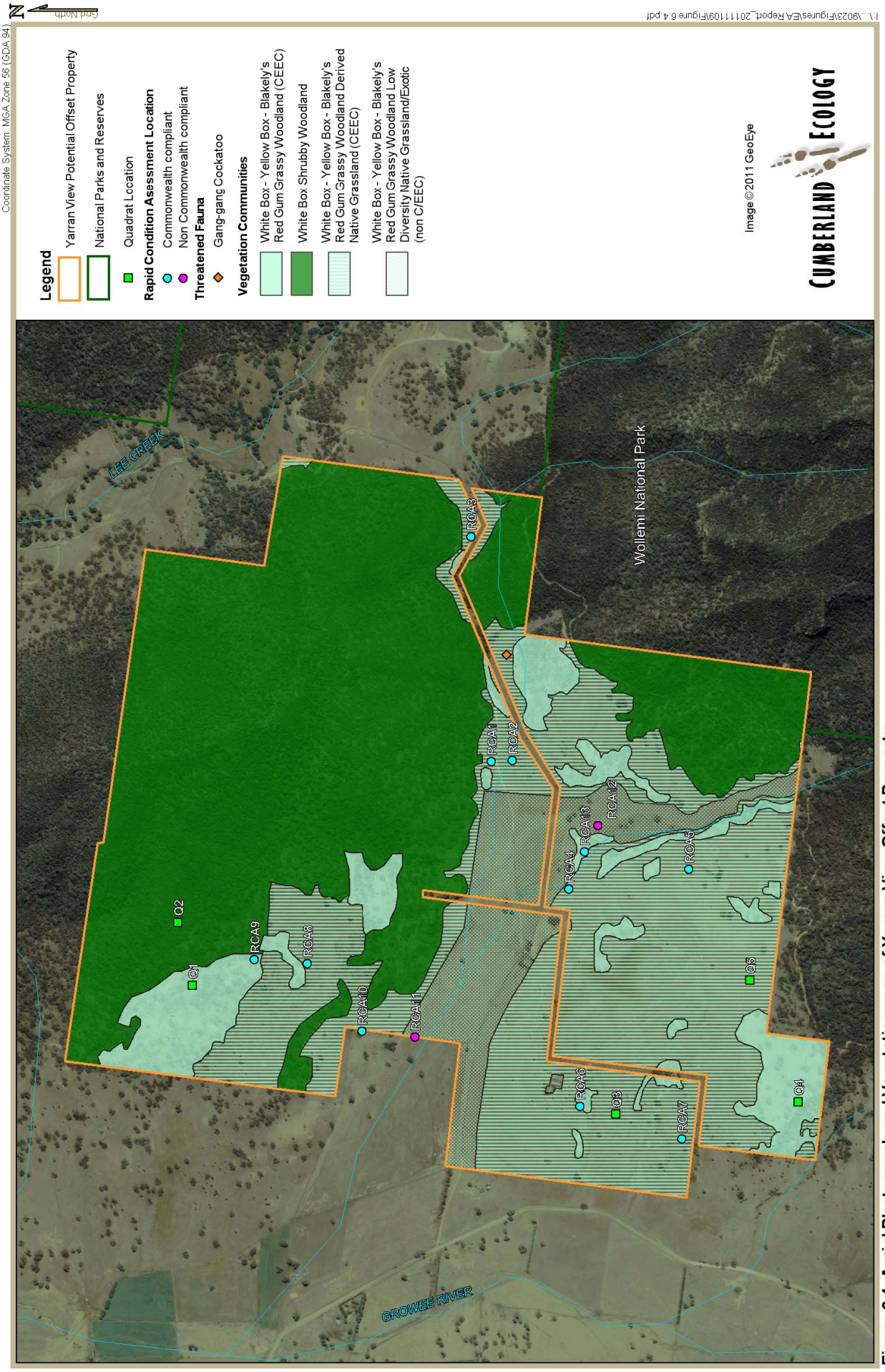


Figure 6.4. Aerial Photograph and Vegetation map of Yarran View Offset Property

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6.4.3 Hillview/Billabong Property

i. Purpose

The primary objective for acquiring Hillview/Billabong is to conserve and rehabilitate similar vegetation to that located within the Project Disturbance Boundary and conserved *Eucalyptus cannonii* habitat. Hillview/Billabong provides 41 ha of *Eucalyptus cannonii* habitat, 48.5 ha of non-C/EEC impacted by the Project (Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest). The property also provides 35 ha of CEEC Capertee Rough-barked Apple – Red Gum – Yellow Box Woodland and Derived Native Grassland impacted by the Project and contributes to SEWPaC's and OEH's requirement to offset C/EEC impacted by the Project.

ii. Background

The Hillview/Billabong property covers an area of approximately 83 ha and is situated on the western side of the Castlereagh Highway west of the Invincible Colliery (approximate easting and northing of 223610 and 6309330) (see **Figure 6.1**). This property is owned by Coalpac and used for accommodation only.

Coalpac can confirm that there has been no cultivation on Hillview/Billabong. There has been partial clearing for sheep grazing purposes which has no ceased. Coalpac is unsure of whether any fertiliser has been applied by the previous landholder.

iii. Vegetation

The property contains Tableland Slopes Brittle Gum Broad-leaved Peppermint Grassy Forest and derived native grasslands on the upper slopes and plateaus. *Eucalyptus cannonii* was also found in this community. This community observed on the property varied in species composition, which seemed to relate to aspect or exposure. Along the drier western aspects and exposed ridgelines, the community appeared to be dominated by *Eucalyptus rossii*. Conversely, the eastern aspect appeared to shift to *Eucalyptus dives* and *E. mannifera* becoming more frequent.

The lower areas would once have supported Capertee Rough-barked Apple – Red Gum – Yellow Box Woodland (see **Photo 6.10**), but have been cleared and grazed. As a result, the diversity of native herbs is low and the ground cover is dominated by native grasses. Notwithstanding the disturbed nature of the community, native species account for approximately 80% of the groundcover. Technically, these areas do not conform to the Commonwealth description of Box Gum Woodland due to a shortfall in understorey species richness. However, it is highly possible that more survey effort may capture the required number of species. Furthermore, these areas show high resilience and provide adequate foundations to be restored to CEEC Capertee Rough-barked Apple red Gum Yellow Box Woodland. For this reason these areas have been classified as CEEC Box Gum Woodland and Derived Native Grassland (refer to **Figure 6.5**).



Photograph 6.10 **Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest. Scribbly Gum Variant on Western Aspect.**



Photograph 6.11 **Capertee Rough-barked Apple – Red Gum – Yellow Box Woodland**

Table 6.7 provides an approximation of the area of each vegetation community on the Hillview/Billabong property.

Table 6.7 Approximate Areas of Vegetation in the Hillview/Billabong Offset Property

Vegetation Community	Area (ha)
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest	41.31
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest Derived Native Grassland	7.17
Capertee Rough-barked Apple – Red Gum – Yellow Box Woodland (CEEC)	5.53
Capertee Rough-barked Apple – Red Gum – Yellow Box Woodland Derived Native Grassland (CEEC)	29.34
TOTAL	83.35

iv. Connectivity

The southern boundary of the Hillview/Billabong property adjoins Ben Bullen State Forest and immediately to the east is the existing Invincible Colliery offset 8, although dissected by the Castlereagh Highway. Once the property is rehabilitated it will increase the extent of woodland and forest adjacent Ben Bullen State Forest while also providing a stepping stone for fauna moving through the landscape.

v. Threatened Species Habitat

a. Flora

The property contains 34 ha of Capertee Rough-barked Apple – Red Gum – Yellow Box and Derived Native Grassland habitat.

One *Eucalyptus cannonii* individual was recorded during quadrat survey of the Hillview/Billabong property. The species was found in Tableland Slopes Brittle Gum Broad-leaved Peppermint Grassy Forest.

The results of quadrats and population estimates are provided below.

Table 6.8 ***Eucalyptus cannonii*** **Population Estimates for Removal, Retention and Rehabilitation in Hillview/Billabong**

Vegetation Community	quadrat number	No of Eucalyptus cannonii recorded per quadrat	Average no of Eucalyptus cannonii in each vegetation community [A]	Average Density per hectare [B]	Area of Vegetation within the Offset Property (ha)	Estimated no of Individuals [C]=AxB	Area of potential habitat for rehabilitation (ha) [D]	Estimated nos for rehabilitation of grasslands [E]=DxB
Tableland Slopes Brittle Gum - Broad-leaved Peppermint Grassy Forest	20	1						
	21	0	1	3	41.31	103	0.00	n/a
Tableland Slopes Brittle Gum - Broad-leaved Peppermint Grassy Forest Derived Native Grassland	n/a	0	0	0	7.17	0	7.17	22
Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland^	15	2						
	11	24	13	65	5.53	359	0.00	n/a
Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland Derived Native Grassland (EPBC Act)	n/a	0	0	0	29.34	0	29.34	1907.1
TOTAL		**27**	**13.5**	**68**	**83.35**	**463**	**36.51**	**1929**

Notes: *^ data obtained from Project Boundary surveys*

b. Fauna

The Hillview/Billabong is a relatively small portion of habitat, when considered against the other properties. Nevertheless the property is close to the Project Boundary and would aid resident fauna movement through the landscape and provide some refugia during operations of the mine, particularly as it is connected to parts of Ben Bullen State Forest that will not be cleared by the Project.

vi. Rehabilitation

The rehabilitation of grasslands also provides some scope to re-introduce *Eucalyptus cannonii.* The density of *E. cannonii* in Capertee Rough-barked Apple – Red Gum – Yellow Box Woodland Derived Native Grassland on the property is unknown; however densities of Capertee Rough-barked Apple – Red Gum – Yellow Box Woodland recorded during surveys on the nearby Project Boundary can be used. Using data obtained from surveys of *Eucalyptus cannonii* in the Project Boundary within Capertee Rough-barked Apple – Red Gum – Yellow Box Woodland, approximately 36.51 ha estimated to support 1,929 individuals.

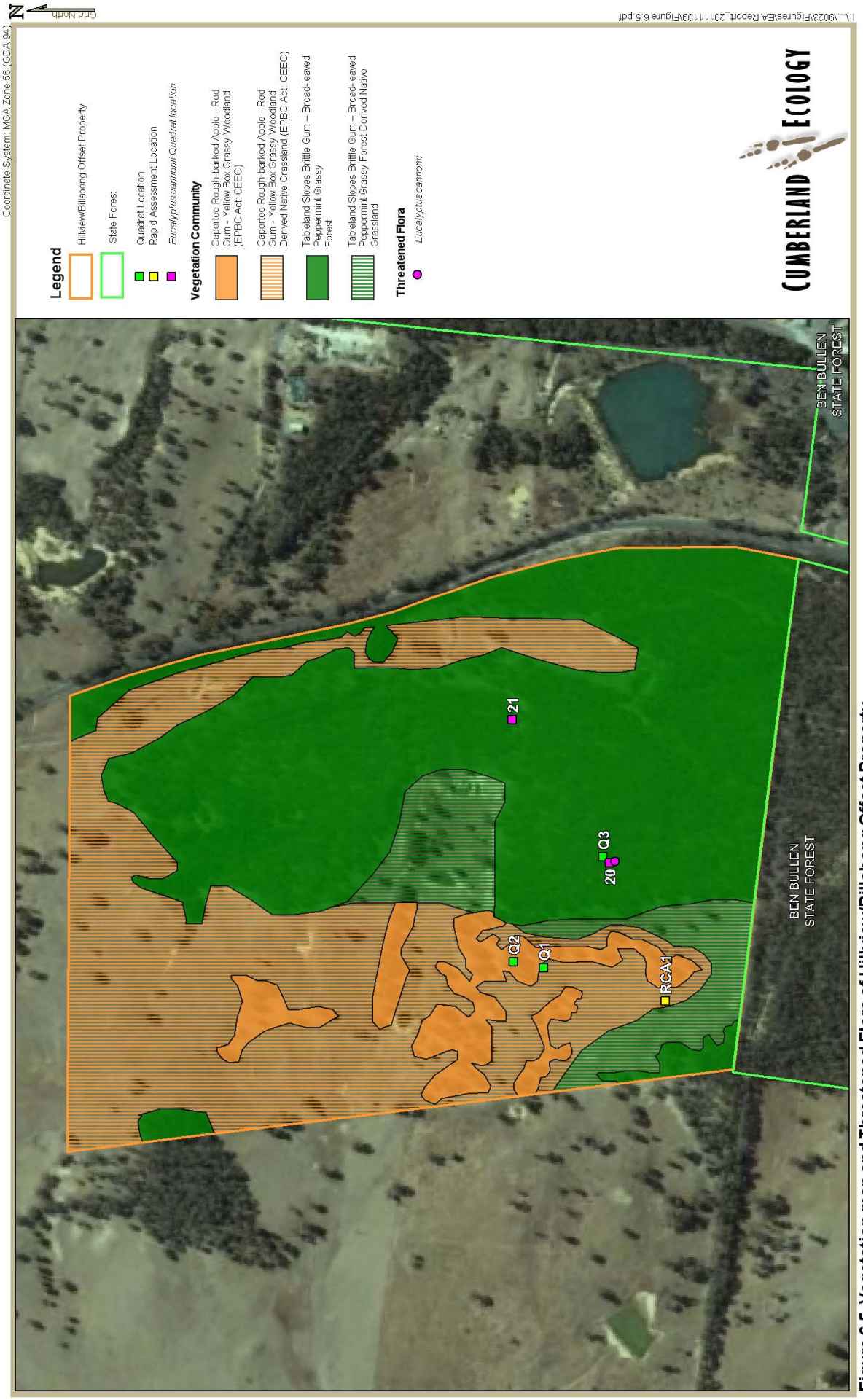


Figure 6.5. Vegetation map and Threatened Flora of Hillview/Billabong Offset Property

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6.4.4 Hyrock Hartley Property

i. Purpose

The primary objective for acquiring Hyrock Hartley is to conserve similar sandstone habitats to those occurring within the Project Boundary, particularly those used by fauna species. Hyrock Hartley provides approximately 240 ha of non-EEC native vegetation including vegetation which resembles Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Forest and contributes to OEH's requirement to offset non-C/EECs impacted by the Project.

This property provides an important link within the GOS2 proposed extension of the Blue Mountains National Park (see **Figure 4.2**).

ii. Background

The property is located 35 km south-east of the Project Boundary in Hartley Vale (refer to **Figure 6.1**) and is covered in high quality remnant sandstone vegetation supporting similar habitats to those found within the Project Boundary. This property is private freehold land and is not currently used.

iii. Vegetation

Hyrock Hartley has varying landscapes and as such supports a diversity of habitats from rocky escarpments and exposed heathland and shrub lands to sheltered deep soiled gullies and riparian habitats. The property supports a suite of different vegetation communities, explained further below.

Along the rocky escarpments and outcrops in moist, sheltered rock faces the Blue Mountains Escarpment Complex contains a diverse mixture of cliff line vegetation, heath, swamp, rainforest and mallee. On more exposed sites with skeletal soils Blue Mountains Heath and Scrub occur, usually with a western aspect. The majority of the site contains *Eucalyptus sieberi – Eucalyptus piperita* Open forest/Woodland, a community heavily impacted by the Project. Sheltered gullies contain Montane Gully Forest. Blue Mountains Swamp has been mapped within parts of the property. This community conforms to the Temperate Highland Peat Swamps on Sandstone, an EEC listed under the EPBC Act and Blue Mountain Swamps of the Sydney basin Bioregion, listed as Vulnerable under the TSC Act. The distribution of each vegetation community on the property is indicated in **Figure 6.6.**



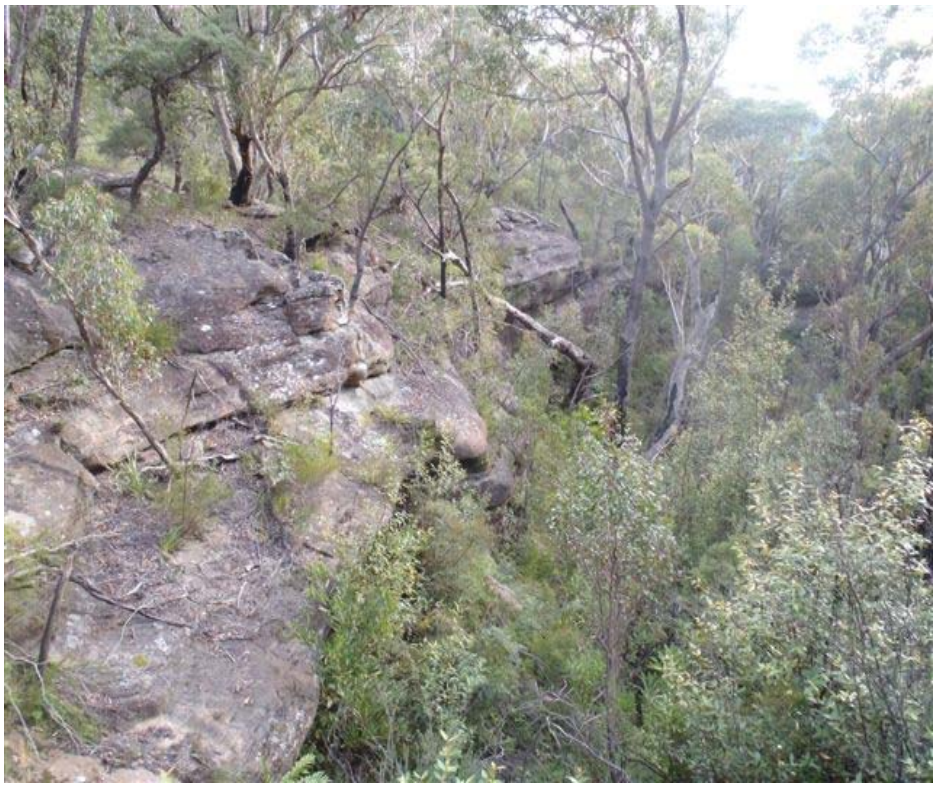
Photograph 6.12 Overlooking Hyrock Hartley



Photograph 6.13 Blue Mountains Heath and Scrub at Hyrock Hartley



Photograph 6.14 ***Eucalyptus oreades*** **Tall Open Forest at Hyrock Hartley.**



Photograph 6.15 **Blue Mountains Escarpment Complex at Hyrock Hartley**



Photograph 6.16 Creek in *Eucalyptus oreades* Forest

Table 6.9 provides an approximation of the area of each vegetation type occurring on the Hyrock Hartley Property.

Table 6.9 Approximate areas of vegetation in the Hyrock Hartley Offset Property

Vegetation Community	Area (ha)
Blue Mountains Escarpment Complex	20.21
Blue Mountains Heath and Scrub	27.02
Blue Mountains Riparian Complex	1.14
Blue Mountains Swamps	3.38
Eucalyptus oreades Open-forest/Tall Open-forest	5.39
Eucalyptus sieberi - Eucalyptus piperita Open forest/Woodland	157.92
Modified Bushland	4.87
Montane Gully Forest	16.16
Total	236.09

iv. Connectivity

Not directly connected with the Hyrock Hartley property but across the road (Darling Causeway) lies the Blue Mountains National Park. Upon transferral to National Parks this property would increase the area of Blue Mountains National Park. The property is connected on all sides by high quality sandstone escarpment vegetation.

v. Threatened Species Habitat

a. Flora

No threatened flora species were recorded during surveys despite *Derwentia blakelyi* considered as having potential to occur.

b. Fauna

From observation in the field during habitat assessment, the property supports suitable habitat for a number of threatened fauna impacted by the Project as well as suitable habitat for various other threatened fauna species not considered as likely to occur within the Project Boundary. This suitability of habitat is also supported with proximity to Blue National Park.

The Giant Dragonfly (*Petalura gigantea*) is listed as Endangered under the TSC Act. Fourteen records occur within 5 km of the property. Of these 14 records, 2 recent records (2007 and 2008) are located in the property. Suitable habitat (permanent swamps and bogs with some free water and open vegetation) were recorded in areas mapped as Blue Mountains Swamps and Blue Mountains Heath and Scrub on the plateaus of the property. The Giant Dragonfly is considered likely to occur on Hyrock Hartley.

Although not found or considered likely to occur in the Project Boundary, three threatened frogs have been recorded within 5 km of Hyrock Hartley. These include the Red-crowned Toadlet, Giant Burrowing Frog and the Stuttering Frog. These records occur west of the property in the Blue Mountains National Park.

The Blue Mountains Water Skink (*Eulamprus leuraensis*) is listed Endangered under the EPBC Act and TSC Act. Two records occur within 5 km of Hyrock. One of these records, dated 2004, is located on the property. The species habitat inhabits sedge and shrub swamps that have boggy soils and appear to be permanently wet. The vegetation in these swamps typically takes the form of a sedgeland interspersed with shrubs, but may occur as a dense shrub thicket. Suitable habitat was observed within areas mapped as Blue Mountains Swamps and Blue Mountains Heath and Scrub on the plateaus of the property. It is highly likely that Hyrock Hartley provides habitat for the Blue Mountains Water Skink.

Project impacted birds considered with potential to occur at Hyrock Hartley include:

- Six records of the Scarlet Robin;
- Two records of Gang-gang Cockatoo; and

- One record of Little Lorikeet.

Fifteen records of the Spotted-tail Quoll have been recorded within 5 km of Hyrock Hartley. Two of these records, dated in 2004 are located in the property. The number of records in the area, in combination with the quality of vegetation and high connective value suggests the property provides known habitat for the Spotted-tailed Quoll. Habitat features such as trees with hollows, hollow logs on the ground, rocky outcrops, caves and rock crevices were recorded on the property. These areas provide shelter, den and breeding sites, and support a more abundant food supply such as birds and other small animals. The Spotted-tail Quoll is considered likely to occur on Hyrock Hartley.

Although not known within 5 km of the property, suitable habitat also exists for microbats, Broad-headed Snake and Brush-tailed Rock Wallaby.

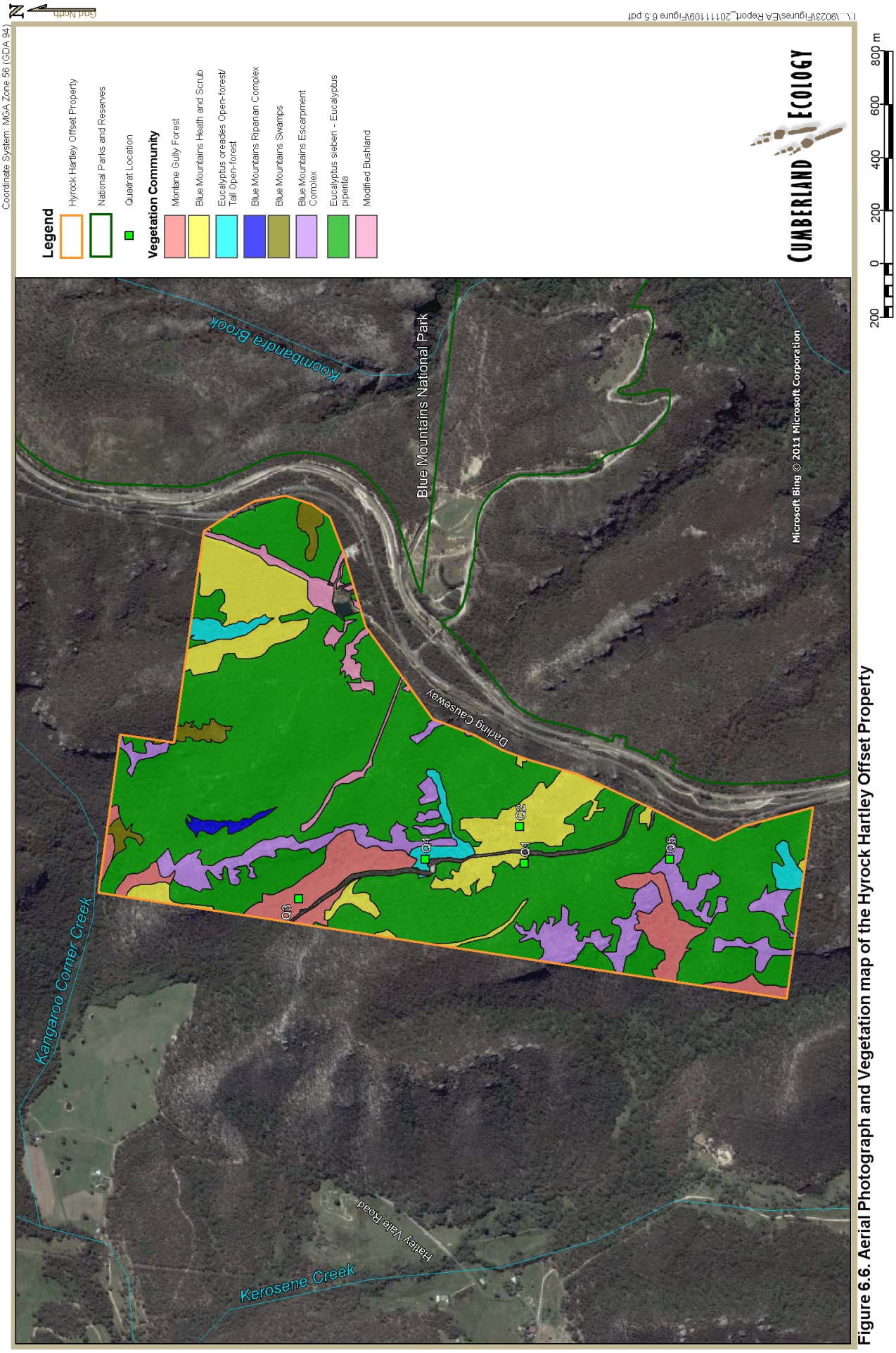


Figure 6.6. Aerial Photograph and Vegetation map of the Hyrock Hartley Offset Property

6.4.5 Summary of Threatened Species Habitats Provided within Offsets

The Biodiversity Offset Package will provide suitable habitat for a range of threatened species and communities impacted by the Project.

Table 6.10 includes a list of threatened species that the proposed offset package would provide habitat for. It should be noted this list is not exhaustive and is not deemed to be limited to the below mentioned species.

Table 6.10 Habitats for Threatened Species with Project Offset Properties

Family	Scientific Name	Common Name	TSC	EPBC	Habitat Present in Offsets
Insecta					
Petaluridae	*Petalura gigantea*	Giant Dragonfly	V		Present
Amphibia					
Hylidae	*Litoria Booroolongensis*	Booroolong Frog	E	E	Present
Reptiles					
Elapidae	*Hoplocephalus bungaroides*	Broad-headed Snake	E	V	Present
Scincidae	*Eulamprus leuraensis*	Blue Mountains Water Skink	E	E	Present
Varanidae	*Varanus rosenbergi*	Rosenberg's Goanna	V		Present
Aves					
Acanthizidae	*Pyrrholaemus saggitatus*	Speckled Warbler	V		Present
Accipitridae	*Circus assimilis*	Spotted Harrier	V		Present
Accipitridae	*Hieraaetus morphnoides*	Little Eagle	V		Present
Accipitridae	*Lophoictinia isura*	Square-tailed Kite	V		Present
Apodidae	*Apus pacificus*	Fork-tailed Swift		M	Present
Apodidae	*Hirundapus caudacutus*	White-throated Needletail		M	Present
Artamidae	*Artamus superciliosus*	White-browed Woodswallow	V		Present
Climacteridae	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	V		Present

Table 6.10 Habitats for Threatened Species with Project Offset Properties

Family	Scientific Name	Common Name	TSC	EPBC	Habitat Present in Offsets
Cacatuidae	*Callocephalon fimbriatum*	Gang gang Cockatoo	V		Present
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black Cockatoo	V		Present
Estrildidae	*Stagonopleura guttata*	Diamond Firetail	V		Present
Meliphagidae	*Xanthomyza phrygia*	Regent Honeyeater	CE	E	Present
Meliphagidae	*Grantiella picta*	Painted Honeyeater	V		Present
Meliphagidae	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subspecies)	V		Present
Meropidae	*Merops ornatus*	Rainbow Bee-eater		M	Present
Monarchidae	*Myiagra cyanoleuca*	Satin Flycatcher		M	Present
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V		Present
Petroicidae	*Petroica phoenicea*	Flame Robin	V		Present
Petroicidae	*Melanodryas cucullata*	Hooded Robin	V		Present
Petroicidae	*Petroica boodang*	Scarlet Robin	V		Present
Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V		Present
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	V		Present
Psittacidae	*Neophema pulchella*	Turquoise Parrot	V		Present
Psittacidae	*Lathamus discolor*	Swift Parrot	E	E	
Strigidae	*Ninox connivens*	Barking Owl	V		Present
Strigidae	*Ninox strenua*	Powerful Owl	V		Present
Tytonidae	*Tyto novaehollandiae*	Masked Owl	V		Present
Mammalia					
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail Bat	V		Present
Burramyidae	*Cercartetus nanus*	Eastern Pygmy Possum	V		Present

Table 6.10 Habitats for Threatened Species with Project Offset Properties

Family	Scientific Name	Common Name	TSC	EPBC	Habitat Present in Offsets
Dasyuridae	*Dasyurus maculatus*	Spotted-tailed Quoll	V	E	Present
Macropodidae	*Petrogale penicillata*	Brush-tailed Rock Wallaby	E	V	Present
Petauridae	*Petaurus australis*	Yellow-bellied Glider	V		Present
Petauridae	*Petaurus norfolcensis*	Squirrel Glider	V		Present
Phascolarctidae	*Phascolarctos cinereus*	Koala	V		Present
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	Present
Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V		Present
Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V		Present
Vespertilionidae	*Mormopterus norfolkensis*	Eastern Freetail-bat	V		Present
Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V		Present
Plants					
Myrtaceae	*Eucalyptus cannonii*	Capertee Stringybark	V	V	Present
Proteaceae	*Persoonia marginata*	Clandulla Geebung	V	V	Present

6.4.6 Summary of Threatened Flora Species Conserved and Rehabilitated within Offsets and the Project Boundary

In the long-term the offset package will conserve and rehabilitate 776 ha of *Eucalyptus cannonii* and conserve 86 ha of *Persoonia marginata* habitat.

The table below summarises what will be undertaken within the offsets properties Hillcroft, Hillview/Hillview and in the Project Boundary to conserve and rehabilitate *Eucalyptus cannonii*.

Table 6.11 Summary of Estimated *Eucalyptus cannonii* Conserved and Rehabilitation Targets in Offsets Properties and Project Boundary

	Area of potential and known habitat to be conserved (ha)	Number of Individuals in conserved habitat	Targets Area of suitable habitat to be rehabilitated (ha)	Target Number of Individuals to be rehabilitated	Total Area to be conserved and rehabilitated (ha)	Total number to be conserved and rehabilitated
Offset Properties						
Hillcroft	279.79	5,530.00	413.06	5,370.00	692.85	10,900.00
Hillview/Billabong	46.84	463.00	36.51	22.00	83.35	485.00
Offset Subtotal	**326.63**	**5,993.00**	**449.57**	**5,392.00**	**776.20**	**11,385.00**
Project Boundary						
Project Disturbance Boundary			278.00	19,219.00		
Outside Disturbance Boundary	630.00	18,382.00				
Project Boundary Subtotal	**630.00**	**18,382.00**	**278.00**	**19,219.00**	**908.00**	**37,601.00**
TOTAL	**604.63**	**24,375.00**	**727.57**	**24,611.00**	**1,684.20**	**48,986.00**

The table below summarises what will be done within the offsets property Hillcroft, and in the Project Boundary to conserve and rehabilitate *Persoonia marginata*

Table 6.12 Summary of *Persoonia marginata* Conserved and Rehabilitation Targets in Offsets Properties and Project Boundary

	Area of known habitat to be conserved (ha)	Number of Individuals in conserved habitat	Area of known habitat to be rehabilitated (ha)	Target Number of Individuals to be rehabilitated	Total Area to be conserved and rehabilitated (ha)	Total number to be conserved and rehabilitated
Offset Properties						
Hillcroft	85.96	76,676.00			85.96	76,676.00
Offset Subtotal	**85.96**	**76,676.00**			**85.96**	**76,676.00**
Project Boundary						
Project Disturbance Boundary			3.09^	303^	3.09	303.00
Outside Project Disturbance Boundary	13.1*	4,503.00*			13.10	4,503.00
Project Boundary Subtotal	**0.00**	**4,503.00**			**16.19**	**4,806.00**
TOTAL	**85.96**	**81,179.00**	**3.09^**	**303^**	**102.15**	**81,482.00**

Notes: *^ Does not include habitat or individuals potentially impacted by edge effects.*
** Does not include habitat or individuals occurring outside the Project Boundary within Ben Bullen State Forest*

6.4.7 Strategic Benefits of Biodiversity Offset Properties

Land selected for inclusion in the biodiversity offset package for the Project has been selected based upon various criteria. In general terms, the offset properties were selected because:

- They contain appropriate vegetation communities in good condition, comparable those that are proposed to be cleared for the Project;
- They contain extensive areas of high quality habitat for threatened flora and fauna species including all species predicted to be impacted by the Project;
- Broad areas of the vegetation can be feasibly regenerated and improved to provide additional woodland communities in the medium term (e.g. the 220 ha of Box Gum Woodland in total across all Project Biodiversity Offset Properties);
- They will build onto existing state forests (Ben Bullen State Forest and Sunny Corner State Forest) and protected National Park (Wollemi National Park) and compliment the aims of GOS2;
- They include or adjoin permanent streams, including Dulhuntys Creek and the Turon River, that form high quality habitat for wildlife;
- They can be used to form new, or improve existing, habitat corridors; particularly:
    - Hillcroft links between Ben Bullen State Forest and the eastern tip of the Sunny Corner State Forest;
    - New links between Wollemi National Park and Winburndale Nature Reserve via the Hillcroft property;
- They are freehold land that is free of other mining authorities.

The Offset Strategy for the Project has been devised to comply with the current principles for offsetting set out by SEWPaC (DEWR, 2007) and by OEH.

The establishment, enhancement and maintenance of habitat corridors is proposed as a major feature of the offset package for this Project, particularly areas of remnant vegetation that occur between forests, woodlands and grasslands of high conservation value in order to provide connectivity between these remnant areas. Research has highlighted the importance of maintaining treed habitats in the intervening disturbed landscape between areas of remnant vegetation as these patches or corridors are important for fauna movement and seed dispersal. Remnant patches also serve as stepping stone corridors that facilitate the movement of fauna in the landscape. Stepping stones have been shown to be important in maintaining landscape connectivity and maintaining gene flow between separate population because of the movement of pollen and seed vectors such as animals and insects (Lindenmayer, 2006).

6.5 Biodiversity Offset Management Plan

A key component of the Biodiversity Offset Package is the establishment and future ongoing management of the vegetation and habitats on the offset properties. Biodiversity management of the properties will ensure that there is an improvement in the biodiversity values of the offset properties. On this basis, Coalpac intends to implement a BOMP to achieve a 'maintain and improve' outcome for the Project and associated offsets.

The Biodiversity Offset Handbook (Business and Biodiversity Offsets Programme (BBOP), 2009) is guide that provides suggestions on designing offsets. It was developed by the Business and Biodiversity Offsets Programme (BBOP), which is a partnership between companies, governments, conservation experts and financial institutions. Their aim is to explore whether biodiversity offsets can help achieve better and more cost effective conservation outcomes. According to the Biodiversity Offset Handbook:

> *An offset should deliver conservation gains over and above planned or predicted conservation actions being taken by other parties (otherwise the offset is making no difference). In practice, biodiversity gains can be achieved in a number of ways, such as undertaking positive management interventions to restore an area or stop degradation: improving the conservation status of an area of land by restoring habitats or ecosystems and reintroducing native species. Where proven methods exist or there are no other options, reconstructing or creating ecosystems. Also, reducing or removing current threats or pressures by, for instance, introducing sustainable livelihoods or substitute materials.*

The aforementioned BOMP will prescribe management of each offset property. Different properties and different areas within a single property will inevitably require varying levels and methods of management. The baseline survey information will be used to identify site specific issues; formulate scope of works and indicator performance criteria; prepare a series of site specific management actions; and prepare a set of implementation timeframes and key milestones.

The BOMP is intended to be adaptive and regular ecological monitoring will be prescribed to guide the adaptive management of offset properties.

The preparation of the BOMP will be guided by a number of relevant texts, including the draft National Recovery Plan for Box Gum Woodland and Derived Native Grasslands (DECCW (NSW) 2010a) and (Rawlings et al. 2010). Other references that will guide the development of the BOMP and the rehabilitation of the offset properties also relate to the restoration of grassy temperate woodlands and will include (McIntyre et al. 2002, Spooner et al. 2002, Lindenmayer et al. 2010).

6.5.1 Implementation Objectives

The BOMP will provide clear implementation objectives that will be consistent with the desired outcomes of the draft National Recovery Plan for Box Gum Woodland and Derived Native Grassland.

The objectives for regeneration of vegetation within the offsets will include but not be limited to the following:

- Maintenance and improvement of the condition of existing forest and woodland within all offset areas, specifically to improve conditions for threatened flora and fauna;
- Maintenance and improvement of derived native grassland to promote, through management of grazing pressure, natural succession towards woodland and or open forest;
- Rehabilitation of selected areas of low diversity native grassland by replanting trees and shrubs to promote a more rapid regeneration towards forest or woodland; and
- Improvement of habitat connectivity across offset lands, and from offset lands to adjacent native vegetation and mine rehabilitation in order to improve wildlife movement in the long term.

The land within the offsets contains extensive areas of existing woodland and open forest that will form nuclei for ongoing regeneration of trees and shrubs into grassland areas. Such habitats will provide immediate and ongoing habitats for native plants and animals. Existing forest and woodland areas are currently mature, functioning examples of natural ecosystems, but their condition is expected to improve with time as trees mature, tree hollows are generated and as regeneration of understorey takes place when livestock are progressively removed (McIntyre et al., 2002).

Derived Native Grassland within the offsets has significant floral diversity, including scattered trees and shrubs. It is intended that the cessation of grazing at Hillcroft, Yarran View and Hillview / Billabong combined with the management of weeds and feral animals will be able to accelerate regeneration of Derived Native Grassland to forest and woodland areas. Such habitats are semi-natural and cannot currently be considered fully functional as they generally lack trees and shrubs. However, in the medium to long term, trees and shrubs are expected to regenerate into such areas if the condition of the land is improved through grazing and weed management (Lindenmayer et al. 2010). It is expected that substantial regeneration will occur within the life of the mine and a mature, functional ecosystem will be established across much of the grassland areas within 50 years.

Low diversity native grasslands have low diversity of native ground covers and essentially no trees and shrubs. However, to overcome this, trees and shrubs will be planted into such areas to form nuclei of regenerating woody habitats that will then be able to progressively grow back into woodland or open forest. Replanting of such areas will take place early in the life of the Project (within the first five years) and it is expected that substantial regeneration of woody plants will occur within the life of the mine (21 years). It is expected that substantial regeneration will occur within the life of the mine and a mature, functional ecosystem will be established across much of the grassland areas within 50 years.

6.5.2 Monitoring

The BOMP will establish key performance objectives for various areas and vegetation types within the offsets, consistent with the objectives listed above, and with the objectives of the draft National Recovery Plan for Box Gum Woodland and Derived Native Grassland (DECCW (NSW) 2010a).

The BOMP will include a monitoring program that tracks the progress of regeneration of open forest, woodland and grassland areas on site, and which identifies problems that require active management, such as infestations of weeds and feral animals, or failure of some areas of plant species to regenerate.

6.5.3 Ongoing Management

The BOMP will include:

- Provisions and Management of land that contains and/or can be regenerated to provide Box Gum Woodland at a ratio of approximately 13 ha of conserved land for each hectare to be cleared (i.e. a ratio of 13:1);
- Provision of land that contains or could be regenerated to provide Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Woodland, Tableland Gully Ribbon Gum - Blackwood - Applebox Forest, Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest, Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest or vegetation of similar resemblance and other non-C/EECs at a ratio of 1.9:1;
- Provision of land that includes habitat for all relevant threatened flora and fauna species that could be impacted by the Project;
- Provision of land that contributes to an existing regional conservation area; and
- Re-establishment of habitat linkages to existing areas of habitat in the locality including existing native vegetation within and adjacent to the Project Boundary and the western portion of the Great Dividing Range.

The BOP will also include management procedures for weeds and feral animals, maintenance of tracks and trails, active replanting of vegetation within selected areas and for ecological monitoring.

The implementation of the plan will be funded by Coalpac for the life of the Project and during the management of the Project Boundary, post-mining, until key rehabilitation and mine closure commitments are met.

The offset property lands will be permanently protected by an appropriate mechanism to the satisfaction of OEH and D&PI.

6.6 Compliance with State and Commonwealth Offset Principles

The offset package has been designed to comply with State and Commonwealth principles for offsetting (DEWR, 2007, DECC (NSW), 2008a). Offsets will all provide targeted, permanent conservation lands that will be progressively regenerated over time to increase the quality of flora and fauna habitats within them.

Table 6.13 Compliance with NSW Offset Principles

	NSW Biodiversity Offset Principles	Justification
1	Impacts must be avoided first by using prevention and mitigation measures.	Avoidance and mitigation measures have been incorporated into the Project prior to offsetting. The Project has been designed to avoid flora and fauna habitats as much as practicable. In particular, the Project infrastructure and employed highwall mine techniques where feasible to reduce clearing impacts.
2	All regulatory requirements must be met.	All regulatory requirements, both State and Commonwealth, will be met by the Project.
3	Offsets must never reward ongoing poor performance.	The offsets will be managed according to a Biodiversity Management Plan that will have Key Performance Indicators that will require to be met in order to ensure that the Project attains a high environmental standard.
4	Offsets will complement other government programs	The proposed offsets do complement other government Projects - particularly the GOS2, draft Recovery Plan for Box Gum Woodland and other similar threatened species Recovery Plans (e.g. for Spotted-tailed Quoll). The proposed offsetting will increase the area of Box Gum Woodland and other native forests under conservation tenure in the Region and will provide increased quality of habitat in the long term.
5	Offsets must be underpinned by sound ecological principles.	The proposed offsets are underpinned by sound ecological principles. Firstly, they are designed to be "like for like" and will provide increased areas of Box Gum Woodland and other forest types in conservation tenure. Secondly, the offsets are located adjacent National Parks or within intent to link State Forests. They will therefore be available for regenerating forest and woodland that can form a link between existing high quality forest and woodland areas, adding to the size and viability of the Wollemi National Park. Thirdly, the offsets provide habitat for a wide variety of plants and animals, including the threatened species of animals known to occur in the area of impact. All of the threatened species that are known to occur in the Project Boundary also occur within the proposed offset areas. However, in addition, the proposed offsets have potential to support other species not previously recorded in Project Boundary such as the Regent Honeyeater and Spotted-tailed Quoll. Finally, the offsets will be managed sustainably and weeds and feral animals will be

Table 6.13 Compliance with NSW Offset Principles

	NSW Biodiversity Offset Principles	Justification
		controlled, as will grazing by livestock. Hence the landscape will be managed to facilitate an increase in forest and woodland as these vegetation types are regenerated.
6	Offsets should aim to result in a net improvement in biodiversity over time.	The offsets contain broad areas of derived native grassland with high potential for regeneration. They will be managed sustainably and weeds and feral animals will be controlled, as will grazing by livestock. Hence the landscape will be managed to facilitate an increase in forest and woodland as these vegetation types are regenerated.
7	Offsets must be enduring and they must offset the impact of the development for the period that the impact occurs.	The offsets will be conserved in the long term and protected by an appropriate legal mechanism to ensure that the conservation measures are permanent.
8	Offsets should be agreed prior to the impact occurring.	The offsets are proposed "up front" and are available prior to the impact occurring. Rehabilitation and management of the native flora and fauna within the offsets will commence at the beginning of the Project, prior to any mining.
9	Offsets must be quantifiable and the impacts and benefits must be reliably estimated.	The offsets are quantified within the EA and the impacts and benefits have been spelled out in tables within Chapter 4 and Chapter 6. The total offset package will result in a net gain in woodland and forest under conservation tenure and will likewise result in an increase in threatened species habitat. The areas of existing derived native grassland will be regenerated to woodland and this will provide a measureable increase in woodland and open forest habitat for threatened species.
10	Offsets must be targeted.	Offsets have been specifically targeted to conserve sandstone habitats and Box Gum Woodland and Derived Native Grassland. The offsets have also been targeted to provide habitat for all threatened species.
11	Offsets must be located appropriately.	All offsets are located within the same bioregion, with one property straddling both the Sydney Basin and neighbouring South-eastern Highlands Bioregion. This means that the majority of vegetation of the proposed offsets is similar to the impacted vegetation. The offsets proposed are located appropriately adjacent Wollemi National Park, Blue Mountains National Park and between Ben Bullen State Forest and Sunny Corner State Forest which will form a continuous link of forest and woodland habitat between the State Forests.
12	Offsets must be supplementary.	Offsets are supplementary to the avoidance and mitigation measures that have or will be deployed at the mine site. The mine site will be rehabilitated to forest and woodland in the long term and so the

Table 6.13 Compliance with NSW Offset Principles

	NSW Biodiversity Offset Principles	Justification
		original area of forest and woodland will be recreated for flora and fauna. The offsets will be supplementary to these measures and will add sizeable areas of forest and woodland to conservation tenure in the longer term.
13	Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.	The proposed offsets are readily enforceable through development consent conditions.

Table 6.14 Compliance with Commonwealth Offset Principles

	Draft Environmental Offset Policy Principles	Justification
1	Environmental offsets should be targeted to the matter protected by the EPBC Act that is being impacted.	Offsets have been specifically targeted to provide Box Gum Woodland and Derived Native Grassland and sandstone habitats. The offsets have also been targeted to provide habitat for all threatened species that are known to occur in Project Boundary. They provide habitat for threatened birds including Regent Honeyeater and Swift Parrot and adjoins Booroolong Frog (Litoria booroolongensis) habitat although not impacted by the Project. Although not found within the Project Boundary, the offsets, particularly Hyrock Hartley offsets are also likely to provide habitat for Spotted-tailed Quoll and Blue Mountains Water Skink.
2	A flexible approach should be taken to the design and use of environmental offsets to achieve long-term and certain conservation outcomes which are cost effective for proponents.	The proposed offsets will be managed in a cost effective way, with farming (livestock grazing), gradually phased out to provide for effective conservation. Offsets will be managed in a flexible, adaptive way to ensure that conservation outcomes are achieved in a cost effective and practical manner. The progress of regeneration of offsets will be monitored and monitoring data will be provided to fine tune offset management.
3	Environmental offsets should deliver a real conservation outcome.	The proposed offsets will be managed to provide a real conservation outcome, increasing the quantity and quality of Box Gum Woodland and other forest and woodland types in the region. The existing areas of derived native grassland will be regenerated progressively to woodland and this will provide a net increase in woodland habitat for threatened species.

Table 6.14 Compliance with Commonwealth Offset Principles

	Draft Environmental Offset Policy Principles	Justification
4	Environmental offsets should be developed as a package of actions, which may include both direct and indirect offsets.	The offsets are part of a package that includes rehabilitation of the mine site area back to forest and woodland and the immediate conservation and regeneration of offset land.
5	As a minimum, environmental offsets should be commensurate with the magnitude of the impacts of the development and ideally deliver outcomes that are 'like for like'.	The proposed offsets, when fully regenerated, will greatly exceed the total area that will be impacted by mining. This - when combined with rehabilitation of the mine site - will result in a net increase in forest and woodland habitat in the Region in the long term.
6	Environmental offsets should be located within the same general area as the development activity.	All offsets are located within the same bioregion, with one property straddling both the Sydney Basin and neighbouring South-eastern Highlands Bioregion. This means that the majority of vegetation of the proposed offsets is essentially the same or very similar to the impacted vegetation. The offsets proposed are located appropriately adjacent Wollemi National Park, Blue Mountains National Park and between Ben Bullen State Forest and Sunny Corner State Forest which will form a continuous forest and woodland habitat between the State Forests.
7	Environmental offsets should be delivered in a timely manner and be long lasting.	The proposed offsets will be available at the commencement of mining and will be permanent. The quality of offsets and the quantity of woodland and open forest will increase over time.
8	Environmental offsets should be enforceable, monitored and audited.	The proposed offsets are readily enforceable through development of a BOMP. They will be monitored annually and subjected to independent audit.

Chapter 7

Conclusion

Coalpac seeks Project Approval under Part 3A of the *Environmental Planning & Assessment Act 1979* (EP&A Act) to consolidate the operations and management of the Cullen Valley Mine and Invincible Colliery sites under a single, contemporary planning approval to allow coal mining operations largely within its current mining tenements to continue for a further period of 21 years. The Project, once approved, will continue to supply coal to the local Mount Piper Power Station and (emergency supply to) Wallerawang Power Station, with flexible supply to additional domestic destinations and Port Kembla for export. Extraction of the Marangaroo Sandstone horizon will also be used for sale into the Sydney (and surrounds) industrial sand market.

The Project is largely located within Ben Bullen State Forest, which comprises a very large remnant patch of vegetation connected to Gardens of Stone to the north and Newnes State Forest and Wollemi National Park to the east and south. There is evidence that extensive logging has occurred in some areas however overall, high quality habitat for an array of threatened flora and fauna was found to be present within the Project Boundary.

The Project would require removal 835 ha of native forest and woodland which provides habitat for a range of threatened species. Of this area, 16.48 ha of vegetation conform to the description of Box Gum Woodland and Derived Native Grassland CEEC as defined by the Commonwealth's listing advice, 1.96 ha of Box Gum Woodland and Derived Native Grassland EEC as defined under the TSC Act, approximately 278 ha of potential and known *Eucalyptus cannonii* habitat and impact 3.28 ha of *Persoonia marginata* habitat. At least 35 fauna species listed by the TSC Act and/or the EPBC Act were recorded, or have potential to occur within the Project Boundary. Three threatened flora species, *Eucalyptus cannonii* and *Persoonia marginata*, both listed as Vulnerable under both the TSC Act and the EPBC Act were recorded within the Project Boundary. *Eucalyptus aggregata*, Vulnerable under the TSC Act was also recorded, albeit within Coalpac's existing offsets. The Project will entail removal of broad areas of vegetation and associated habitat from the Project Boundary, which in the absence of appropriate impact amelioration measures, would result in a substantial ecological impact at the local level.

There will be minimal impacts to the area of the Project currently within the Ben Bullen State Forest or proposed as the GOS2. Although some of the mining proposal is within the GOS2 area, all lands within the Project Disturbance Boundary will be rehabilitated in the long term and the proposed biodiversity offset areas will add to and complement some of the stated objectives of GOS2.

In recognition of the potential ecological impacts of the Project, substantial mitigation measures will be implemented. The considerations for reducing the ecological impacts followed a hierarchy of principles:

- Avoid – to the extent possible, developments should be designed to avoid or minimise ecological impacts;
- Mitigate – where certain impacts are unavoidable through design changes, mitigation measures should be introduced to ameliorate the ecological impacts of the Project; and
- Compensate – the residual impacts of the Project, following the implementation of mitigation measures, will be compensated to offset what would otherwise be a net loss of habitat.

One of the key mitigation measures of the Project is the avoidance of 30 ha of CEEC Box Gum Woodland, 630 ha of known and potential *Eucalyptus cannonii* habitat and 8.98 ha of *Persoonia marginata* habitat. By preferentially implementing highwall mining techniques to extract coal, instead of open cut mining, significant reductions in the extent of broad scale clearing of Federally listed communities, threatened species' habitats and non listed ecological communities have been achieved. All forest and woodland areas to be cleared by mining will be rehabilitated to forest and woodland communities in the long term, using local native species, thereby redeveloping treed habitat in the locality.

Rehabilitation plans for the Project have been designed to include the restoration of Ben Bullen State Forest to the existing (pre-project development) forest and woodland communities where practical. The restoration of Ben Bullen State Forest within the Project Disturbance Boundary will be a progressive process and has been designed with the intention of providing a self-sustaining native forestry operation as well as restoring pre-mine biodiversity values in the long term. To ensure the effective coordination of rehabilitation efforts, a Rehabilitation and Landscape Management Plan will be developed that prescribes the progressive rehabilitation of all Project Disturbance Areas, including 18.44 ha of Box-Gum Woodland and supplementary habitat features, including translocated hollow logs and other habitat features.

In order to compensate for the residual impacts of the Project and improve ecological outcomes, a carefully designed and robust offsets strategy is proposed. The offset strategy identifies large patches of remnant vegetation that contain high quality habitat and would create a valuable corridor for threatened species in the region.

Vegetation: Approximately 1,752 ha of forest, woodland and grassland habitat occur within the offset lands that will be permanently conserved, including 221 ha of CEEC Box Gum Woodland and Derived Native Grassland. In the long term, the 175 ha of Derived Native Grassland within the offset properties will also be regenerated to Box Gum Woodland. Not including mine rehabilitation an overall offset ratio of 2:1 for native vegetation is considered adequate as Coalpac have committed to continuing high quality rehabilitation of mined areas. The offset ratio for CEEC Box Gum Woodland estimated at 13:1.

Threatened Species: An existing offset supports a known population of *Eucalyptus aggregata*. The offset properties provide habitat for all impacted threatened fauna and threatened flora including *Eucalyptus cannonii* and *Persoonia marginata*. Collectively the offset package will conserve 327 ha of *E. cannonii* habitat and rehabilitate 450 ha of suitable habitat for this species.

Approximately 86 ha of *Persoonia marginata* habitat, estimated to support 76,676 individuals will also be conserved in the Hillcroft offset property. In total, the combination of mine rehabilitation and offsetting the Project will result in 1,684 ha of *Eucalyptus cannonii* habitat (estimated 48,986 individuals) and 102 ha of *Persoonia marginata* habitat (estimated 81,482 individuals).

Another critical component of the strategy would be the restoration and establishment of a regional corridor linking the Ben Bullen State Forest with the Sunny Corner State Forest and large vegetation remnants beyond (Wollemi National Park and Winburndale Nature Reserve). The inclusion of these lands as potential biodiversity offsets would provide additional conservation areas in the region for threatened flora and fauna, which has previously been highly fragmented. Collectively, the Biodiversity Offset Strategy will conserve suitable habitat for all impacted flora and fauna found within the Project Boundary during current and previous surveys.

It is recognised that the Project will impact on known habitat for endangered vegetation communities and threatened flora and fauna species. However, the combined mitigation measures and biodiversity offset strategy to be implemented over the life of the Project are expected to ameliorate these impacts to the extent that no threatened species are likely to become extinct as a result of the Project. Moreover, the long term outcome of the offsets package will provide for a net benefit to flora and fauna within the locality and region, substantially increasing the proportion of native forest and woodland in conservation tenure. This will complement the existing large areas of nearby habitats for all of the affected threatened flora and fauna that are known to occur within the locality of the Project Boundary.

When the mitigation and offsetting package is considered, the Project will have a major ecological benefit in the medium to long term. It will considerably increase the area of forest and woodland under conservation tenure in the region, adding substantial areas of CEEC Box Gum Woodland and Derived Native Grassland to conservation tenure.

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Appendix A

Recorded Flora Species

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Trees																									
	Allocasuarina littoralis				X																				
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak	X		X																				
Cupressaceae	*Callitris rhomboidea*	Port Jackson Pine			X																				
Fabaceae	*Acacia dealbata*	Silver Wattle	X	X	X																		X		
	Acacia falciformis	Broad-leaved Hickory			X	X	X			X		X					X	X				X			
	Acacia floribunda				X																				
	Acacia obtusifolia				X		X	X																	
Myrtaceae	*Eucalyptus aggregata*	Black Gum			X																				
	Eucalyptus blakelyi	Blakely's Red Gum			X	X																			X
	Eucalyptus blaxlandii			X	X					X															
	Eucalyptus bridgesiana ssp. bridgesiana		X	X	X																X				X
	Eucalyptus cannonii	Capertee Stringybark	X		X	X	X					X		X			X	X		X	X	X	X	X	
	Eucalyptus dalrympleana	Mountain Gum	X	X	X	X			X								X					X	X		
	Eucalyptus dives	Broad-leaved Peppermint	X	X	X										X										
	Eucalyptus goniocalyx		X	X																					

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																				
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Eucaltptus laophila x E. stricta				X																				
	Eucalyptus macrorhyncha	Red Stringybark	X	X	X			X																	X
	Eucalyptus mannifera	Brittle Gum	X	X	X																			X	
	Eucalyptus mannifera?				X																				
	Eucalyptus mannifera ssp. praecox	Brittle Gum			X															X					
	Eucalyptus melliodora		X		X	X																			
	**Eucalytpus nicholii*																								
	Eucalyptus pauciflora	Snow Gum	X		X																				
	Eucalyptus piperita		X	X	X	X	X		X																
	Eucalyptus punctata	Grey Gum	X	X																					
	Eucalyptus radiata		X		X																				
	Eucalyptus rossii	Inland Scribbly Gum	X	X	X			X				X		X	X				X	X	X			X	
	Eucalyptus rubida		X																						
	Eucalyptus sieberi		X	X	X							X						X	X						
	Eucalyptus sparsifolia		X	X	X				X		X	X	X		X				X						
	Eucalyptus stellulata	Black Sally																							

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Eucalyptusd stricta				X																				
	Eucalyptus viminalis	Ribbon Gum	X		X	X				X						X	X	X							
Shrubs																									
Apiaceae	*Platysace ericoides*		X	X																					
	Platysace lanceolata		X	X	X																				
Apocynaceae	*Hymenanthera dentata*				X																				
Asteraceae	*Cassinia arcuata*		X	X	X			X																	
	Cassinia laevis			X																					
	Cassinia longifolia																								X
	Cassinia quinquefaria				X																				
	Cassinia sp.				X																				
	Olearia erubescens				X																				
	Ozothamnus diosmifolius		X		X						X					X					X				
Dilleniaceae	*Hibbertia obtusifolia*		X	X	X	X		X		X							X	X	X	X		X			
	Hibbertia riparia																								
	Hibbertia sericea				X																				
	Hibbertia stricta				X																				
	Hibbertia sp.				X																				

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ericaceae	*Acrotriche divaricata*																								
	Acrotriche serrulata		X																						X
	Brachyloma daphnoides		X	X	X			X																		
	Epacris reclinata				X																				
	Leucopogon appressus			X																					
	Leucopogon lanceolata		X		X	X	X			X					X				X						
	Leucopogon microphyllus			X																					
	Leucopogon muticus		X	X	X			X		X		X	X		X				X	X	X			X	
	Leucopogon neo-anglicus				X																				
	Leucopogon virgatus		X		X			X	X				X	X		X	X				X			X	
	Leucopogon virgatus?																								X
	Lissanthe strigosa	Peach Heath	X		X	X																			
	Lissanthe strigosa ssp. subulata				X																				
	Monotoca scoparia		X	X	X			X																	X
	Melichrys erubescens				X																				
	Sprengelia incarnata				X																				

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																						
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Styphelia triflora				X	X																			
	Styphelia tubiflora		X		X					X	X							X		X		X			
Fabaceae	*Acacia acinacea*				X																				
	Acacia brownii				X																				
	Acacia buxifolia	Sunshine Wattle	X	X	X				X		X		X	X	X				X	X	X			X	
	Acacia dealbata				X	X												X		X		X	X	X	
	Acacia falciformis		X	X	X				X	X						X						X			
	Acacia floribunda				X																				
	Acacia gunnii		X																						
	Acacia mearnsii		X																						
	Acacia myrtifolia				X			X																	
	Acacia obtusifolia		X	X	X	X		X								X							X		
	Acacia paradoxa				X			X													X				
	Acacia sp.				X																				X
	Acacia terminalis		X	X	X						X				X										
	Acacia ulicifolia		X	X	X			X							X	X									
	Bossiaea buxifolia				X																				
	Bossiaea prostrata				X																				X
	Bossiaea neo-anglica		X		X																				

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Daviesia ulicifolia				X																				
	Daviesia virgata			X	X																				
	Dillwynia phylicoides		X	X																					
	Dillwynia ?retorta				X																				
	Dillwynia retorta				X																				
	**Genista monspessulana*																								
	Gompholobium huegelii		X	X																					
	Hovea linearis		X		X			X											X	X					
	Hovea longifolia				X																				
	Hovea sp.				X																				
	Indigofera australis		X		X				X				X				X		X	X				X	X
	Mirbelia platyloboides		X																						
	Oxylobium sp.				X																				
	Platylobium sp.				X																				
	Podolobium ilicifolium		X	X	X				X	X					X		X		X	X		X			
	Pultenaea elliptica																								
	Pultenaea microphylla		X	X	X															X			X	X	
	Pultenaea retusa				X																				
	Pultenaea sp.				X																				X

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Logania albiflora				X																				
Malaceae	**Malus sp.*																								
Myrtaceae	*Callistemon ?pinifolius*				X																				
	Calytrix tetragona		X		X																				
	Eucalyptus blakelyi				X																				
	Eucalyptus bridgesiana ssp. bridgesiana				X																				
	Eucalyptus dalrympleana				X																				
	Eucalyptus dives				X																				
	Eucalyptus pauciflora																								
	Eucalyptus rossii																								
	Harmogia densifolia				X																				
	Kunzea parvifolia				X																				
	Leptospermum continentale		X		X			X																	
	Leptospermum juniperinum				X																				
	Leptospermum myrtifolium																								

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																					
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Leptospermum obovatum																							
	Leptospermum parvifolium		X	X	X																			
	Leptospermum polygalifolium			X	X		X	X																
	Leptospermum sphaerocarpum		X																					
	Leptospermum sp.																							X
	Leptospermum trinervium		X																					
	Micromyrtus ciliata			X																				
Oleaceae	*Notelaea longifloia*				X																			
	Notelaea neglecta				X																			
Pittosporaceae	*Bursaria longisepala*				X																			
	Bursaria spinosa				X																			
	Rhytidosporum procumbens		X		X																			
Proteaceae	*Banksia cunninghamii*		X		X																			
	Hakea dactyloides				X																			

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Hakea laevipes																								
	Hakea teretifolia				X																				
	Isopogon anethifolius				X																				
	Isopogon dawsonii		X																						
	Lomatia myricoides				X																				
	Persoonia linearis	Narrow-leaved Geebung	X	X	X			X	X	X	X		X				X		X		X	X			
	Persoonia marginata	Clandulla Geebung			X																				
	Persoonia mollis																								
	Persoonia myrtilloides		X		X			X							X										
	Persoonia oblongata																								
Rhamnaceae	*Cryptandra amara*			X	X																				
	Cryptandra spinescens				X																				
	Pomaderris andromedifolia		X																						
	Pomaderris andromedifolia ssp. andromedifolia				X																				
	Pomaderris prunifolia				X																				

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																				
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Rosaceae	**Cottoneaster sp.*																								X
	**Rubus fruticosus*	Blackberry			X																				
	**Rosa rubiginosa*	Briar Rose																							X
	Rubus sp.				X																				
Rutaceae	*Boronia microphylla*		X		X																				
	Boronia rigens		X																						
	Boronia sp.				X																				
	Correa reflexa		X																						
	Phebalium lamprophyllum		X																						
	Philotheca myoporoides ssp. Myoporoides				X																				
	Zieria aspalathoides				X																				
	Zieria cytisoides		X		X																				
	Zieria sp.		X																						
Santalaceae	*Choretrum pauciflorum*	Dwarf Sour Bush																							
	Exocarpos cupressiformis		X	X	X												X								
	Exocarpos strictus		X	X																					

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Leptomeria acida		X	X	X				X	X	X		X	X	X				X	X			X	X	X
	Omphacomeria acerba		X																						
Sapindaceae	*Dodonaea multijuga*				X																				
	Dodonaea viscosa ssp cuneata		X		X																				
	Dodonaea viscosa ssp spatulata				X																				
Scrophulariaceae	*Derwentia perfoliata*				X																				
Simaroubaceae	**Ailanthus altissima*	Tree of Heaven																							
Solanaceae	*Solanum laciniatum*	Kangaroo Apple			X																				
	Solanum linearifolium	Mountain Kangaroo Apple																							
	Solanum prinophyllum				X																				
Herbs - Fern																									
Adiantaceae	*Adiantum aethiopicum*				X																				
Aspleniaceae	*Asplenium flabellifolium*		X		X																				
Blechnaceae	*Blechnum cartilagineum*				X																				
	Blechnum nudum		X																						
Cyatheaceae	*Cyathea australis*		X		X																				

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																					
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Dennstaedtiaceae	*Pteridium esculentum*		X	X	X	X				X								X							
Dicksoniaceae	*Calochlaena dubia*				X																				
Lindsaeaceae	*Lindsaea linearis*			X	X																				
Polypodiaceae	*Pyrrosia rupestris*		X																						
Sinopteridaceae	*Cheilanthes austrotenuifolia*		X																						
	Cheilanthes sieberi		X	X	X																X				
Herbs - Dicots																									
Acanthaceae	*Brunoniella australis*				X																				X
	Brunoniella pumilio																								
Apiaceae	*Centella asiatica*																								
	**Conium maculatum*																								
	Daucus glochidiatus				X	X																			
	Hydrocotyle laxiflora		X		X	X	X			X	X	X		X		X	X	X					X	X	
	Hydrocotyle tripartita				X																				X
	Hydrocotyle sp.																								
	Xanthosia pilosa				X																				
Asteraceae	*Brachycome angustifolia*																								
	Brachycome spathulata			X	X				X	X															

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																						
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Calotis cuneifolia		X		X																				X
	**Cathamus lanatus*																								
	Centipeda minima		X																						
	Chrysocephalum apiculatum				X																				
	Chrysocephalum semipaposum				X																				
	Chrysocephalum sp																								
	**Cirsium vulgare*	Scotch Thistle	X		X	X												X				X	X		
	**Conyxa bonariensis*	Flaxleaf Fleabane																							
	**Conyza sp.*				X																				
	Cymbonotus lawsonianus		X		X	X																			
	Euchiton sphaericus		X	X	X																		X		
	Euchiton sp.																								
	**Facelis retusa*																								
	**Gnaphalium americanum*				X		X																		
	**Gnaphalium sp.*				X																				

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																					
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Helichrysum scorpiodes		X		X			X																X	
	**Hypochaeris radicata*	Flatweed	X		X	X				X						X	X				X		X		X
	**Lactuca seriola*																								
	?Lagenophora sp.																								
	Lagenophora stipitata		X		X	X	X		X	X										X	X	X	X	X	
	Olearia erubescens	Pink-tip Daisy-bush																							
	Senecio hispidulus																								
	Senecio lautus				X																				
	Senecio linearifolius		X		X																				
	Senecio quadridentatus				X	X	X																		
	Senecio sp.																								
	Senecio tenuiflorus				X																				
	Senecio ?vagus				X																				
	**Silybum marianum*				X																				
	Solenogyne sp.				X																				
	**Sonchus aspera*																								
	**Sonchus oleraceus*	Sow Thistle																							
	**Taraxacum officinale*	Dandelion																							
	**Tragopogon porrifolius*																								

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																				
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Vittadinia cuneata		X		X																				
Brassicaceae	**Brassica sp.*																								
	**Lepidium africanum*																								
	**Sisymbrium sp.*				X																				
Boraginaceae	*Cynoglossum australe*		X		X		X		X							X	X	X							
	Cynoglossum suaveolens																								
	**Echium vulgare*	Patterson's Curse																							
Campanulaceae	*Wahlenbergia communis*				X																				
	Wahlenbergia gracilis		X		X															X					
	Wahlenbergia stricta		X	X	X																				
	Wahlenbergia sp.				X																				
Caryophyllaceae	**Polycarpon tetraphyllum*	Four-leaf All-seed																							
	Stellaria pungens		X		X		X		X		X						X	X							
Chenopodiaceae	*Einadia hastata*		X		X																				
Clusiaceae	*Hypericum gramineum*		X		X			X				X		X							X	X	X		X
	**Hypericum perforatum*	St John's Wort			X		X																		
Convolvulaceae	*Dichondra repens*	Kidney Weed	X		X		X				X						X	X	X						
Crassulaceae	*Crassula decumbens*				X																				

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																					
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Crassula sieberana		X																					
Dilleniaceae	*Hibbertia obtusifolia*				X																			
	Chamaesyce sp.				X																			
Droseraceae	*Drosera peltata*																							
Fabaceae	*Desmodium varians*	Tick Trefoil			X	X				X														
	Bossiaea prostrata																							
	**Medicago sp.*																							
	**Trifolium dubia*	Yellow Suckling Clover	X																					
	**Trifolium repens*	White Clover																						
Gentianaceae	**Centaurium erythrea*	Common Centaury																						
	**Centaurium tenuiflorum*																							
	Schenkia spicata				X		X																	
Geraniaceae	*Geranium solanderi*	Storksbill	X	X	X	X	X											X						
	Geranium homeanum				X																			
	Geranium sp. 1																							
	Geranium sp. 2																							
Goodeniaceae	*Coopernookia barbata*			X																				
	Goodenia bellidifolia				X																			
	Goodenia hederacea		X	X	X			X	X												X	X		X

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																				
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Goodenia sp.				X																				
Haloragaceae	*Gonocarpus longifolius*				X																				
	Gonocarpus sp.				X																				X
	Gonocarpus ?sp.				X																				
	Gonocarpus tetragyna		X	X	X	X	X	X										X			X	X	X	X	
	Gonocarpus teucrioides																								
	Haloragis heterophylla		X																						
Hemerocallidaceae	*Caesia sp.*																								
Hypoxidaceae	*Hypoxis hygrometrica*				X																				
Labiaceae	**Marrubium vulgare*																								
Lamiaceae	*Ajuga australis*	Australian Bugle	X																						
	Ajuga sp.				X																				
	**Lamium amplexicaule*																								
	Metha diemenica		X																						
	**Prunella vulgaris*	Self-heal																							
Linaceae	*Linum marginale*		X		X																			X	
	Linum trigynum	French Flax																							
Lobelieaceae	*Isotoma axillaris*		X		X																				
	Isotoma fluviatilis		X																						

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																				
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Pratia pedunculata				X																				
	Pratia purpurascens		X		X				X																
Loganaceae	*Mitracacme polymorpha*		X																						
Malvaceae	**Modiola caroliniana*																								
Onagraceae	**Oenothera sp.*																								
Oxalidaceae	*Oxalis exilis*				X		X				X														
	**Oxalis ?sp. A*		X																						
	**Oxalis sp. B.*																								
	**Oxalis sp.*				X																				X
	Oxalis sp.				X																				
	Oxalis perennans				X																				
Phyllanthaceae	*Phyllanthus hirtellus*		X		X																				
	Poranthera corymbosa		X		X																				
	Poranthera microphylla				X		X	X		X	X		X	X					X	X	X		X			
Pittosporaceae	*Rhytidosporum procumbens*																								
Plantaginaceae	*Plantago debilis*		X		X		X				X								X		X			X	X	
	**Plantago lanceolata*				X																			X	
	Plantago sp.				X																				X

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																					
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Plantago varia																								
Primulaceae	**Anagallis arvensis*	Scarlet Pimpernel																							
Polygalaceae	*Comesperma ericinum*		X																						
	**Acetosella vulgaris*																								
	**Emex australis*				X																				
	Rumex brownii				X																				
	**Rumex crispus*	Dock																							
Ranunculaceae	*Ranunculus lappaceus*																								
Rosaceae	*Acaena agnipila*				X																				
	Acaena novae-zealandiae		X		X	X				X													X		
	Acaena ovina		X																						
	Acaena sp.																								
Rubiaceae	*Asperula conferta*	Common Bedstraw			X																		X		
	Asperula sp.X				X																				
	Asperula sp.X				X																				X
	Galium binifolium				X																				X
	Galium propinquum		X	X	X	X	X		X	X	X	X					X	X		X		X	X	X	
	Galium gaudichaudii				X																				

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																					
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Galium sp.				X																				
	Opercularia aspera		X		X									X	X		X				X	X		X	
	Opercularia hispida				X																				
	Opercularia sp.				X																				X
	Pomax umbellata		X		X						X														
	**Sherardia arvensis*				X																				
Scrophulariaceae	**Verbascum thapsus*	Blanket Weed																							
	**Verbascum virgatum*	Twiggy Mullein																							
	Veronica calycina		X		X		X	X								X	X	X			X				
	Veronica gracilis																								
	Veronica plebeia		X	X	X																				X
Solanaceae	*Solanum brownii*				X	X																			
Stackhousiaceae	*Stackhousia monogyna*	Creamy Candles	X		X				X								X	X		X			X		
Stylidiaceae	*Stylidium graminifolim*		X		X																				
	Stylidium lineare				X																				
Thymeliaceae	*Pimelea glauca*				X																				
	Pimelea linifolia		X																						
Verbenaceae	**Verbena bonariensis*				X																				
Violaceae	*Viola betonicifolia*	Native Violet	X	X	X	X				X		X						X						X	

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																					
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Viola hederacea	Ivy-leaved Violet	X		X		X																		
Herbs - Monocots																									
*Agavaceae	**Agave americana*	Yucca																							
Anthericaceae	*Anthericaceae sp.*																								
	Laxmannia gracilis		X																						
	Thysanotus sp.		X																						
	Tricoryne elatior				X																				X
	Tricoryne simplex																								
Caryophyllaceae	**Petrorhagia nanteulii*				X																				
Colchicaceae	*Wurmbea dioica*	Early Nancy																							
Cyperaceae	*Carex appressa*																								
	Carex inversa				X																				
	Carex sp.																								
	Cyperus sp.																								
	Lepidosperma laterale				X																				
	Lepidosperma urophorum		X																						
	Lepidosperma sp.		X																						
	Schoenus sp.		X																						

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																						
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Droseraceae	*Drosera sp.*				X																				
Iridaceae	**Iris sp.*																								
	Patersonia glabrata	Purple Flag																							
	Patersonia longifolia			X	X																				
	Patersonia sericea		X																						
	Patersonia sp.				X																				
Juncaceae	*Juncus australis*																								
	**Juncus cognatus*				X																				
	Juncus planifolius		X																						
	Juncus sp.				X																				
	Juncus subsecundus																								
	Luzula flaccida																								
	Luzula sp.		X		X																				
Lomandraceae	*Lomandra confertifolia*		X	X																					X
	Lomandra confertifolius ssp. rubiginosa				X																				
	Lomandra filiformis				X																				
	Lomandra filiformis ssp. coriacea		X	X	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																						
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Lomandra filiformis ssp. filiformis																								
	Lomandra glauca		X		X	X				X															
	Lomandra longifolia		X	X	X		X									X									X
	Lomandra multiflora		X		X					X	X		X				X	X		X		X	X	X	
	Lomandra sp.				X																				
Orchidaceae	*Acianthus exsertus*	Mosquito Orchid			X																				
	Acianthus sp.				X																				
	Caladenia alba				X																				
	Caladenia carnea	Pink Fingers			X																				
	Caladenia sp.				X																				
	Dipodium punctatum		X																						
	Diuris maculata				X			X			X			X	X										
	Diuris sulphurea	Tiger Orchid																							
	Glossodia major	Waxlip Orchid																							
	Microtis uniflora		X																						
	Pterostylis sp.			X	X		X	X	X																
	Thelymitra sp.	a Sun Orchid	X		X			X																	
Phormiaceae	*Dianella longifolia*																								

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Dianella revoluta	Paroo Lily	X	X	X			X	X		X		X		X	X	X		X	X	X	X		X	X
	Stypandra galuca				X																				
Poaceae	*Agrostis avenacea var. avenacea*		X																						
	Anisopogon avenaceus		X																						
	**Anthoxanthum odoratum*	Sweet Vernal Grass			X																				
	Aristida calycina																								
	Aristida jerichoensis																								
	Aristida ramosa			X	X						X														
	Aristida sp.																								
	Austrodanthonia caespitosa		X																						
	Austrodanthonia fulva				X																				
	Austrodanthonia laevis		X																						
	Austrodanthonia penicillata				X																				
	Austrodanthonia racemosa		X	X	X																				X
	Austrodanthonia sp.X				X																				

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																					
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Austrodanthonia sp.X				X																				
	Austrodanthonia sp.				X																				
	Austrostipa rudis		X																						
	Austrostipa scabra				X		X			X	X	X													
	Austrostipa sp.		X		X																				X
	Bothriochloa sp.				X																				
	**Briza minor*	Shivery Grass																							
	**Bromus catharticus*	Prairie Grass																							
	**Bromus molliformis*																								
	Cymbopogon refractus				X																				
	**Cynodon dactylon*	Couch Grass			X		X	X			X	X			X			X						X	
	Chionochloa pallida		X																						
	**Chloris gayana*	Rhodes Grass																							
	Danthonia sp.	a Wallaby Grass																							
	Dichelachne micrantha	Short-haired Plume Grass		X																					
	Dichelachne rara		X																						
	Echinopogon caespitosus		X		X						X				X	X	X	X		X	X	X			X

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																					
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Echinopogon ovatus		X	X	X	X																	X		
	**Eleusine tristachya*				X																				
	Elymus scaber				X																				
	Entolasia stricta		X	X	X																			X	
	**Eragrostis cilianensis*																								
	**Eragrostis curvula*	African Love-grass																							
	Eragrostis leptostachya				X																				
	Eragrostis sp.																								
	**Festuca sp.*																								
	Imperatia cylindrica				X																				
	Joycea pallida			X	X			X							X	X	X			X	X	X	X	X	X
	**Lolium perenne*	Perennial Rye																							
	Lolium sp.				X																				
	Microlaena stipoides	Weeping Meadow-grass		X	X	X	X			X		X				X	X	X			X	X	X		X
	**Nassella neesiana*	Chillean Needle Grass																							
	Panicum effusum				X																				
	**Paspalum dilatatum*	Paspalum																							
	**Paspalum urvellei*																								

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name	CE Quadrats																						
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	**Paspalum sp.*																								
	**Pennesitum clandestinum*	Kikuyu																							
	Phelaris aquatica																								
	Phragmites australis	Common Reed																							
	Poa labillardieri		X																						
	Poa sieberiana ssp cyanophylla		X																						
	Poa sieberiana ssp sieberiana		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
	Poa sp.																								
	Poaceae sp.																								
	Themeda australis	Kangaroo Grass	X	X	X	X														X			X	X	X
	Vulpia bromoides		X																						
	*?*Vulpia sp.*																								
Restionaceae	*Lepyrodia scariosa*		X																						
Typhaceae	*Typha orientalis*	Cumbungi			X																				
Xanthorrhoeaceae	*Xanthorrhoea arborea*				X																				
	Xanthorrhoea sp.		X		X																				

Table A.1 Flora Species Recorded in the Project Boundary Quadrats 1-20

Family/Form	Scientific Name	Common Name				CE Quadrats																	
			Lembit 1997	Lembit 2003	CE 2009-2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Vines & Scramblers																									
Apocynaceae	*Parsonsia brownii*				X																				
Araliaceae	**Hedera helix*	English Ivy																							
Convolvulaceae	*Convolvulus erubescens*	Blushing Bindweed			X																				
Fabaceae	*Glycine clandestina*		X		X	X																			
	Glycine microphylla																								X
	Glycine tabacina		X		X																		X		
	Hardenbergia violacea	Purple Coral Pea	X		X				X		X				X				X	X					
	Vicia sativa subsp. nigra	Narrow-leaved Vetch																							
Lauraceae	*Cassytha melantha*				X																				
	Cassytha pubescens				X																				
Pittosporaceae	*Billardia scandens*	Apple Berry	X		X				X						X							X			X
Ranunculaceae	*Clematis aristata*		X		X	X				X															
Rosaceae	**Rubus parviflora*				X																				
	Rubus hillii				X																				
Santalaceae	*Amperea xiphoclada*				X																				
Mistletoes																									
Loranthaceae	*Amyema pendulum ssp. pendulum*		X		X																				

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Trees																													
	Allocasuarina littoralis				X																								
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak	X		X																								
Cupressaceae	*Callitris rhomboidea*	Port Jackson Pine			X																								
Fabaceae	*Acacia dealbata*	Silver Wattle	X	X	X																								
	Acacia falciformis	Broad-leaved Hickory			X						X	X																	
	Acacia floribunda				X		X																						
	Acacia obtusifolia				X																								
Myrtaceae	*Eucalyptus aggregata*	Black Gum			X																								
	Eucalyptus blakelyi	Blakely's Red Gum			X	X																							
	Eucalyptus blaxlandii			X	X								X																
	Eucalyptus bridgesiana ssp. bridgesiana		X	X	X	X									X								X						
	Eucalyptus cannonii	Capertee Stringybark	X		X				X	X		X		X															
	Eucalyptus	Mountain Gum	X	X	X	X								X	X		X	X	X				X						

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																															
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	dalrympleana																																	
	Eucalyptus dives	Broad-leaved Peppermint	X	X	X					X		X		X	X		X																	
	Eucalyptus goniocalyx		X	X																														
	Eucaltptus laophila x E. stricta				X																													
	Eucalyptus macrorhyncha	Red Stringybark	X	X	X			X	X	X																								
	Eucalyptus mannifera	Brittle Gum	X	X	X					X	X	X			X	X		X																
	Eucalyptus ?mannifera				X			X																										
	Eucalyptus mannifera ssp. praecox	Brittle Gum			X																													
	Eucalyptus melliodora		X		X																													
	**Eucalytpus nicholii*																																	
	Eucalyptus pauciflora	Snow Gum	X		X																		adj											
	Eucalyptus piperita		X	X	X		X						X																					
	Eucalyptus punctata	Grey Gum	X	X																														
	Eucalyptus radiata		X		X																													
	Eucalyptus rossii	Inland Scribbly	X	X	X								X																					

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
		Gum																											
	Eucalyptus rubida		X																										
	Eucalyptus sieberi		X	X	X		X																						
	Eucalyptus sparsifolia		X	X	X								X				X	X	X				adj						
	Eucalyptus stellulata	Black Sally																											
	Eucalyptus stricta				X																								
	Eucalyptus viminalis	Ribbon Gum	X		X	X			X																				
Shrubs																													
Apiaceae	*Platysace ericoides*		X	X																									
	Platysace lanceolata		X	X	X																								
Apocynaceae	*Hymenanthera dentata*				X					X		X																	
Asteraceae	*Cassinia arcuata*		X	X	X																								
	Cassinia laevis			X																									
	Cassinia longifolia																												
	Cassinia quinquefaria				X						X																		
	Cassinia sp.				X	X				X		X								X	X	X							
	Olearia erubescens				X																								
	Ozothamnus		X		X																								

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	diosmifolius																												
Dilleniaceae	*Hibbertia obtusifolia*		X	X	X			X									X	X		X									
	Hibbertia riparia																												
	Hibbertia sericea				X			X																					
	Hibbertia stricta				X											X													
	Hibbertia sp.				X					X																			
Ericaceae	*Acrotriche divaricata*																												
	Acrotriche serrulata		X																										
	Brachyloma daphnoides		X	X	X													X			X								
	Epacris reclinata				X																								
	Leucopogon appressus			X																									
	Leucopogon lanceolata		X		X			X																					
	Leucopogon microphyllus			X																									
	Leucopogon muticus		X	X	X		X									X		X											
	Leucopogon neo-anglicus				X																								

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Leucopogon virgatus		X		X		X	X																					
	Leucopogon virgatus?																												
	Lissanthe strigosa	Peach Heath	X		X												X	X	X										
	Lissanthe strigosa ssp. subulata				X															X	X	X							
	Monotoca scoparia		X	X	X																X								
	Melichrys erubescens				X																								
	Sprengelia incarnata				X																								
	Styphelia triflora				X																								
	Styphelia tubiflora		X		X																								
Fabaceae	*Acacia acinacea*				X		X																						
	Acacia brownii				X									X		X													
	Acacia buxifolia	Sunshine Wattle	X	X	X											X	X	X	X	X	X	X							
	Acacia dealbata				X												X			X		X							X
	Acacia falciformis		X	X	X					X			X																
	Acacia floribunda				X			X	X				X																
	Acacia gunnii		X																										
	Acacia mearnsii		X																										
	Acacia myrtifolia				X																								

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Acacia obtusifolia		X	X	X																								
	Acacia paradoxa				X																								
	Acacia rubida																												
	Acacia sp.				X	X			X																				
	Acacia terminalis		X	X	X		X	X													X								
	Acacia ulicifolia		X	X	X																								
	Bossiaea buxifolia				X																				X				
	Bossiaea prostrata				X																								
	Bossiaea neo-anglica		X		X										X														
	Daviesia ulicifolia				X																								
	Daviesia virgata			X	X																								
	Dillwynia phylicoides		X	X																									
	Dillwynia ?retorta				X	X																							
	Dillwynia retorta				X																								
	**Genista monspessulana*																												
	Gompholobium huegelii		X	X																									
	Hovea linearis		X		X																								

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																											
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Hovea longifolia				X											X													
	Hovea sp.				X									X				X											
	Indigofera australis		X		X									X															
	Mirbelia platyloboides		X																										
	Oxylobium sp.				X		X	X																					
	Platylobium sp.				X											X													
	Podolobium ilicifolium		X	X	X													X				X							
	Pultenaea elliptica																												
	Pultenaea microphylla		X	X	X																								
	Pultenaea retusa				X																								
	Pultenaea sp.				X											X													
	Logania albiflora				X																								
Malaceae	**Malus sp.*																												
Myrtaceae	*Callistemon ?pinifolius*				X																								
	Calytrix tetragona		X		X																								
	Eucalyptus blakelyi				X																				X				
	Eucalyptus bridgesiana ssp. bridgesiana				X																		X						

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																												
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Eucalyptus dalrympleana				X																X	X								
	Eucalyptus dives				X															X		X								
	Eucalyptus pauciflora																														
	Eucalyptus rossii																														
	Harmogia densifolia				X																										
	Kunzea parvifolia				X																										
	Leptospermum continentale		X		X																										
	Leptospermum juniperinum				X																										
	Leptospermum myrtifolium																														
	Leptospermum obovatum																														
	Leptospermum parvifolium		X	X	X																										
	Leptospermum polygalifolium			X	X				X																						
	Leptospermum		X																												

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	sphaerocarpum																												
	Leptospermum sp.																												
	Leptospermum trinervium		X																										
	Micromyrtus ciliata			X																									
Oleaceae	*Notelaea longifloia*				X							X																	
	Notelaea neglecta				X																								
Pittosporaceae	*Bursaria longisepala*				X									X															
	Bursaria spinosa				X																								
	Rhytidosporum procumbens		X		X																								
Proteaceae	*Banksia cunninghamii*		X		X																								
	Hakea dactyloides				X																								
	Hakea laevipes																												
	Hakea teretifolia				X											X													
	Isopogon anethifolius				X																								
	Isopogon dawsonii		X																										
	Lomatia myricoides				X																								
	Persoonia linearis	Narrow-leaved	X	X	X		X	X								X		X		X									

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																												
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
		Geebung																													
		Clandulla																													
	Persoonia marginata	Geebung			X																										
	Persoonia mollis																														
	Persoonia myrtilloides		X		X																										
	Persoonia oblongata																														
Rhamnaceae	*Cryptandra amara*			X	X																										
	Cryptandra spinescens				X																										
	Pomaderris andromedifolia		X																												
	Pomaderris andromedifolia ssp. andromedifolia				X																										
	Pomaderris prunifolia				X																										
Rosaceae	**Cottoneaster sp.*																														
	**Rubus fruticosus*	Blackberry			X							X									X		X	X							X
	**Rosa rubiginosa*	Briar Rose																					X								
	Rubus sp.				X	X																									
Rutaceae	*Boronia microphylla*		X		X																										

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Boronia rigens		X																										
	Boronia sp.				X											X													
	Correa reflexa		X																										
	Phebalium lamprophyllum		X																										
	Philotheca myoporoides ssp. Myoporoides				X																								
	Zieria aspalathoides				X																								
	Zieria cytisoides		X		X																								
	Zieria sp.		X																										
Santalaceae	*Choretrum pauciflorum*	Dwarf Sour Bush																											
	Exocarpos cupressiformis		X	X	X																								
	Exocarpos strictus		X	X																									
	Leptomeria acida		X	X	X	X																							
	Omphacomeria acerba		X																										
Sapindaceae	*Dodonaea multijuga*				X																								

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Dodonaea viscosa ssp cuneata		X		X																								
	Dodonaea viscosa ssp spatulata				X																								
Scrophulariaceae	*Derwentia perfoliata*				X																								
Simaroubaceae	**Ailanthus altissima*	Tree of Heaven																											
Solanaceae	*Solanum laciniatum*	Kangaroo Apple			X																								
	Solanum linearifolium	Mountain Kangaroo Apple																											
	Solanum prinophyllum				X																								
Sterculiaceae	*Rulingia dasyphylla*	Kerrawang			X																								
Herbs - Fern																													
Adiantaceae	*Adiantum aethiopicum*				X																								
Aspleniaceae	*Asplenium flabellifolium*		X		X																								
Blechnaceae	*Blechnum cartilagineum*				X																								
	Blechnum nudum		X																										
Cyatheaceae	*Cyathea australis*		X		X																								

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Dennstaedtiaceae	*Pteridium esculentum*		X	X	X				X											X									
Dicksoniaceae	*Calochlaena dubia*				X																								
Lindsaeaceae	*Lindsaea linearis*			X	X																								
Osmundaceae	*Todea barbara*	King Fern			X																								
Polypodiaceae	*Pyrrosia rupestris*		X																										
Sinopteridaceae	*Cheilanthes austrotenuifolia*		X																										
	Cheilanthes sieberi		X	X	X	X					X	X		X	X		X		X	X	X								
Herbs - Dicots																													
Acanthaceae	*Brunoniella australis*				X	X								X															
	Brunoniella pumilio																												
Apiaceae	*Centella asiatica*																												
	**Conium maculatum*																												
	Daucus glochidiatus				X																								
	Hydrocotyle laxiflora		X		X															X	X								
	Hydrocotyle tripartita				X	X			X	X	X	X		X	X		X		X										
	Hydrocotyle sp.																												
	?Oreromyrrhis eriopoda	Australian Carraway																											

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																												
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Xanthosia pilosa				X																								
Asteraceae	*Brachycome angustifolia*																												
	Brachycome spathulata			X	X																								
	Calotis cuneifolia		X		X																								
	**Cathamus lanatus*																							X					
	Centipeda minima		X																										
	Chrysocephalum apiculatum				X																				X				
	Chrysocephalum semipaposum				X															X	X						X		
	Chrysocephalum sp																												
	**Cirsium vulgare*	Scotch Thistle	X		X							X													X				
	**Conyxa bonariensis*	Flaxleaf Fleabane																											
	**Conyza sp.*				X	X																		X	X	X	X		
	Cymbonotus lawsonianus		X		X	X																							
	Euchiton sphaericus		X	X	X															X			X		X		X	X	

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																													
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Euchiton sp.																												
	**Facelis retusa*																												
	**Gnaphalium americanum*				X																								
	**Gnaphalium sp.*				X	X																							
	Helichrysum scorpiodes		X		X	X										X		X			X	X							X
	**Hypochaeris radicata*	Flatweed	X		X	X						X								X	X		X	X				X	X
	**Lactuca seriola*																												
	?Lagenophora sp.																												
	Lagenophora stipitata		X		X				X					X					X										
	Olearia erubescens	Pink-tip Daisy-bush																											
	Senecio hispidulus																												
	Senecio lautus				X						X	X	X																
	Senecio linearifolius		X		X																								
	Senecio quadridentatus				X																								
	Senecio sp.																												

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																											
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Senecio tenuiflorus				X	X																							
	Senecio ?vagus				X																								
	**Silybum marianum*				X							X																	
	Solenogyne sp.				X							X					X												
	**Sonchus aspera*																												
	**Sonchus oleraceus*	Sow Thistle																											
	**Taraxacum officinale*	Dandelion																											
	**Tragopogon porrifolius*																												
	Vittadinia cuneata		X		X												X												
Brassicaceae	**Brassica sp.*																												
	**Lepidium africanum*																					X							
	**Sisymbrium sp.*				X																								X
Boraginaceae	*Cynoglossum australe*		X		X							X			X				X										
	Cynoglossum suaveolens																												
	**Echium vulgare*	Patterson's Curse																											
Campanulaceae	*Wahlenbergia*				X																								

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																												
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	communis																														
	Wahlenbergia gracilis		X		X	X																									
	Wahlenbergia stricta		X	X	X	X																									
	Wahlenbergia sp.				X							X		X	X		X	X			X										
Caryophyllaceae	**Polycarpon tetraphyllum*	Four-leaf All-seed																													
	Stellaria pungens		X		X					X	X																				
Chenopodiaceae	*Einadia hastata*		X		X																										
Clusiaceae	*Hypericum gramineum*		X		X	X			X	X						X														
	**Hypericum perforatum*	St John's Wort			X															X	X		X	X		X	X	X	X		
Convolvulaceae	*Dichondra repens*	Kidney Weed	X		X	X			X												X										
Crassulaceae	*Crassula decumbens*				X																										
	Crassula sieberana		X																												
Dilleniaceae	*Hibbertia obtusifolia*				X		X							X																	
	Chamaesyce sp.				X									X																	
Droseraceae	*Drosera peltata*																														
Fabaceae	*Desmodium varians*	Tick Trefoil			X	X						X																			
	Bossiaea prostrata																														

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																												
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	**Medicago sp.*																						X			X		
	**Trifolium dubia*	Yellow Suckling Clover	X																										
	**Trifolium repens*	White Clover																				X							
Gentianaceae	**Centaurium erythrea*	Common Centaury																								X	X		
	**Centaurium tenuiflorum*																												
	Schenkia spicata				X																								
Geraniaceae	*Geranium solanderi*	Storksbill	X	X	X	X						X										X			X	X		X
	Geranium homeanum				X				X																				
	Geranium sp. 1																												
	Geranium sp. 2																												
Goodeniaceae	*Coopernookia barbata*			X																									
	Goodenia bellidifolia				X																								
	Goodenia hederacea		X	X	X	X		X					X	X	X	X		X											
	Goodenia sp.				X															X	X	X							
Haloragaceae	*Gonocarpus longifolius*				X																								

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																															
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Gonocarpus sp.				X	X			X						X	X	X		X													
	Gonocarpus ?sp.				X	X																												
	Gonocarpus tetragyna		X	X	X															X	X	X											
	Gonocarpus teucrioides																																	
	Haloragis heterophylla		X																															
Hemerocallidaceae	*Caesia sp.*																																	
Hypoxidaceae	*Hypoxis hygrometrica*				X	X																												
Labiaceae	**Marrubium vulgare*																																	
Lamiaceae	*Ajuga australis*	Australian Bugle	X																															
	Ajuga sp.				X	X																												
	**Lamium amplexicaule*																																	
	Metha diemenica		X																		X													
	**Prunella vulgaris*	Self-heal																																
Linaceae	*Linum marginale*		X		X																													
	Linum trigynum	French Flax																																
Lobelieaceae	*Isotoma axillaris*		X		X								X																					
	Isotoma fluviatilis		X																															
	Pratia pedunculata				X																													

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																													
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Pratia purpurascens		X		X																											
Loganaceae	*Mitracacme polymorpha*		X																													
Malvaceae	**Modiola caroliniana*																															
Onagraceae	**Oenothera sp.*																															
Oxalidaceae	*Oxalis exilis*				X																											
	**Oxalis ?sp. A*		X																													
	**Oxalis sp. B.*																															
	**Oxalis sp.*				X		X			X										X												
	Oxalis sp.				X						X	X									X	X										
	Oxalis perennans				X								X		X																	
Phyllanthaceae	*Phyllanthus hirtellus*		X		X											X																
	Poranthera corymbosa		X		X																											
	Poranthera microphylla				X							X																				
Pittosporaceae	*Rhytidosporum procumbens*																															
Plantaginaceae	*Plantago debilis*		X		X									X																		

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																										
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	**Plantago lanceolata*				X	X						X								X	X		X			X	X	X	X
	Plantago sp.				X				X	X		X																		
	Plantago varia																													
Primulaceae	**Anagallis arvensis*	Scarlet Pimpernel																		X										
Polygalaceae	*Comesperma ericinum*		X																											
	Comesperma volubile																													
	**Acetosella vulgaris*																						X			X			X
	**Emex australis*				X																									
	Rumex brownii				X																					X	X	X	
	**Rumex crispus*	Dock																												
Ranunculaceae	*Ranunculus lappaceus*																													
Rosaceae	*Acaena agnipila*				X					X																				
	Acaena novae-zealandiae		X		X				X			X							X	X	X		X						
	Acaena ovina		X																											
	Acaena sp.																											X		
Rubiaceae	*Asperula conferta*	Common			X									X																

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																															
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
		Bedstraw																																
	Asperula sp.X				X				X																								
	Asperula sp.X				X																												
	Galium binifolium				X	X																											
	Galium propinquum		X	X	X					X																							
	Galium gaudichaudii				X																												
	Galium sp.				X			X	X					X	X																		
	Opercularia aspera		X		X																												
	Opercularia hispida				X																												
	Opercularia sp.				X	X																X											
	Pomax umbellata		X		X			X										X															
	**Sherardia arvensis*				X																												
Scrophulariaceae	**Verbascum thapsus*	Blanket Weed																															
	**Verbascum virgatum*	Twiggy Mullein																															
	Veronica calycina		X		X																												
	Veronica gracilis																				X												
	Veronica plebeia		X	X	X	X			X	X	X	X	X							X													
Solanaceae	*Solanum brownii*				X																												
Stackhousiaceae	*Stackhousia*	Creamy	X		X							X							X														

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																													
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	monogyna	Candles																											
Stylidiaceae	*Stylidium graminifolim*		X		X	X													X										
	Stylidium lineare				X																								
Thymeliaceae	*Pimelea glauca*				X																								
	Pimelea linifolia		X																										
Verbenaceae	**Verbena bonariensis*				X																								
Violaceae	*Viola betonicifolia*	Native Violet	X	X	X					X							X												
	Viola hederacea	Ivy-leaved Violet	X		X				X																				
Herbs - Monocots																													
*Agavaceae	**Agave americana*	Yucca																											
Anthericaceae	*Anthericaceae sp.*																												
	Laxmannia gracilis		X																										
	Thysanotus sp.		X																										
	Tricoryne elatior				X	X																							
	Tricoryne simplex																												
Caryophyllaceae	**Petrorhagia nanteulii*				X																								X
Colchicaceae	*Wurmbea dioica*	Early Nancy																											

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	Lembit 1997	Lembit 2003	CE 2009-2011	CE Quadrats 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Cyperaceae	*Carex appressa*																												
	Carex inversa				X															X									X
	Carex sp.																												
	Cyperus sp.																												
	Lepidosperma laterale				X																								
	Lepidosperma urophorum		X																										
	Lepidosperma sp.		X																										
	Schoenus sp.		X																										
Droseraceae	*Drosera sp.*				X										X						X								
Iridaceae	**Iris sp.*																												
	Patersonia glabrata	Purple Flag																											
	Patersonia longifolia			X	X																								
	Patersonia sericea		X																										
	Patersonia sp.				X		X								X														
Juncaceae	*Juncus australis*																							X					X
	**Juncus cognatus*				X																								
	Juncus planifolius		X																										
	Juncus sp.				X																		X	X	X	X		X	X

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																												
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Juncus subsecundus																								X			
	Luzula flaccida																											
	Luzula sp.		X		X																							
Lomandraceae	*Lomandra confertifolia*		X	X				X																				
	Lomandra confertifolius ssp. rubiginosa				X																							
	Lomandra filiformis				X															X	X	X			X		X	
	Lomandra filiformis ssp. coriacea		X	X	X		X	X		X	X	X		X	X	X	X	X	X									
	Lomandra filiformis ssp. filiformis																											
	Lomandra glauca		X		X																							
	Lomandra longifolia		X	X	X														X		X							
	Lomandra multiflora		X		X					X											X				X			
	Lomandra sp.				X		X																					
Orchidaceae	*Acianthus exsertus*	Mosquito Orchid			X																							
	Acianthus sp.				X				X					X														
	Caladenia alba				X											X												

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																													
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Caladenia carnea	Pink Fingers			X																								
	Caladenia sp.				X			X																					
	Dipodium punctatum		X																										
	Diuris maculata				X																								
	Diuris sulphurea	Tiger Orchid																											
	Glossodia major	Waxlip Orchid																											
	Microtis uniflora		X																										
	Pterostylis sp.			X	X																								
	Thelymitra sp.	a Sun Orchid	X		X															X									
Phormiaceae	*Dianella longifolia*														X														
	Dianella revoluta	Paroo Lily	X	X	X		X		X						X	X	X	X			X	X							
	Stypandra galuca				X																								
Poaceae	*Agrostis avenacea var. avenacea*		X																										
	Anisopogon avenaceus		X																										
	**Anthoxanthum odoratum*	Sweet Vernal Grass			X																						X		
	Aristida calycina																												

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																														
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	Aristida jerichoensis																			X									
	Aristida ramosa			X	X										X	X			X		X								
	Aristida sp.																					X		X					
	Austrodanthonia caespitosa		X																										
	Austrodanthonia fulva				X																								
	Austrodanthonia laevis		X																										
	Austrodanthonia penicillata				X					X				X			X												
	Austrodanthonia racemosa		X	X	X		X				X																		
	Austrodanthonia sp.X				X							X																	
	Austrodanthonia sp.X				X							X																	
	Austrodanthonia sp.				X								X													X			
	Austrostipa rudis		X																										
	Austrostipa scabra				X																								
	Austrostipa sp.		X		X		X			X	X								X	X	X		X					
	Bothriochloa sp.				X																								

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																											
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	**Briza minor*	Shivery Grass																											
	**Bromus catharticus*	Prairie Grass																											
	**Bromus molliformis*																												
	Cymbopogon refractus				X																								
	**Cynodon dactylon*	Couch Grass			X																		X			X	X	X	X
	Chionochloa pallida		X																										
	**Chloris gayana*	Rhodes Grass																											
	Danthonia sp.	a Wallaby Grass																											
	Dichelachne micrantha	Short-haired Plume Grass		X																									
	Dichelachne rara		X																										
	Echinopogon caespitosus		X		X		X					X		X	X					X	X	X				X			
	Echinopogon ovatus		X	X	X																								
	**Eleusine tristachya*				X																		X		X				
	Elymus scaber				X		X																						
	Entolasia stricta		X	X	X																								
	**Eragrostis cilianensis*																												

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																												
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	**Eragrostis curvula*	African Love-grass																													
	Eragrostis leptostachya				X															X						X	X	X			
	Eragrostis sp.																														X
	**Festuca sp.*																						X		X	X					
	Imperatia cylindrica				X																										
	Joycea pallida			X	X		X				X		X	X	X	X	X	X			X	X							X		
	**Lolium perenne*	Perennial Rye																													
	Lolium sp.				X																		X			X				X	
	Microlaena stipoides	Weeping Meadow-grass		X	X		X			X	X	X			X					X	X			X	X				X	X	
	**Nassella neesiana*	Chillean Needle Grass																													
	Panicum effusum				X							X		X							X		X			X	X				
	**Paspalum dilatatum*	Paspalum																													
	**Paspalum urvellei*																									X					
	**Paspalum sp.*																						X								
	**Pennesitum*	Kikuyu																					X	X	X						

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																												
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	clandestinum																														
	Phelaris aquatica																							X	X						
	Phragmites australis	Common Reed																													
	Poa labillardieri		X																												
	Poa sieberiana ssp cyanophylla		X															X	X												
	Poa sieberiana ssp sieberiana		X		X		X		X		X			X	X		X			X	X		X	X	X	X	X	X	X	X
	Poa sp.																														
	Poaceae sp.																							X	X	X	X			X	
	Themeda australis	Kangaroo Grass	X		X		X		X						X						X					X			X	X	
	Vulpia bromoides		X																												
	*?*Vulpia sp.*																														
Restionaceae	*Lepyrodia scariosa*		X																												
Typhaceae	*Typha orientalis*	Cumbungi			X																										
Xanthorrhoeaceae	*Xanthorrhoea glauca ssp. angustifolia*				X																										
	Xanthorrhoea sp.		X		X								X																		
Vines & Scramblers																															

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																												
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Apocynaceae	*Parsonsia brownii*				X																								
Araliaceae	**Hedera helix*	English Ivy																											
Convolvulaceae	*Convolvulus erubescens*	Blushing Bindweed			X																								
Fabaceae	*Glycine clandestina*		X		X	X																							
	Glycine microphylla																												
	Glycine tabacina		X		X							X																	
	Hardenbergia violacea	Purple Coral Pea	X		X			X	X					X			X			X		X							
	Vicia sativa subsp. nigra	Narrow-leaved Vetch																											
Lauraceae	Cassytha melantha				X																								
	Cassytha pubescens				X																								
Pittosporaceae	Billardia scandens	Apple Berry	X		X				X																				
Ranunculaceae	Clematis aristata		X		X				X			X																	
Rosaceae	*Rubus parviflora				X																								
	Rubus hillii				X				X			X																	
Santalaceae	Amperea xiphoclada				X																								
Mistletoes																													

Table A.2 Flora Species Recorded in the Project Boundary Quadrats 21 - 44

Family/Form	Scientific Name	Common Name	CE Quadrats																											
			Lembit 1997	Lembit 2003	CE 2009-2011	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Loranthaceae	Amyema pendulum ssp. pendulum		X		X																									

x: Present for tables A1 and A2 above

Appendix B

Recorded Fauna Species

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Amphibia												
Myobatrachidae												
Common Eastern Froglet	*Crinia signifera*		x									x
Eastern Banjo Frog	*Limnodynastes dumerilii*											x
Brown-striped Frog	*Limnodynastes peronii*											x
Spotted Grass Frog	*Limnodynastes tasmaniensis*		x									x
Bibron's Toadlet	*Pseudophryne bibronii*		x									
Smooth Toadlet	*Uperoleia laevigata*		x									x
Hylidae												
Bleating Tree Frog	*Litoria dentata*		x									x
Peron's Tree Frog	*Litoria peronii*		x									x
Reptiles												
Gekkonidae												
Lesueur's Velvet Gecko	*Oedura lesueurii*											x

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Varanidae												
Lace Monitor	*Varanus varius*							x				x
Agamidae												
Jacky Lizard	*Amphiloburus muricatus*						x					x
Eastern Bearded Dragon	*Pogona barbata*							x				
Mountain Dragon	*Rankinia diemensis*						x					x
Scincidae												
Red-throated Skink	*Acritoscincus platynotum*						x					
Cunningham's Skink	*Egernia cunninghami*											x
White's Skink	*Egernia whitii*											x
Garden Skink	*Lampropholus delicata*						x					x
Grass Skink	*Lampropholus guichenoti*											x
Woodland Tussock-skink	*Pseudomoia entrecasteauxii*		x				x					x
Blotched Blue-tongue	*Tiliqua nigrolutea*						x					x
Elapidae												
Mustard-bellied Snake	*Drysdalia rhodogaster*						x					

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Birds												
GALLIFORMES												
Phasianidae												
Brown Quail	*Coturnix ypsilophora*	x						x				x
ANSERIFORMES												
Anatidae												
Australian Wood Duck	*Chenonetta jubata*											x
PODICIPEDIFORMES												
Podicipedidae												
Australasian Grebe	*Tachybaptus novaehollandiae*											x
COLUMBIFORMES												
Columbidae												
Common Bronzewing	*Phaps chalcoptera*	x						x		x		x
Wonga Pigeon	*Leucosarcia picata*							x				x
CAPRIMULGIFORMES												
Podargidae												

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Tawny Frogmouth	*Podargus strigoides*		x							x		x
Eurostopodidae												
White-throated Nightjar	*Eurostopodus mystacalis*											x
APODIFORMES												
Aegothelidae												
Australian Owlet-nightjar	*Aegotheles cristatus*		x					x				x
ACCIPITRIFORMES												
Accipitridae												
Brown Goshawk	*Accipiter fasciatus*	x						x		x		x
Square-tailed Kite	*Lophoictinia isura*							x				
Wedge-tailed Eagle	*Aquila audax*	x						x		x		x
FALCONIFORMES												
Falconidae												
Nankeen Kestrel	*Falco cenchroides*							x				x
CHARADRIIFORMES												
Turnicidae												

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Painted Button-quail	*Turnix varius*	x										
PSITTACIFORMES												
Cacatuidae												
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	x										
Gang-gang Cockatoo	*Callocephalon fimbriatum*	x						x				x
Galah	*Eolophus roseicapillus*	x										x
Sulphur-crested Cockatoo	*Cacatua galerita*	x						x				
Psittacidae												
Rainbow Lorikeet	*Trichoglossus haematodus*							x				
Musk Lorikeet	*Glossopsitta concinna*	x										
Australian King-Parrot	*Alisterus scapularis*							x		x		x
Crimson Rosella	*Platycercus elegans*	x						x		x		x
Eastern Rosella	*Platycercus eximius*	x						x		x		x
CUCULIFORMES												
Cuculidae												

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	x								x		x
Pallid Cuckoo	*Cacomantis pallidus*	x										
Brush Cuckoo	*Cacomantis variolosus*											x
Shining Bronze-cuckoo	*Chrysococcyx lucidus*	x										
STRIGIFORMES												
Strigidae												
Powerful Owl	*Ninox strenua*											x
Southern Boobook	*Ninox novaeseelandiae*	x	x							x		x
CORACIIFORMES												
Halcyonidae												
Laughing Kookaburra	*Dacelo novaeguineae*	x						x		x		
Sacred Kingfisher	*Todiramphus sanctus*	x								x		x
Meropidae												
Rainbow Bee-eater	*Merops ornatus*	x										
PASSERIFORMES												
Menuridae												

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Superb Lyrebird	*Menura novaehollandiae*	x								x		x
Climacteridae												
Climacteris picumnus	*Brown Tree creeper*							x				
White-throated Treecreeper	*Cormobates leucophaea*	x								x		x
Red-browed Treecreeper	*Climacteris erythrops*	x										
Ptilonorhychidae												
Satin Bowerbird	*Ptilonorhynchus violaceus*	x										x
Maluridae												
Superb Fairy-wren	*Malurus cyaneus*	x								x		x
Acanthizidae												
Speckled Warbler	*Pyrrholaemus saggitatus*							x				
Rockwarbler	*Origma solitaria*	x										x
White-browed Scrubwren	*Sericornis frontalis*	x								x		x
Large-billed Scrubwren	*Sericornis magnirostra*											x
White-throated Gerygone	*Gerygone albogularis*	x								x		
Striated Thornbill	*Acanthiza lineata*	x								x		x

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*											x
Buff-rumped Thornbill	*Acanthiza reguloides*	x								x		x
Brown Thornbill	*Acanthiza pusilla*	x								x		x
Pardalotidae												
Spotted Pardalote	*Pardalotus punctatus*	x								x		x
Striated Pardalote	*Pardalotus striatus*	x								x		x
Meliphagidae												
Eastern Spinebill	*Acanthorhynchus tenuirostris*	x								x		x
Yellow-faced Honeyeater	*Lichenostomus chrysops*	x								x		x
White-eared Honeyeater	*Lichenostomus leucotis*	x										
Noisy Miner	*Manorina melanocephala*	x						x				
Red Wattlebird	*Anthochaera carunculata*	x								x		x
Brown-headed Honeyeater	*Melithreptus brevirostris*	x										
White-naped Honeyeater	*Melithreptus lunatus*	x										x
Noisy Friarbird	*Philemon corniculatus*	x								x		x
Eupetidae												

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Spotted Quail-thrush	*Cinclosoma punctatum*	x										x
Neosittidae												
Varied Sittella	*Daphoenositta chrysoptera*									x		
Campephagidae												
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	x						x		x		x
Cicadabird	*Coracina tenuirostris*	x										x
Pachycephalidae												
Crested Shrike-tit	*Falcunculus frontatus*	x								x		
Golden Whistler	*Pachycephala pectoralis*	x								x		
Rufous Whistler	*Pachycephala rufiventris*	x								x		x
Grey Shrike-thrush	*Colluricincla harmonica*	x								x		x
Oriolidae												
Olive-backed Oriole	*Oriolus sagittatus*	x								x		
Artamidae												
Grey Butcherbird	*Cracticus torquatus*	x						x		x		
Australian Magpie	*Cracticus tibicen*	x						x		x		x

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Pied Currawong	*Strepera graculina*	x						x		x		x
Grey Currawong	*Strepera versicolor*	x						x				
Rhipiduridae												
Grey Fantail	*Rhipidura albiscapa*	x						x		x		x
Rufous Fantail	*Rhipidura rufifrons*							x				
Willie Wagtail	*Rhipidura leucophrys*	x						x				x
Corvidae												
Australian Raven	*Corvus coronoides*	x						x				x
Monarchidae												
Leaden Flycatcher	*Myiagra rubecula*	x								x		x
Satin Flycatcher	*Myiagra cyanoleuca*	x						x		x		x
Restless Flycatcher	*Myiagra inquieta*											x
Magpie-lark	*Grallina cyanoleuca*							x				
Corcoracidae												
White-winged Chough	*Corcorax melanorhamphos*	x						x				x
Petroicidae												

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Scarlet Robin	*Petroica boodang*	x						x		x		x
Rose Robin	*Petroica rosea*							x				
Eastern Yellow Robin	*Eopsaltria australis*	x						x		x		x
Acrocephalidae												
Australian Reed-Warbler	*Acrocephalus australis*											x
Timaliidae												
Silvereye	*Zosterops lateralis*							x		x		x
Hirundinidae												
Welcome Swallow	*Hirundo neoxena*							x				x
Sturnidae												
Common Starlingl	*Sturnus vulgaris*											x
Nectariniidae												
Mistletoebird	*Dicaeum hirundinaceum*									x		x
Passeridae												
House Sparrowl	*Passer domesticus*											x
Motacillidae												

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Australasian Pipit	*Anthus novaeseelandiae*											x
Mammals												
Prototheria												
MONOTREMATA												
Tachyglossidae												
Short-beaked Echidna	*Tachyglossus aculeatus*		x									x
Marsupialia												
DASYUROMORPHIA												
Dasyuridae												
Yellow-footed Antechinus	*Antechinus flavipes*					x						
Brown Antechinus	*Antechinus stuartii*											x
DIPROTODONTIA												
Vombatidae												
Common Wombat	*Vombatus ursinus*		x							x		x
Phalangeridae												
Common Brushtail Possum	*Trichosurus vulpecula*		x							x		x

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Petauridae												
Sugar Glider	*Petaurus breviceps*		x							x		x
Squirrel Glider	*Petaurus norfolcensis*		x									
Pseudocheiridae												
Greater Glider	*Petauroides volans*		x									x
Common Ringtail Possum	*Pseudocheirus peregrinus*		x							x		x
Macropodidae												
Eastern Grey Kangaroo	*Macropus giganteus*		x					x		x		x
Wallaroo	*Macropus robustus*							x		x		x
Red-necked Wallaby	*Macropus rufogriseus*		x					x		x		x
Swamp Wallaby	*Wallabia bicolor*							x		x		x
Eutheria												
CHIROPTERA												
Rhinolophidae												
Eastern Horseshoe Bat	*Rhinolophus megaphyllus*			x								
Mollossidae												

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
Little Freetail Bat	*Mormopterus sp. 2*									x		
White-striped Freetail Bat	*Tadarida australis*			x						x	x	
Vespertilionidae												
Large-eared Pied Bat	*Chalinolobus dwyeri*			?								
Gould's Wattled Bat	*Chalinolobus gouldii*			x						x	x	
Chocolate Wattled Bat	*Chalinolobus morio*			x						x	x	
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*										?	
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*			x	x					x		
Large-footed Myotis	*Myotis adversus*									?		
Lesser Long-eared Bat	*Nyctophilus geoffroyi*				x						x	
Gould's Long-eared Bat	*Nyctophilus gouldi*				x						x	
Long-eared Bat Sp.	*Nyctophilus sp.*			x								
Eastern Broad-nosed Bat	*Scotorepens orion*									x	x	
Large Forest Bat	*Vespadelus darlingtoni*			x	x					x	x	
Southern Forest Bat	*Vespadelus regulus*			x	x					x	x	
Little Forest Bat	*Vespadelus vulturnus*			x	x					x	x	

Table B.1 Fauna Species Recorded From the Project Boundary Including Previous Surveys

Family/Common Name	Scientific Name	Bird census	Spotlighting quadrat	Anabat	Harp Trapping	Trapping	Active Searches	Incidental	AES 2005	AES 2003	Ecotone 1996	Wildsearch 1996
RODENTIA												
Muridae												
Bush Rat	*Rattus fuscipes*											x
CARNIVORA												
Canidae												
Dog	*Canis familiaris*							x				x
Red Fox	*Vulpes vulpes*		x					x		x		x
PERISSODACTYLA												
Equidae												
Horse	*Equus caballus*											x
ARTIODACTYLA												
Bovidae												
Cattle	*Bos taurus*							x				x
LAGOMORPHA												
Leporidae												
European Rabbit	*Oryctolagus cuniculus*		x					x		x		x

Appendix C

Eucalyptus cannonii Quadrat Data

Table C.1 *Eucalyptus cannonii* Quadrat data

Quadrat	Division of quadrat	No. of E. cannonii
1	0-10m	0
	10-20m	0
	20-30m	0
	30-40m	4
	40-50m	2
	50-60m	2
	60-70m	0
	70-80m	0
	80-90m	0
	90-100m	6
	Total:	14
2	0-10m	4
	10-20m	6
	20-30m	0
	30-40m	1
	40-50m	6
	50-60m	4
	60-70m	5
	70-80m	2
	80-90m	3
	90-100m	0
	Total:	31
3	0-10m	0
	10-20m	3
	20-30m	1
	30-40m	5
	40-50m	0
	50-60m	0
	60-70m	1
	70-80m	4
	80-90m	4
	90-100m	0
	Total:	18
4	0-10m	0
	10-20m	0
	20-30m	0
	30-40m	0
	40-50m	0
	50-60m	3
	60-70m	1
	70-80m	0
	80-90m	0
	90-100m	0
	Total:	4
5	0-10m	10
	10-20m	5
	20-30m	9
	30-40m	2
	40-50m	12
	50-60m	5
	60-70m	3
	70-80m	9
	80-90m	0
	90-100m	0
	Total:	55
10	0-10m	0
	10-20m	0
	20-30m	0
	30-40m	0
	40-50m	0
	50-60m	0
	60-70m	0
	70-80m	0
	80-90m	0
	90-100m	0
	Total:	0
11	0-10m	7
	10-20m	5
	20-30m	5
	30-40m	0
	40-50m	2
	50-60m	3
	60-70m	0

	70-80m	2
	80-90m	0
	90-100m	0
	Total:	24
12	0-10m	0
	10-20m	1
	20-30m	0
	30-40m	3
	40-50m	0
	50-60m	0
	60-70m	0
	70-80m	1
	80-90m	4
	90-100m	0
	Total:	9
13	0-10m	0
	10-20m	0
	20-30m	0
	30-40m	0
	40-50m	0
	50-60m	0
	60-70m	0
	70-80m	0
	80-90m	0
	90-100m	0
	Total:	0
14	0-10m	0
	10-20m	0
	20-30m	1
	30-40m	0
	40-50m	0
	50-60m	3
	60-70m	1
	70-80m	0
	80-90m	0
	90-100m	1
	Total:	6
15	0-10m	0
	10-20m	0
	20-30m	0
	30-40m	0
	40-50m	0
	50-60m	1
	60-70m	1
	70-80m	0
	80-90m	0
	90-100m	0
	Total:	2
16	0-10m	0
	10-20m	0
	20-30m	0
	30-40m	0
	40-50m	0
	50-60m	0
	60-70m	0
	70-80m	0
	80-90m	0
	90-100m	0
	Total:	0
17	0-10m	0
	10-20m	0
	20-30m	0
	30-40m	0
	40-50m	0
	50-60m	1
	60-70m	0
	70-80m	0
	80-90m	0
	90-100m	0
	Total:	1
18	0-10m	0
	10-20m	0
	20-30m	0
	30-40m	0
	40-50m	0
	50-60m	0
	60-70m	0
	70-80m	0

	80-90m	0
	90-100m	0
	Total:	0
19	0-10m	0
	10-20m	1
	20-30m	0
	30-40m	3
	40-50m	2
	50-60m	0
	60-70m	1
	70-80m	0
	80-90m	3
	90-100m	1
	Total:	11

Appendix D

Persoonia marginata Quadrat Data

Table D.1 Persoonia marginata Quadrat Results at Cullen Valley Mine Subpopulation

Quadrats	count	size of quadrat (m2)	No m2	No per ha
Area 1	2	10	0.20	2000
	0	10	0.00	0
	0	10	0.00	0
	0	10	0.00	0
Area 2	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	2	20	0.10	1000
Area 3	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	1	20	0.05	500
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	1	20	0.05	500
	0	20	0.00	0
	6	20	0.30	3000
	0	20	0.00	0
	0	20	0.00	0
	9	20	0.45	4500
	6	20	0.30	3000
Area 4 rail siding (plants present)	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
Area 5	0	20	0.00	0
	3	20	0.15	1500

Table D.1 Persoonia marginata Quadrat Results at Cullen Valley Mine Subpopulation

Quadrats	count	size of quadrat (m2)	No m2	No per ha
	1	20	0.05	500
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	1	20	0.05	500
	0	20	0.00	0
	1	20	0.05	500
	0	20	0.00	0
	1	20	0.05	500
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	2	20	0.10	1000
	0	20	0.00	0
Area 6	1	20	0.05	500
	0	20	0.00	0
	3	20	0.15	1500
	1	20	0.05	500
	1	20	0.05	500
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	6	20	0.30	3000
	1	20	0.05	500

Table D.1 Persoonia marginata Quadrat Results at Cullen Valley Mine Subpopulation

Quadrats	count	size of quadrat (m2)	No m2	No per ha
	0	20	0.00	0
	1	20	0.05	500
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	2	20	0.10	1000
Area 7 (north of railway line)	1	20	0.05	500
	2	20	0.10	1000
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	1	20	0.05	500
	0	20	0.00	0
	0	20	0.00	0
	2	20	0.10	1000
	3	20	0.15	1500
	6	20	0.30	3000
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	1	20	0.05	500
	3	20	0.15	1500
Area 8	1	20	0.05	500
	2	20	0.10	1000
	0	20	0.00	0
	3	20	0.15	1500
	2	20	0.10	1000
	4	20	0.20	2000
	1	20	0.05	500
	3	20	0.15	1500

Table D.1 Persoonia marginata Quadrat Results at Cullen Valley Mine Subpopulation

Quadrats	count	size of quadrat (m2)	No m2	No per ha
	8	20	0.40	4000
	11	20	0.55	5500
	1	20	0.05	500
	0	20	0.00	0
	0	20	0.00	0
	1	20	0.05	500
	0	20	0.00	0
	1	20	0.05	500
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
	0	20	0.00	0
Mean				466
Standard Deviation				965

Table D.2 Persoonia marginata quadrat results at North-eastern Subpopulation

Quadrats	Count	size of quadrat (m2)	No m2	No per ha
11	0	20	0	0
12	0	20	0	0
13	0	20	0	0
14	0	20	0	0
15	0	20	0	0
16	0	20	0	0
17	0	20	0	0
18	0	20	0	0
19	0	20	0	0
20	0	20	0	0
21	0	20	0	0
22	4	20	0.2	2000
23	3	20	0.15	1500
24	3	20	0.15	1500
25	0	20	0	0
26	0	20	0	0
27	0	20	0	0
28	0	20	0	0
29	0	20	0	0
30	0	20	0	0
31	0	20	0	0
32	3	20	0.15	1500
33	0	20	0	0
34	0	20	0	0
35	4	20	0.2	2000
36	0	20	0	0
37	0	20	0	0
38	0	20	0	0
39	0	20	0	0
40	0	20	0	0
41	0	20	0	0
42	0	20	0	0
43	0	20	0	0
44	0	20	0	0
45	2	20	0.1	1000

Table D.2 Persoonia marginata quadrat results at North-eastern Subpopulation

Quadrats	Count	size of quadrat (m2)	No m2	No per ha
46	3	20	0.15	1500
47	0	20	0	0
48	0	20	0	0
49	0	20	0	0
50	0	20	0	0
51	1	20	0.05	500
52	0	20	0	0
53	0	20	0	0
54	0	20	0	0
55	0	20	0	0
56	0	20	0	0
57	0	20	0	0
58	0	20	0	0
59	2	20	0.1	1000
60	1	20	0.05	500
61	0	20	0	0
62	0	20	0	0
63	0	20	0	0
64	0	20	0	0
65	0	20	0	0
66	1	20	0.05	500
67	0	20	0	0
68	0	20	0	0
69	0	20	0	0
70	0	20	0	0
71	0	20	0	0
72	0	20	0	0
73	0	20	0	0
74	1	20	0.05	500
75	0	20	0	0
76	0	20	0	0
77	0	20	0	0
78	0	20	0	0
79	0	20	0	0
80	0	20	0	0
81	0	20	0	0

Table D.2 Persoonia marginata quadrat results at North-eastern Subpopulation

Quadrats	Count	size of quadrat (m2)	No m2	No per ha
82	0	20	0	0
83	0	20	0	0
84	0	20	0	0
85	0	20	0	0
86	0	20	0	0
87	0	20	0	0
88	0	20	0	0
89	0	20	0	0
90	0	20	0	0
91	0	20	0	0
92	0	20	0	0
93	1	20	0.05	500
94	0	20	0	0
95	0	20	0	0
96	0	20	0	0
97	0	20	0	0
98	0	20	0	0
99	0	20	0	0
100	0	20	0	0
101	0	20	0	0
102	0	20	0	0
103	0	20	0	0
104	2	20	0.1	1000
105	0	20	0	0
106	0	20	0	0
107	0	20	0	0
108	0	20	0	0
109	0	20	0	0
110	2	20	0.1	1000
111	0	20	0	0
112	0	20	0	0
113	0	20	0	0
114	0	20	0	0
115	0	20	0	0
116	0	20	0	0
117	0	20	0	0

Table D.2 Persoonia marginata quadrat results at North-eastern Subpopulation

Quadrats	Count	size of quadrat (m2)	No m2	No per ha
118	2	20	0.1	1000
119	0	20	0	0
Mean				**161**
Standard Deviation				**435**

Table D.3 Persoonia marginata Quadrat Results at Cullen Valley Mine Habitat Compensatory Area 5

Quadrats	Count	size of quadrat (m2)	No m2	No per ha
120	1	20	0.05	500
121	0	20	0	0
122	1	20	0.05	500
123	2	20	0.1	1000
124	0	20	0	0
125	0	20	0	0
126	0	20	0	0
127	3	20	0.15	1500
128	5	20	0.25	2500
129	3	20	0.15	1500
130	0	20	0	0
131	1	20	0.05	500
132	1	20	0.05	500
133	2	20	0.1	1000
134	5	20	0.25	2500
135	3	20	0.15	1500
136	7	20	0.35	3500
137	2	20	0.1	1000
138	4	20	0.2	2000
139	2	20	0.1	1000
140	3	20	0.15	1500
141	6	20	0.3	3000
142	0	20	0	0
143	0	20	0	0
144	0	20	0	0
145	1	20	0.05	500
146	0	20	0	0
147	0	20	0	0
148	0	20	0	0
149	0	20	0	0
150	0	20	0	0
151	0	20	0	0
152	0	20	0	0
153	2	20	0.1	1000

Table D.3 Persoonia marginata Quadrat Results at Cullen Valley Mine Habitat Compensatory Area 5

Quadrats	Count	size of quadrat (m2)	No m2	No per ha
154	2	20	0.1	1000
155	2	20	0.1	1000
156	1	20	0.05	500
157	0	20	0	0
158	0	20	0	0
159	0	20	0	0
160	0	20	0	0
161	0	20	0	0
162	1	20	0.05	500
163	0	20	0	0
165	0	20	0	0
166	0	20	0	0
167	0	20	0	0
168	0	20	0	0
170	0	20	0	0
171	0	20	0	0
172	1	20	0.05	500
173	0	20	0	0
174	0	20	0	0
176	0	20	0	0
177	0	20	0	0
179	0	20	0	0
180	0	20	0	0
181	0	20	0	0
182	0	20	0	0
Mean				517.
Standard Deviation				830

Appendix E

Likelihood of Threatened Flora Species Recorded from the Lithgow LGA

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
Anthericaceae	*Caesia parviflora var. minor*	Small Pale Grass-lily	E		1	This variety occurs uncommonly in Tasmania, southern Victoria and south-east South Australia with an outlying population in NSW, in Barcoongere State Forest, between Grafton and Coffs Harbour. Found in damp places in open forest on sandstone	Low. Ostensible suitable habitat occurs in gullies of Project Boundary. Only known record is located more than 10km east of the Project in Newnes State Forest. Not detected during past or current surveys.
Asteraceae	*Olearia cordata*		V	V	6	Generally restricted to the south-western Hunter Plateau, eastern Colo Plateau, and the far north-west of the Hornsby Plateau near Wisemans Ferry east of Maroota. The species prefers sheltered easterly aspects slopes in dry open sclerophyll forest and open shrubland on sandstone ridges on Hawkesbury soil landscapes.	Low. Suitable habitat occurs on ridges in the Project Boundary. Not recorded within 10km of the Project Boundary. Closest known records are more than 30 km north east within Wollemi National Park. Not detected during past or current surveys.
Fabaceae (Faboideae)	*Pultenaea sp. Genowlan Point*		CE	CE	7	Known from a single population at Genowlan Point in the Capertee Valley within the Rylstone Local Government Area. The population is restricted to a very small area of only 250 square metres on Crown Land. Occurs on well-drained soil near cliff edge.	Low. Only known from a single population in Capertee Valley that occurs at the tip of a north-facing projection of Genowlan Mountain, an isolated mesa. Has a very restricted geographic distribution, with its current extent of occurrence estimated to be 0.0025 km². Not detected during past or current surveys.
Fabaceae	*Pultenaea glabra*	Swamp	V	V	0	In NSW, it is confined to the higher Blue Mountains	Low. Confined to the higher Blue

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
(Faboideae)		Bush-pea				(Katoomba-Hazelbrook and Mount Victoria). Occurs in swamp margins, hillslopes, gullies and creekbanks in dry sclerophyll forest and in tall damp death on sandstone	Mountains (Katoomba-Hazelbrook and Mt Victoria). Not detected during past surveys or current surveys.
Fabaceae (Mimosoideae)	*Acacia bynoeana*	Bynoe's Wattle	E	V	1	Hunter district on the Central Coast south to Berrima and Mittagong in the Southern Highlands. The stronghold of the species' distribution is in the Blue Mountains area. Occurs in dry sclerophyll forest on sandy soils and seems to prefer open, disturbed sites. The substrate is typically sand and sandy clay, often with ironstone gravels and is usually very infertile and well-drained.	Low. Known records in NSW occur largely east of the Great Dividing Range and within the Blue Mountains National Park. One records within the Lithgow LGA since 1980. Located near Bogee approximately 30km away (date 2007) of the Project Boundary. Suitable habitat occurs in the Project Boundary. Not detected during past or current surveys.
Haloragaceae	*Haloragodendron lucasii*		E	E	12	Known locations within NSW occur on North Shore Sydney and within Wollemi National Park. Reported to grow in moist sandy loam soils in sheltered aspects, and on gentle slopes below cliff-lines near creeks in low open woodland	Low. Known locations occur largely on Sydney's North Shore. Records from the LGA are confined to two positions within Wollemi National Park more than 20km east of the Project Boundary. Suitable habitat found within Project Boundary. Not detected during past or current surveys.
Lamiaceae	*Prostanthera cryptandroides subsp.*	Wollemi Mint-bush	V	V	22	Occurs in restricted areas but over a fairly broad range from the Lithgow and Sandy Hollow Districts into the Border Rivers/Gwydir Catchment and up into	Moderate. Recorded from Ben Bullen State Forest to north of Baal Bone Colliery. Potential to occur in within

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
	cryptandroides					Queensland. Occurs in the Wollemi National Park and is likely to also occur within the Goulburn River National Park. Occurs in open forest, exposed woodland, heath and scrubland.	pagoda shrublands and exposed ridgetops. Not detected during past surveys or current targeted searches.
Lamiaceae	*Prostanthera stricta*	Mount Vincent Mint-bush	V	V	13	Prostanthera stricta occurs in the Widden Valley district of New South Wales. The species is also known from Mt Vincent and Genowlan Mountain in the Central Tablelands. Prostanthera aff. stricta is found at Dingo Creek and the Widden and Baerami Valleys in the Central Western Slopes. Occurs on skeletal or well-drained soils in areas of steep rocky slopes, cliff lines, sandstone platforms or sandstone outcropping, usually within the riparian zone.	Low. Known records within Lithgow LGA occur around Capertee Valley and further north. Closest record is approximately 15km away. No suitable habitat in the form of riparian habitats recorded within the Project Boundary. Not detected during past or current surveys.
Myrtaceae	*Callistemon linearifolius*	Nettled Bottlebrush	V		1	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically recorded in the Sydney area. Three of the remaining populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve and Spectacle Island Nature Reserve. The species has also been recorded from Yengo National Park.	Low. Known distribution occurs predominantly east of the Great Dividing Range. One known records exists in Lithgow LGA approximately 25 km north of the Project Boundary. Suitable habitat exists within areas of dry sclerophyll forest, however not well known in the LGA. Not detected during past surveys or current surveys.

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
						Grows in dry sclerophyll forest on the coast and adjacent ranges.	
Myrtaceae	*Darwinia peduncularis*		V		9	Occurs as local disjunct populations in coastal NSW with a couple of isolated populations in the Blue Mountains. Occurs on or near rocky outcrops on sandy, well-drained low nutrient soils.	Low. Within the Lithgow LGA known records occupy habitats within Wollemi National Park. The closest known record is approximately 20 km north east of Project Boundary. Not well known within the LGA. Ostensible suitable habitat exists according to broad habitat descriptions. Not detected during past or current surveys.
Myrtaceae	*Eucalyptus aggregata*	Black Gum		V	9	In NSW it occurs in the South Eastern Highlands Bioregion and on the western fringe of the Sydney Basin Bioregion. Black Gum has a moderately narrow distribution, occurring mainly in the wetter, cooler and higher parts of the tablelands, for example in the Blayney, Crookwell, Goulburn, Braidwood and Bungendore districts. Grows in the lowest parts of the landscape. Grows on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers. Often grows with other cold-adapted eucalypts, such as Snow Gum or White Sallee (Eucalyptus pauciflora), Manna or Ribbon Gum (E. viminalis), Candlebark (E.	Present. Found within Lot 112 DP DP 877190, Invincible Coal Mine's 2008 offset.

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
						rubida), Black Sallee (E. stellulata) and Swamp Gum (E. ovata). Black Gum usually occurs in an open woodland formation with a grassy groundlayer dominated either by River Tussock (Poa labillardierei) or Kangaroo Grass (Themeda australis), but with few shrubs.	
Myrtaceae	*Eucalyptus cannonii*	Capertee Stringybark	V	V	129	Eucalyptus cannonii is restricted to an area of about 100 by 60 km in the central tablelands of NSW. The western border is approximately marked by a line between Bathurst and Mudgee, while the eastern locations occur approximately on a line between Lithgow and the town of Bylong. Within this area the species is often locally frequent. The altitude range of Eucalyptus cannonii is from about 460 m to 1040 m. Within the range, the species appears to tolerate most situations except the valley floors. Has been recorded on the midslopes to floors of steep-sided gullies and on some east-facing slopes.	Present. Found to be locally abundant with Eucalyptus macrorhyncha (Red Stringybark) on mid slopes of Project Boundary. Detected during past surveys and current targeted searches.
Myrtaceae	*Eucalyptus pulverulenta*	Silver-leafed Gum	V	V	12	The Silver-leafed Gum is found in two quite separate areas, the Lithgow to Bathurst area and the Monaro. . Silver-leaved Mountain Gum occurs on the crests or upper slopes of moderately steep hillsides or mountain, at altitudes of 800–1000 m, usually on well-drained skeletal soils with frequent rock outcrops. Occurs in	Moderate. Known distribution within Lithgow LGA, occupies habitat further south and south-east of Project Boundary. Closest record is approximately 6 km away, though dated in 1958. Suitable habitat occurs within upper slopes where

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
						the understorey on shallow soils in communities with Brittle Gum (Eucalyptus mannifera), Red Stringybark (E. macrorhyncha), Broad-leaved Peppermint (E. dives), Silvertop Ash (E. sieberi) and Apple Box (E. bridgesiana)	aforementioned species occur. Not detected during past or current surveys.
Myrtaceae	*Homoranthus darwinioides*		V	V	1	Rare in the central tablelands and western slopes of NSW, occurring from Putty to the Dubbo district. It is found west of Muswellbrook between Merriwa and Bylong, and north of Muswellbrook to Goonoo SF. The species has been collected from Lee's Pinch, but not relocated at its original locality north of Mt Coricudgy above the headwaters of Widden Brook. Goonoo SF is established as a definite locality. Grows in various woodland habitats with shrubby understoreys, usually in gravely sandy soils. Landforms the species has been recorded growing on include flat sunny ridge tops with scrubby woodland, sloping ridges, gentle south-facing slopes, and a slight depression on a roadside with loamy sand.	Low. Ostensible suitable habitat occurs within flat sunny ridge tops with scrubby woodland, sloping ridges, gentle south-facing slopes of Project Boundary. Only known record is located more than 40km north of the Project in Wollemi National Park. Not detected during past or current surveys
Myrtaceae	*Melaleuca biconvexa*	Biconvex Paperbark	V		1	Found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Occurs in damp places, near streams or low-lying areas on alluvial soils of low slopes of sheltered aspects.	Low. No suitable habitat in the form of damp stream habitats. Not detected during past or current surveys.

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
Myrtaceae	*Triplarina imbricata*	Creek Triplarina	E	E	1	Found only in a few locations in the ranges south-west of Glenreagh and near Tabulam in north-east NSW. Along watercourses in low open forest with Water Gum (Tristaniopsis laurina).	Low. No suitable habitat of associated tree species found within Project Boundary. Not detected during past or current surveys.
Orchidaceae	*Caladenia tessellata*	Thick-lipped Spider Orchid	E	V	0	The Tessellated Spider Orchid is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	Low. Project Boundary is west of known distribution. Not recorded during current or previous surveys of the Project Boundary. Not known in the LGA.
	Genoplesium superbum		E		2	The Superb Midge Orchid is restricted to the Southern Tablelands of NSW where it has been recorded from 2 locations near Nerriga, c. 20 km apart. Some plants occur in Morton National Park. Occurs in wet heathland on shallow soils above sandstone capping but also occurs in open woodland interspersed with heath.	Low. Only known record occurs within Newnes State Forest in the Lithgow LGA. No suitable habitat recorded within the Project Boundary. Not detected during past or current surveys.
Orchidaceae	*Microtis angusii*	Midge Orchid	E	E	0	Currently known from only one site at Ingleside, north of Sydney. Natural habitat is unknown as both confirmed locations are highly disturbed	Low. Only known from one population in the Warringah/ Pittwater area in Sydney. A collection from Sunny Corner State Forest close to the Project Boundary has been confirmed to be genetically distinct. Not known within the Lithgow LGA. Not

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
							detected during past or current surveys.
	Prasophyllum sp. Wybong	a leek Orchid		CE	0	The species' area of occupancy is estimated to be 1.5 km2. It is known from seven populations in eastern NSW near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell and Tenterfield. Occurs in open eucalypt woodland and grassland.	Low. Not known within the Lithgow LGA. Known distribution is very restricted. Project Boundary is beyond southern limit of known distribution. Suitable habitat occurs in the Project Boundary. Not detected during past or current surveys.
Poaceae	*Digitaria porrecta*	Finger Panic Grass	E	E	1	In NSW it is found on the North West Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran. It largely occurs on private land. Native grassland, woodlands or open forest with a grassy understorey, on richer soils. In NSW, the most frequently recorded associated tree species are Eucalyptus albens and Acacia pendula. Common associated grasses and forbs in NSW sites include Austrostipa aristiglumis, Enteropogon acicularis, Cyperus bifax, Hibiscus trionum and Neptunia gracilis.	Low. One record found more than 30 km north of the Project. Suitable habitat occurs within areas of grassy woodlands and forests. Aforementioned species were not recorded in the Project Boundary. Not detected during past or current surveys.
Proteaceae	*Grevillea evansiana*	Evans Grevillea	V	V	17	Restricted to a small area east of Rylstone on the Central Tablelands. Known populations occur on the western side of Wollemi National Park and nearby private lands, within the Rylstone Local Government Area. Occurs in dry sclerophyll forest and occasionally	Moderate. Distribution within NSW is largely within Wollemi National Park around Muswellbrook and Singleton. Known within Gardens of Stone National Park. Suitable habitat occurs as dry sclerophyll forest in Project Boundary.

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
						swampy heath in sandy soils over Hawkesbury Sandstone.	Not detected during past or current surveys.
Proteaceae	*Grevillea obtusiflora*		E	E	43	Subspecies obtusiflora occurs near Rylstone, while subspecies fecunda occurs in the Capertee Valley, north-west of Lithgow, and in the Gardens of Stone National Park. Subspecies obtusiflora occurs as scattered groups in the understorey of low open eucalypt forest at an altitude of 730 metres above sea level. Subspecies fecunda occurs in clusters within low, open scrub beneath open, dry sclerophyll forest, on orange, sandy loam soils with sandstone boulders, at an altitude of 570 metres.	Moderate. Numerous records found within Gardens of Stone National Park, north of the Project Boundary. Majority of Project Boundary sits above 800 m above sea level. Suitable habitat occurs in eucalypt forest in the Project Boundary. Not detected during past or current surveys.
Proteaceae	*Persoonia acerosa*	Needle Geebung	V		2	The Needle Geebung has been recorded only on the central coast and in the Blue Mountains, from Mt Tomah in the north to as far south as Hill Top where it is now believed to be extinct. Mainly in the Katoomba, Wentworth Falls, Springwood area. Occurs in dry sclerophyll forest, scrubby low woodland and heath on low fertility soils.	Low. Not well distributed in the Lithgow LGA, more common south east of Lithgow LGA. Closet records occurs in Newnes State Forest approximately 25 km south-east of the Project Boundary. Suitable habitat occurs in the Project Boundary. Not detected during past or current surveys.
Proteaceae	*Persoonia hindii*		E		73	Restricted to the Newnes Plateau in the Blue Mountains, north of Lithgow. Was only discovered in 1989 and all known locations occur within Newnes	Low. Only known from the Newnes Plateau. Suitable habitat occurs in the Project Boundary. Not detected during

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
						State Forest. Occurs in dry sclerophyll forests and woodland on sandy soils.	past or current surveys.
Proteaceae	*Persoonia marginata*	Clandulla Geebung	V	V	29	Known from only four disjunct locations on the Central Tablelands and Central Coast. Core of the species distribution is within Clandulla State Forest, west of Kandons. Disjunct populations occur; to the north at Dingo Creek and Mount Dangar within the Wollemi and Goulburn River National Parks; to the south within Ben Bullen State Forest, south-east of Capertee; and to the south-east at Devils Hole, north of Colo Heights within Parr State Recreation Area. P. marginata is found in dry woodland communities associated with Shoalhaven Group sediments. Soils are shallow hardsetting sandy loams, generally with gravel or rocks, and the topography is flat.	Present in three locations north of Cullen Valley Mine pit 106, to the east of pit 106 in the northern extremities of the Project Boundary and within Cullen Valley Mine Habitat Compensation Area 5. Could potentially occur in other areas of the Project Boundary; however has not been recorded elsewhere during past or current surveys.
Proteaceae	*Persoonia nutans*	Nodding Geebung	E	E	1	Restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south, though this record contradicts this. Confined to aeolian and alluvial sediments and occurs in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.	Low. One record located in Jenolan State Forest, more than 30 km south. Within Project Boundary valleys contain alluvium sediments. No aeolian sediments were recorded in the Project Boundary. No detected during past or current surveys.

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
Rhamnaceae	*Pomaderris brunnea*	Brown Pomaderris	V	V	2	Brown Pomaderris is found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area. Occurs in open forest in moist woodland or forest on clay or alluvial soils on floodplains or in creek lines.	Low. Not well distributed within Lithgow LGA. Closest record occurs within Wollemi National Park, more than 35 kms away. No suitable habitat recorded within the Project Boundary. Not detected during past or current surveys.
Rubiaceae	*Galium asutrale*	Tangled Bedstraw	E		2	Once regarded as presumed extinct in NSW, this species is now known from the Towamba Valley near Bega, Lake Yarrunga near Kangaroo Valley, Cullendulla Creek Nature Reserve near Batemans Bay, Conjola National Park, Swan Lake near Swanhaven, and the Big Hole in Deua National Park. It was recorded historically from the Clyde River near Batemans Bay and the Mongarlowe area near Braidwood. In NSW Tangled Bedstraw has been found in moist gullies of tall forest, Eucalyptus tereticornis forest, coastal Banksia shrubland, and Allocasuarina nana heathland	Low. Not well known in the LGA. Closest records are located approx. 10 km east in Newnes State Forest. Suitable habitat occurs in moist gullies of tall forest i.e. Tableland Gully Ribbon Gum – Blackwood – Apple Box Forest in Project Boundary. Not detected during past or current surveys.
Rutaceae	*Asterolasia buxifolia*		E		3	Occurs on a granitic outcrop near Lett River. Apparently restricted to dense riparian scrub along rocky watercourses with a granitic substrate. Known from a single site at a granite outcrop in the riparian zone of the Lett River	Low. Not well distributed within Lithgow LGA. Known records occur near Hartley, approximately 20km south east. No suitable habitat recorded within the Project Boundary. Not detected during

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
							past or current surveys.
Rutaceae	*Boronia deanei*	Deane's Boronia	V	V	24	There are scattered populations of Deane's Boronia between the far south-east of NSW and the Blue Mountains (including the upper Kangaroo River near Carrington Falls, the Endrick River near Nerriga and Nalbaugh Plateau), mainly in conservation reserves. Occurs in wet weather, often along forest margins adjoining swamps or along streams.	Low. Closest records scatter Newnes State Forest. No suitable habitat recorded within the Project Boundary. Not detected during past or current surveys.
Rutaceae	*Leionema sympetalum*	Rylstone Bell	V		32	Restricted to a small area within Wollemi National Park, east of Rylstone on the Central Tablelands. Has only ever been recorded at four sites. All known sites are in the Rylstone Local Government Area. Restricted to pagoda formations in dry sclerophyll forest or heath communities.	Low. Only known at four sites approximately 30 km north-east within Wollemi National Park in the Rylestone LGA. Suitable habitat occurs within pagoda habitats in the Project Boundary. Not detected during past or current surveys. .
Rutaceae	*Phebalium bifidum*		E		17	Phebalium bifidum is restricted to the Capertee Valley, south east of Kandos in the South Eastern Highlands bioregion in NSW. The species is extremely rare, in being known from only four disjunct sites from within the Valley. Occurs in dry sclerophyll woodland or heath on structured loamy soils.	Low. Species has a known restricted distribution. Known only from two populations in the Capertee Valley. Suitable habitat occurs in Project Boundary. Not detected during past or current surveys.
Rutaceae	*Philotheca ericifolia*			V	0	Known only from the upper Hunter Valley and Pilliga to Peak Hill districts of NSW. The records are scattered	Low. Not known within the Lithgow LGA. Not suitable habitat recorded within the

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
						over a range of over 400 km between West Wyalong and the Pilliga Scrub. Site localities include Pilliga East State Forest, Goonoo State Forest, Hervey Range, Wingen Maid Nature Reserve, Toongi, Denman, Rylestone district and Kandos Weir. Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies. It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. Specific microclimates include damp sandy flats, alluvial deposits of coarse gravel in dry creek beds and along a spur receiving soakage from high ground.	Project Boundary. Not detected during past or current surveys.
Santalaceae	*Thesium australe*	Austral Toadflax, Toadflax	V	V	0	Austral Toad-flax is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. Occurs in grassy woodland or grassland in association with Themeda australis, on which it parasitises.	Low. Not known within the Lithgow LGA. Suitable habitat occurs in Project Boundary associated within grassy woodlands. Project Boundary occurs beyond known distribution. Not detected during past or current surveys.
Scrophulariaceae	*Derwentia blakelyi*		V		50	Restricted to the western Blue Mountains, near Clarence, near Mt Horrible, on Nullo Mountain and in the Coricudgy Range. Occurs in eucalypt forest, often in moist areas.	Moderate-high. In the Lithgow LGA known distribution largely occupies Newnes State Forest, though outliers occur within areas of Ben Bullen State Forest, less than 5 km away. Suitable habitat occurs in the Project Boundary.

Table E.1 Likelihood Of Threatened Flora Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Count in LGA	Distribution and Habitat Requirements	Likelihood of Occurrence
							Not detected during past or current surveys.
Scrophulariaceae	*Euphrasia arguta*			CE	0	Recorded from Bathurst to Walcha area Grows in grassy areas near rivers,	Low. Species listed as Critically Endangered under EPBC. No suitable habitat occurs in Project Boundary. Not known within the Lithgow LGA. Not detected during past or current surveys.

V – Vulnerable, E – Endangered, CE – Critically Endangered,

Appendix F

Likelihood of Threatened Fauna Species Recorded from the Lithgow LGA

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Insecta							
Lycaenidae	*Paralucia spinifera*	Bathurst Copper Butterfly	E1	V	88	Occurs above 850 m elevation, at sites with a south-west to north-west aspect, usually where direct sunlight reaches the habitat, and with extremes of cold such as regular winter snowfalls or heavy frosts. Geology, soils and dominant vegetation canopy species vary between habitat locations. However vegetation structure is consistent, commonly open woodland or open forest with a sparse understorey that is dominated by the shrub, Blackthorn *Bursaria spinosa subsp. lasiophylla*. Its lifecycle relies on a mutualistic relationship with the ant, *Anonychomyra itinerans*, and on the presence of *B. spinosa subsp. lasiophylla* which is used as the larval food plant. Adult males fly rapidly at about one metre from the ground and rest with wings parted in places exposed to full sun. Females fly less rapidly and tend to remain nearer to the host plant. The butterflies generally remain in the vicinity of *B. spinosa subsp. lasiophylla*, and are rarely observed more than 10 m distant from the plant.	Low-medium. Nearby OEH records at Blackmans Flat on what looks to be south-west and south-east facing slopes, Within the project Boundary there are some areas of suitable habitat in the form of open woodland or open forest above 900m, though a shrub layer dominated by *Bursaria spinosa subsp. lasiophylla* was not recorded. Not detected during past or current surveys.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Petaluridae	*Petalura gigantea*	Giant Dragonfly	E1		25	Live in permanent swamps and bogs with some free water and open vegetation. Adults spend most of their time settled on low vegetation on or adjacent to the swamp. Females lay eggs into moss or other soft vegetation bordering swamps. Larvae dig long branching burrows under the swamp. Larvae leave their burrows at night and feed on insects and other invertebrates on the surface and also use underwater entrances to hunt for food in the aquatic vegetation.	Low. Not recorded within the Project Boundary during current or previous surveys. No nearby OEH records. No suitable habitat within the Project Boundary.
Amphibia							
Hylidae	*Litoria booroolongensis*	Booroolong Frog	E1	E	15	Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins. Shelter under rocks or amongst vegetation near the ground on the stream edge. Sometimes bask in the sun on exposed rocks near flowing water during summer. Eggs are laid in submerged rock crevices and tadpoles grow in slow-flowing connected or isolated pools.	Low. Not recorded within the Project Boundary during current or previous surveys. Nearest OEH records in Turon National Park, approximately 6km northwest of the Project Boundary. No suitable habitat within the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
	Litoria littlejohni	Littlejohn's Tree Frog		V	0	This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.	Low. Not associated with any habitat type but is infrequently recorded in general and no records within the vicinity of the Project. .
Myobatrachidae	*Heleioporus australiacus*	Giant Burrowing Frog	V	V	4	Found in heath, woodland and open forest with sandy soils. Generally lives in the heath or forest and will travel several hundred metres to creeks to breed. Burrows into deep litter or loose soil, emerging to feed or breed after rain. Breeds from August to March, laying eggs under vegetation in creeks or in yabby holes.	Low. Not recorded within the Project Boundary during current or previous surveys. The Project Boundary is well to the west of the known distribution. No suitable habitat within the Project Boundary.
	MIxophyes balbus	Stuttering Frog	E1	V	2	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. Breed in streams during summer after heavy rain. Eggs are laid on rock shelves or shallow riffles in small, flowing streams. As the tadpoles grow they move to deep permanent pools and take approximately 12 months to metamorphose.	Low. Not recorded within the Project Boundary during current or previous surveys. The Project Boundary is to the west of the known distribution. No suitable habitat within the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
	Mixophyes iteratus	Giant Barred Frog	E	E	0	Giant Barred Frogs forage and live amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m. They breed around shallow, flowing rocky streams from late spring to summer	Low. Not recorded within the Project Boundary during current or previous surveys. Not known in the LGA. No suitable habitat.
	Pseudophryne australis	Red-crowned Toadlet	V		14	Occurs in open forests, mostly on Hawkesbury or Narabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Eggs are laid in moist leaf litter, from where they are washed by heavy rain; a large proportion of the development of the tadpoles takes place in the egg. Disperses outside the breeding period, when they are found under rocks and logs on sandstone ridges and forage amongst leaf-litter.	Low. Not recorded within the Project Boundary during current or previous surveys. The Project Boundary is well to the west of the known distribution. No suitable habitat within the Project Boundary.
Fish							
Ambassidae	*Ambassis agassizii*	Olive Perchlet / Agassiz's glassperch		E	0	Inhabits rivers, creeks, ponds and swamps in both eastern (coastal) and western (Murray-Darling) drainage lines. This species is usually found in slow flowing or still water, often in proximity to overhanging vegetation, snags and	Low. There is no preferred habitat available for this species in the Project Boundary. Not known in the

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
						boulders during the day. At night they disperse to feed on microcrustaceans and insects (NSW Department of Primary Industries 2009).	LGA.
Eleotridae	*Mogurnda adspersa*	Purple Spotted Gudgeon		E	0	A Murray-Darling fish, now reduced to a patchy distribution in Northern New South Wales and Southern Queensland. Slow flowing waters among weed where suitable hard objects are available for spawning. Primarily a bottom dweller, rarely swims continuously. Longer distances accomplished by a series of jerky darts. Migrate from deeper water and spend winter in sheltered situations. An ambush predator, lying motionless on bottom until suitable prey approaches.	Low. There is no preferred habitat available for this species in the Project Boundary. Not known in the LGA.
Percichthyidae	*Maccullochella peelii peelii*	Murray Cod	-	V	Yes	The Murray Cod occurs in lower reaches of the Murray-Darling Basin, where the water temperature is warm. The diverse range of habitats frequented by the Murray Cod includes slow moving rivers, murky billabongs and clear, rocky rivers (Department of the Environment and Water Resources, 2007).	Low. There is no preferred habitat available for this species in the Project Boundary. Not known in the LGA.
Reptillia							

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Elapidae	*Hoplocephalus bungaroides*	Broad-headed Snake	E1	V	8	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.	Moderate-high. Not recorded during the current or previous surveys within the Project Boundary. Nearby recent record (2010) just south-east of Project Boundary. Suitable forage, shelter and habitat occur within the sandstone escarpments of the Project Boundary.
Scincidae	*Eulamprus leuraensis*	Blue Mountains Water Skink	E1	E	19	Occurs at high elevation: the lowest altitude recorded for this species is 560 m at Williams Ridge, south of Hazelbrook, NSW. Restricted to an isolated and naturally fragmented habitat of sedge and shrub swamps that have boggy soils and appear to be permanently wet. The vegetation in these swamps typically takes the form of a sedgeland interspersed with shrubs, but may occur as a dense shrub thicket. The lizard is semi-aquatic and is active on warm, sunny days from September until late April. When disturbed, the lizards flee to shelter in dense grass tussocks or down holes.	Low. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records within several kilometres of the Project Boundary. No suitable habitat within the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Varanidae	*Varanus rosenbergi*	Rosenberg's Goanna	V		5	Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat. 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.	Low. Not recorded during the current or previous surveys within the Project Boundary. Few OEH records in wider locality (Turon and Wollemi National Parks). Suitable forage, shelter and breeding habitat occurs within the Project Boundary.
Aves							
Acanthizidae	*Chthonicola sagittata*	Speckled Warbler	V		56	Lives in a wide range of *Eucalyptus* dominated communities that have a grassy understorey, often on rocky ridges or gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees. Pairs are sedentary, occupying a breeding territory of about 10ha, with a slightly larger home-range when not breeding.	Present. Recorded during current survey. Suitable habitat occurs within the grassy woodlands of the survey area.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Accipitridae	*Hieraaetus morphnoides*	Little Eagle			26	Occupies open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used	Moderate. Not recorded during current or previous surveys. Suitable habitat occurs within the grassy woodlands of the survey area.
	Lophoictinia isura	Square-tailed Kite	V		6	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage. Appears to occupy large hunting ranges of more than 100km^2.	Present. Recorded foraging over Project Boundary during the current surveys.
Anatidae	*Oxyura australis*	Blue-billed Duck	V		3	Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. Blue-billed Ducks will feed by day far from the shore, particularly if dense cover is available in the central parts of the wetland. Blue-billed Ducks are partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer. Blue-billed Ducks usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes.	Low. Not recorded within the Project Boundary during current or previous surveys. No suitable habitat within the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Apodidae	*Hirundapus caudacutus*	White-throated Needletail		M	0	Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April (Pizzey & Knight 2007).	Low. Suitable habitat within the Project Boundary. Not known in the LGA. Not recorded within the Project Boundary during current or previous surveys.
Ardeidae	*Ardea alba*	Great Egret		M	0	Great Egrets occur throughout most of the world. They are common throughout Australia, with the exception of the most arid areas. Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. Great Egrets can be seen alone or in small flocks, often with other egret species, and roost at night in groups. In Australia, the breeding season of the Great Egret is normally October to December in the south and March to May in the north. This species breeds in colonies, and often in association with cormorants, ibises and other egrets. (Australian Museum 2003).	Low. Not recorded within the Project Boundary during current or previous surveys. No suitable habitat within the Project Boundary.
Ardeidae	*Ardea ibis*	Cattle Egret		M	0	Subspecies A. i. coromanda is found across the Indian subcontinent and Asia as far north as Korea and Japan, and in South-east Asia, Papua New Guinea and Australia (McKilligan 2005).	Low. Not recorded within the Project Boundary during current or previous surveys. No suitable habitat within the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Ardeidae	*Ixobrychus flavicollis*	Black Bitten	V		1	In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland. Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night.	Low. Project is located inland west of the dividing range. No suitable habitat recorded in the Project Boundary. One record in the LGA. Not detected during past or current surveys.
Cacatuidae	*Callocephalon fimbriatum*	Gang-gang Cockatoo	V		229	In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet eucalypt forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. Often found in urban areas. Favours old-growth attributes for nesting and roosting.	Present. Recorded within the Project Boundary during current and previous surveys. Suitable forage and breeding habitat within the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black Cockatoo	V		88	Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur. Feeds almost exclusively on the seeds of several species of she-oak (*Casuarina* and *Allocasuarina* species). Dependent on large hollow-bearing eucalypts for nest sites.	Medium. Suitable forage and breeding habitat within the Project Boundary. Though not feed trees where not recorded in abundance or frequently. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records.
Climacteridae	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	V		67	Found in eucalypt woodlands and dry open forests of the inland slopes and plains inland of the Great Dividing Range. Also occasionally occurs in suitable habitat in coastal areas. Mainly inhabits woodlands dominated by stringybarks and other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. Usually not found in woodland with a dense shrub understorey. Fallen timber is an important habitat component for foraging. Sedentary, with home-ranges from 1.1ha to 10.7ha. Hollows in standing dead or living trees and tree stumps are essential for nesting.	Present. Recorded during current survey. Suitable habitat occurs within the grassy woodlands of the survey area.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Dicruridae	*Myiagra cyanoleuca*	Satin Flycatcher		M	0	Occurs in heavily vegetated gullies, in forests and taller woodlands. During migration it is found in coastal forests, woodlands, mangroves, trees in open country and gardens (Pizzey & Knight 2007).	Present. Recorded during current surveys and previous surveys (wildsearch 1996; AES 2003).
Estrildidae	*Stagonopleura guttata*	Diamond Firetail	V		99	Found in grassy eucalypt woodlands, including Box-Gum Woodlands. Also occurs in open forest, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas, and sometimes in lightly wooded farmland. Feeds exclusively on the ground, primarily on grass and herb seed. Nests and roosts mainly in dense shrubs.	High. Not recorded during current or previous surveys. Nearby recent records (dated 2009) at Baal Bone Colliery. Suitable habitat occurs within the grassy woodlands of the survey area.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Meliphagidae	*Anthochaera phrygia*	Regent Honeyeater	E1	E	596	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast. The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Also utilises : Grey Box *Eucalyptus microcarpa*),Grey Gum (*Eucalyptus punctata*), Red Box (*Eucalyptus polyanthemos*), Grey Box (*Eucalyptus mollucana*), Swamp Messmate (*Corymbia robusta*), Narrow-leaved Stringybark (*Eucalyptus crebra*), Caley's Ironbark (*Eucalyptus caleyi*), Spotted Gum (*Corymbia maculate*), McKie's Stringybark (*Eucalyptus mckieana*), Red Stringybark (*Eucalyptus macrorhyncha*), Silvertop Stringybark (*Eucalyptus laevopinea*) and Rough-barked Apple (*Angophora floribunda*). Nectar and fruit from the mistletoes *Amyema miquelii*, *Amyema pendula* and *Amyema cambagei* are also eaten during the breeding season.	High. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH record (dated 2004) approx. 1 km north of the Project Boundary. Suitable habitat within Box Gum Woodland of the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Meliphagidae	*Epthianura albifrons*	White-fronted Chat	V		1	In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas. Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground.	Low. No suitable habitat recorded in the Project Boundary. One record in the LGA. Not detected during past or current surveys.
	Grantiella picta	Painted Honeyeater	V		3	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema. Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.	Moderate. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records within several kilometres of the Project Boundary. Suitable habitat within the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Meliphagidae	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subspecies)	V		65	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*Eucalyptus albens*), Grey Box (*Eucalyptus microcarpa*), Yellow Box (*Eucalyptus melliodora*) and Forest Red Gum (*Eucalyptus tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees. Feeding territories are large making the species locally nomadic. The Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares	Moderate. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records from within several kilometres of the Project Boundary. Suitable habitat within the Project Boundary, which may form a component of a much larger home-range.
Meropidae	*Merops ornatus*	Rainbow Bee-eater		M	0	Usually occur in open or lightly timbered areas, often near water. Breed in open areas with friable, often sandy soil, good visibility, convenient perches and often near wetlands. Nests in embankments including creeks, rivers and sand dunes. Insectivorous, most foraging is aerial, in clearings (Higgins 1999).	Low. Not recorded during current or previous surveys. No suitable habitat. Not known in the LGA.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V		69	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.	Present. Not recorded within the Project Boundary during current survey. Recorded during 2003 surveys (AES (2003). Nearby OEH records from within several kilometres of the Project Boundary. Suitable habitat within the Project Boundary, which may form a component of a much larger home-range.
Petroicidae	*Melanodryas cucullata cucullata*	Hooded Robin (south-eastern form)	V		8	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season.	Moderate. Not recorded during current or previous surveys. Suitable habitat occurs within the grassy woodlands of the survey area.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
	Petroica boodang	Scarlet Robin	V		175	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude. The Scarlet Robin is primarily a resident in forests and woodlands, but some adults and young birds disperse to more open habitats after breeding	Present. Recorded during current surveys and during previous surveys by Wildsearch (1996) and AES (2003) Suitable habitat occurs within the grassy woodlands of the survey area.
	Petroica phoenicea	Flame Robin			57	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes.	High. Not recorded during current or previous surveys. Suitable habitat occurs within the grassy woodlands of the survey area. Potential to occur.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V		14	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas. Build and maintain several dome-shaped stick nests used for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts.	Low. Not recorded during current or previous surveys. Suitable habitat occurs within the grassy woodlands of the survey area.
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	V		104	Mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. Gregarious, usually foraging in small flocks, often with other species of lorikeet. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands White Box (*Eucalyptus albens*) and Yellow Box (*Eucalyptus melliodora*) are particularly important food sources for pollen and nectar. They are also reported as feeding on fruits, particularly those of mistletoes. Nest hollows are located at heights of between 2m and 15m, mostly in	High. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records within several kilometres of the Project Boundary in Gardens of Stone National Park. Suitable habitat within the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
						living, smooth-barked eucalypts, especially Manna Gum (*Eucalyptus viminalis*), Blakely's Red Gum (*Eucalyptus blakelyi*) and Tumbledown Gum (*Eucalyptus dealbata*). Hollow openings are very small, approximately 3cm in diameter, and are kept open by the activities of the occupants, which use their beaks to bite away living bark from around the opening. Nest hollows are occasionally located in dead trees, but birds generally desert hollows within two years of tree death. Nest-hollows are used "traditionally", with the same hollow known to be occupied for at least 29 years. Breeding season extends from May to September.	

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Psittacidae	*Lathamus discolor*	Swift Parrot	E1	E	30	Migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculate*), Red Bloodwood (*Corymbia gummifera*), Mugga Ironbark (*Eucalyptus sideroxylon*), and White Box (*Eucalyptus albens*). Commonly used lerp infested trees include Grey Box (*Eucalyptus microcarpa*), Grey Box (*Eucalyptus moluccana*) and Blackbutt (*Eucalyptus pilularis*). Return to some foraging sites on a cyclic basis depending on food availability.	High. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records within several kilometres of the Project Boundary. Suitable forage habitat within the Project Boundary.
	Neophema pulchella	Turquoise Parrot	V		57	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Nests in tree hollows, logs or posts, from August to December.	Moderate. Not recorded during current or previous surveys. Suitable habitat occurs within the grassy woodlands of the survey area.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
	Polytelis swainsonii	Superb Parrot	V	V	0	Mainly found in the Riverina where they nest in loose colonies in riparian woodland on River Red Gum. On the inland slopes, Superb Parrots both forage and feed within box woodland, mostly nesting in dead trees (Garnett & Crowley 2000).	Low. Not recorded during current or previous surveys. Suitable habitats are available for this species. Not known in the LGA.
Rostratulidae	*Rostratula benghalensis*	Painted Snipe	E1	VM	0	Inhabits shallow, vegetated, temporary or infrequently filled wetlands, including where there are trees such as *Eucalyptus camaldulensis* (River Red Gum), *E. populnea* (Poplar Box) or shrubs such as *Muehlenbeckia florulenta* (Lignum) or *Sarcocornia quinqueflora* (Samphire). Feeds at the water's edge and on mudlflats on seeds and invertebrates, including insects, worms, mollusks and crustaceans. Males incubate eggs in a shallow scrape nest (Garnett & Crowley 2000).	Low. There is no preferred habitat available for this species in the Project Boundary. Not recorded during current to previous surveys.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Strigidae	*Ninox connivens*	Barking Owl	V		31	Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as *Acacia* and *Casuarina* species, or the dense clumps of canopy leaves in large *Eucalypts*. Feeds on a variety of prey, with invertebrates predominant for most of the year, and birds and mammals such as smaller gliders, possums, rodents and rabbits becoming important during breeding. Live alone or in pairs. Territories range from 30 to 200 hectares and birds are present all year. Three eggs are laid in nests in hollows of large, old eucalypts including River Red Gum (*Eucalyptus camaldulensis*), White Box (*Eucalyptus albens*), Red Box (*Eucalyptus polyanthemos*) and Blakely's Red Gum (*Eucalyptus blakelyi*). Breeding occurs during late winter and early spring.	Moderate. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records within several kilometres of the Project Boundary. Suitable forage, roosting and breeding habitat within the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Strigidae	*Ninox strenua*	Powerful Owl	V		67	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angorphora floribunda*, Cherry Ballart *Exocarpus cupressiformis* and a number of eucalypt species. As most prey species require hollows and a shrub layer, these are important habitat components for the owl. Pairs of Powerful Owls are believed to have high fidelity to a small number of hollow-bearing nest trees and will defend a large home range of 400-1450 ha. Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. During the breeding season, the male Powerful Owl roosts in a "grove" of up to 20-30 trees, situated within 100-200 metres of the nest tree where the female shelters.	Present. Not recorded within the Project Boundary during current surveys. Recorded within the Project Boundary during previous surveys (Wildsearch 1996). Suitable forage, roosting and breeding habitat, particularly in the taller forest communities of the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Tytonidae	*Tyto novaehollandiae*	Masked Owl	V		6	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	Moderate. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records within several kilometres of the Project Boundary. Suitable forage, roosting and breeding habitat within the Project Boundary.
Tytonidae	*Tyto tenebricosa*	Sooty Owl	V		10	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum (*Pseudocheirus peregrinus*) or Sugar Glider (*Petaurus breviceps*). Nests in very large tree-hollows.	Low. Not recorded within the Project Boundary during current or previous surveys. No suitable habitat or nearby OEH records.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Mammalia							
Burramyidae	*Cercartetus nanus*	Eastern Pygmy-possum	V		7	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. Also feeds on insects throughout the year; this feed source may be more important in habitats where flowers are less abundant such as wet forests. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (*Pseudocheirus peregrinus*) dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks. Appear to be mainly solitary, each individual using several nests, with males having non-exclusive home-ranges of about 0.68 hectares and females about 0.35 hectares. Frequently spends time in torpor especially in winter.	Moderate. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records within several kilometres of the Project Boundary. Suitable habitat within the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Dasyuridae	*Dasyurus maculatus maculatus*	Spotted-tailed Quoll	V	E (southeastern mainland population)	29	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares; usually traverse their ranges along densely vegetated creeklines.	Moderate. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records within several kilometres of the Project Boundary. Suitable forage, den and breeding habitat within the Project Boundary.
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V		2	Roosts in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. Forages in most habitats, with and without trees.	Moderate. Not recorded within the Project Boundary during current or previous surveys. No nearby OEH records. Suitable forage, roosting and breeding habitat within the Project Boundary.
Macropodidae	*Petrogale penicillata*	Brush-tailed Rock-wallaby	E1	V	15	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Shelter or bask during the day in rock crevices, caves and	Moderate. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records within several kilometres of the Project

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
						overhangs and are most active at night. Highly territorial and have strong site fidelity with an average home range size of about 15 ha.	Boundary. Suitable habitat on the sandstone escarpment within the Project Boundary.
Molossidae	*Mormopterus norfolkensis*	Eastern Freetail-bat	V		10	Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures.	High. Not recorded within the Project Boundary during current or previous surveys. OEH record in Project Boundary. Suitable forage, roosting and breeding habitat within the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
Petauridae	*Petaurus australis*	Yellow-bellied Glider	V		64	Den, often in family groups, in hollows of large trees. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar. Very mobile and occupy large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources.	High. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records from Newnes State Forest and Wollemi National Park. Suitable forage, roosting and breeding habitat within the Project Boundary.
Petauridae	*Petaurus norfolcensis*	Squirrel Glider	V		14	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia mid-storey. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum,	Present. Recorded within the East Tyldesley portion of the Project Boundary during current surveys. Not recorded during previous surveys. Nearby OEH records within several

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
						eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.	kilometres of the Project Boundary. Suitable habitat throughout the Project Boundary.
Phascolarcidae	*Phascolarctos cinereus*	Koala	V		25	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size.	Low. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records within several kilometres of the Project Boundary. Suitable forage trees within the Project Boundary including *Eucalyptus punctata* and *Eucalyptus viminalis*.
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	62	Found in well-timbered areas containing gullies. Roosts in caves, crevices in cliffs and old mine workings frequenting low to mid-elevation dry open forest and woodland close to these features.	High. Potential anabat record within the Project Boundary during current surveys. Not recorded during previous surveys. Nearby recent OEH record (dated 2009) within several kilometres of the Project Boundary. Suitable forage,

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
							roosting and breeding habitat within the Project Boundary.
	Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		49	Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	High. Not recorded within the Project Boundary during current surveys. Probable record during previous surveys (Wildsearch 1996). OEH record within Project Boundary dated 2003. Suitable forage, roosting and breeding habitat within the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
	Miniopterus australis	Little Bent-wing Bat	V		1	Prefer moist eucalypt forest, rainforest or dense coastal banksia scrub. Roost in caves, tunnels and sometimes tree hollows during the day, and at night forage beneath the canopy of densely vegetated habitats.	Low. Not recorded within the Project Boundary during current or previous surveys. Nearby OEH records within several kilometres of the Project Boundary. Suitable forage, roosting and breeding habitat within the Project Boundary.
	Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V		34	Hunt in forested areas, catching moths and other flying insects above the tree tops. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within about 300 km range of maternity caves. Cold caves are used for hibernation in southern Australia.	Present. Recorded within the Project Boundary during current surveys. Not recorded during previous surveys. Nearby OEH records within several kilometres of the Project Boundary. Suitable forage, roosting and breeding habitat within the Project Boundary.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
	Myotis macropus	Large-footed Myotis	V		6	Most habitats near water, including mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland. Forage over streams and pools catching insects and small fish. Generally roost close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	Low. Potential anabat record within the Project Boundary during previous surveys (AES 2003. Despite this no nearby OEH records. All known records with LGA are located near watersources. No significant forage habitat near water for this species within the Project Boundary.
	Nyctophilus timoriensis	South-eastern Long-eared Bat		V	0	The South-eastern Long-eared Bat occurs in a range of inland woodland vegetation types, including box, ironbark and cypress pine woodlands. The South-eastern Long-eared Bat is known to roost in deadwood or hollow trunks/branches	Low. Not recorded during current or previous surveys. Suitable habitat. Not known in the LGA.

Table F.1 Likelihood Of Threatened Fauna Species within the Project Boundary

Family	Scientific Name	Common Name	TSC Status	EPBC Status	Lithgow LGA Count	Habitat requirements	Likelihood of occurrence
	Scoteanax rueppellii	Greater Broad-nosed Bat	V		10	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Although this species usually roosts in tree hollows, it has also been found in buildings. Females congregate at maternity sites located in suitable trees.	High. Potential anabat record within the Project Boundary during current surveys. Not recorded during previous surveys. Recent OEH record (dated 2003) within Project Boundary. Suitable forage, roosting and breeding habitat within the Project Boundary.

Appendix G

Persoonia marginata Quadrat Locations and Habitat

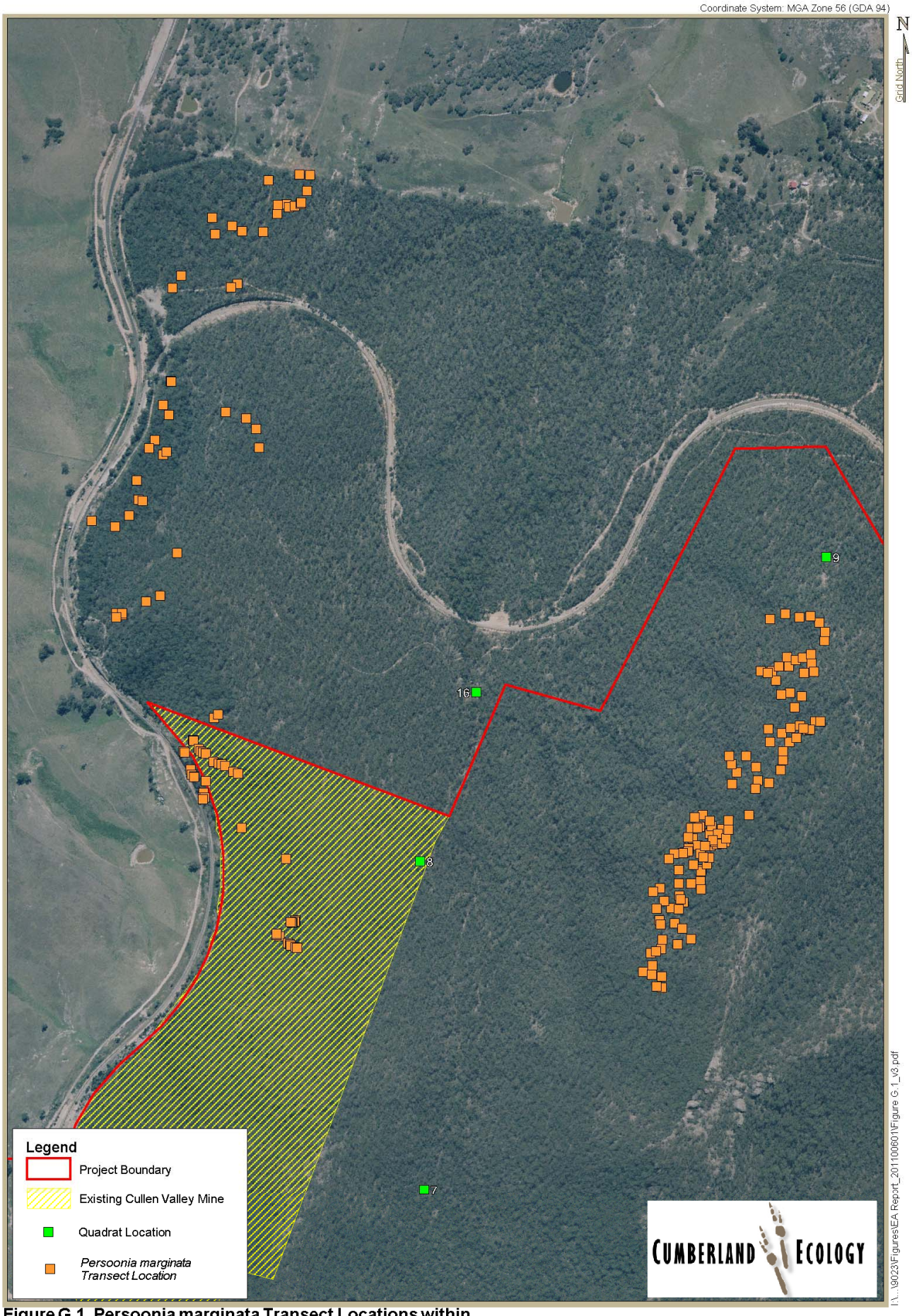


Figure G.1. Persoonia marginata Transect Locations within Cullen Valley Mine and North-eastern Subpopulations

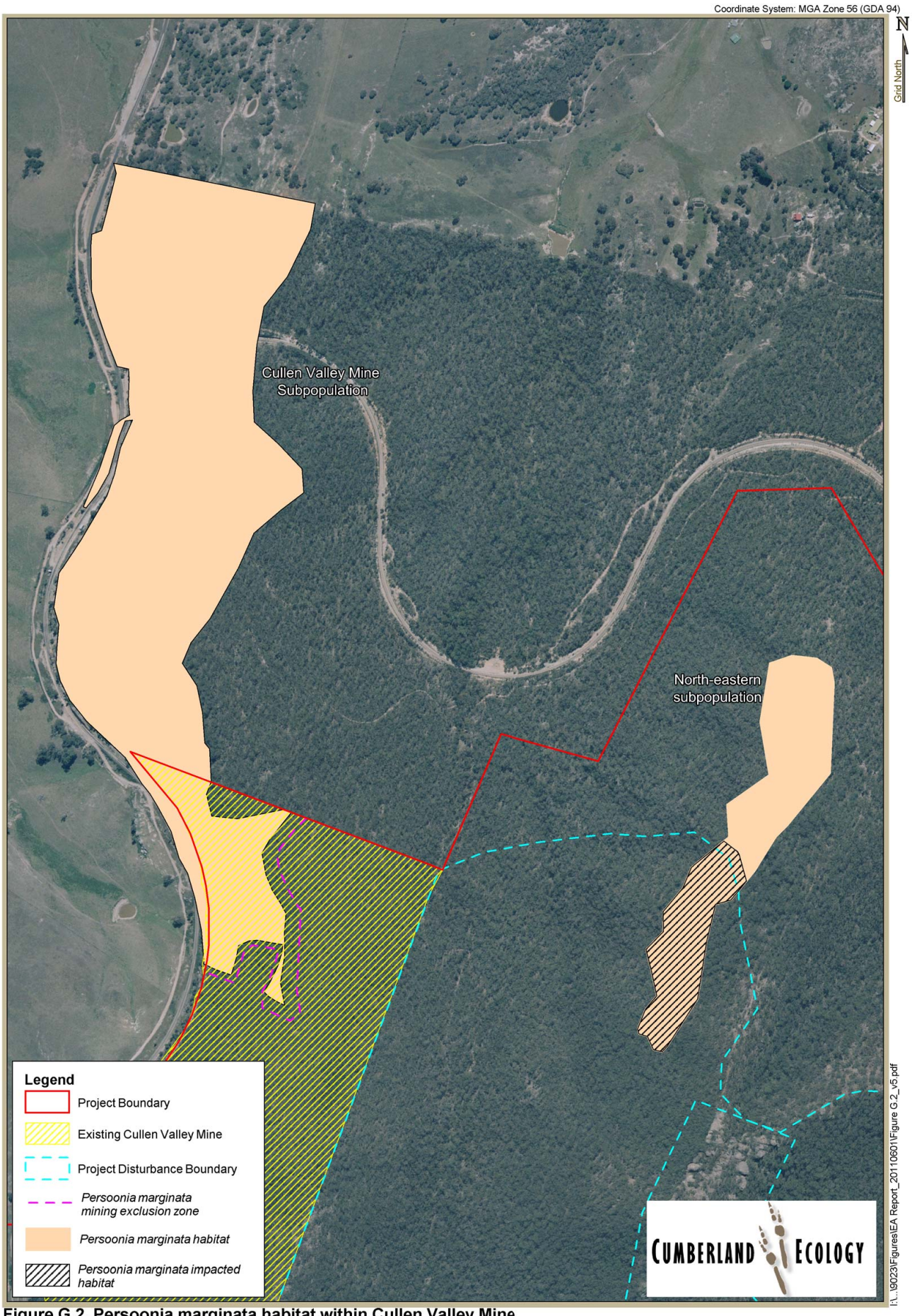


Figure G.2. Persoonia marginata habitat within Cullen Valley Mine and North-eastern Subpopulations

23 March 2012

Appendix H

EPBC Act Policy Statement for Box Gum Woodland and Derived Native Grassland

EPBC Act
Policy Statements

Australian Government
Department of the Environment and Heritage

White Box – Yellow Box – Blakely's Red Gum grassy woodlands and derived native grasslands



Nationally threatened species and ecological communities

ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT

What are the Box–Gum Grassy Woodlands and Derived Grasslands?

This ecological community can occur as either a woodland or a derived grassland (a grassy woodland from which the trees have been removed). It has a ground layer of native tussock grasses and herbs, and a sparse, scattered shrub layer. White Box (Eucalyptus albens), Yellow Box (E. melliodora) or Blakely's Red Gum (E. blakelyi) dominate the ecological community, where a tree layer still occurs. Photos of these dominant species appear below. Some of the other tree species associated with the ecological community are listed opposite.

Sites dominated by other trees species that do not have Yellow Box, White Box or Blakely's Red Gum as co-dominants are not considered to be part of the ecological community, except in the Nandewar Bioregion. In the Nandewar bioregion (see map on page 4), Grey Box trees (Eucalyptus microcarpa or E. moluccana) may also be dominant or co-dominant in the ecological community.

Some other tree species that may occur in association with the ecological community

- Western Grey Box (Eucalyptus microcarpa)
- Coastal Grey Box (E. moluccana)
- Fuzzy Box (E. conica)
- Apple Box (E. bridgesiana)
- Red Box (E. polyanthemos)
- Red Stringybark (E. macrorhyncha)
- Long-leaved Box (E. goniocalyx)
- New England Stringybark (E. calignosa)
- Brittle Gum (E. mannifera)
- Candlebark (E. rubida)
- Argyle Apple (E. cinerea)
- White Cypress Pine (Callitris glaucophylla)
- Black Cypress Pine (C. enderlicheri)
- Kurrajong (Brachychiton populneus)
- Drooping She-oak (Allocasuarina verticillata)

Blakey's Red Gum





Blakeys Red Gum: juvenile (P. Ormay © ANBG) and mature (P. Komidar)

White Box





White Box: juvenile (S. Maas) and mature (T. McLeish)

Yellow Box





Yellow Box: juvenile (P. Ormay © ANBG) and mature (H. Mills)



Box-Gum Woodlands of high (left), moderate (centre) and poor (right) quality condition (H. Mills).

Why are the Box–Gum Grassy Woodlands and Derived Grasslands important?

This ecological community provides important habitat for a large number of plants and animals, including rare and threatened species such as Superb Parrots, Regent Honeyeaters and Squirrel Gliders.

More than 400 native plant species have been recorded as occurring within the ecological community. Most of these species are grasses and herbs that occur in the ground layer, which is why the ecological community can exist in the absence of trees. The ground layer species include grasses, sedges, pea plants, daisies and lilies, amongst many others. Kangaroo Grass (Themeda triandra, also known as Themeda australis) and Snow Grass (Poa sieberiana) were originally the dominant grasses across a large part of the ecological community's range. For a full list of species that can be found in the ecological community visit: **www.deh.gov.au/box-gum** or call 1800 803 772.



Yellow Box flowers (P. Komidar)



Derived grassland (S. Maas)

Why is this ecological community listed as endangered under the Environment Protection and Biodiversity Conservation Act?

The Box–Gum Grassy Woodlands and Derived Grasslands were formerly widespread along the western slopes and tablelands of the Great Dividing Range, throughout southern Queensland, western New South Wales, the Australian Capital Territory and Victoria. Now less than 5 per cent remains in good condition and much of this occurs in small isolated patches. The remaining patches are still being lost due to clearing, weed invasion and overgrazing – hence the ecological community's listing under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). You can read more about these threatening processes at **www.deh.gov.au/box-gum**.

What is the range in which patches of the ecological community occur?



Yam Daisy with native bee and fly (H. Mills)



How can I tell if I have the listed ecological community on my property?

If you have a patch of the listed ecological community on your land, congratulations! Due to the vulnerability of this ecological community to overgrazing, clearing and weed invasion, it only remains on land that has been well managed.

Many areas that were formerly part of the ecological community have been excluded from the listed ecological community (see flowchart), as they are now heavily degraded and no longer retain sufficient values to merit protection under the EPBC Act. If you have a patch of woodland on your land that is too degraded to be part of the listed ecological community, but still retains some of the values of the ecological community, you are encouraged to manage the area to maintain and enhance those values.

Areas that are part of the listed ecological community must have either:

- an intact tree layer and a predominantly native ground layer; or
- an intact native ground layer with a high diversity of native plant species but no remaining tree layer.

Shrubs can occur naturally in grassy woodlands and form an important part of the ecological community, providing habitat for many birds and insects. However, a patch that has a continuous shrub layer of more than 30 per cent cover is no longer considered to be a grassy woodland and is excluded from the listed ecological community.

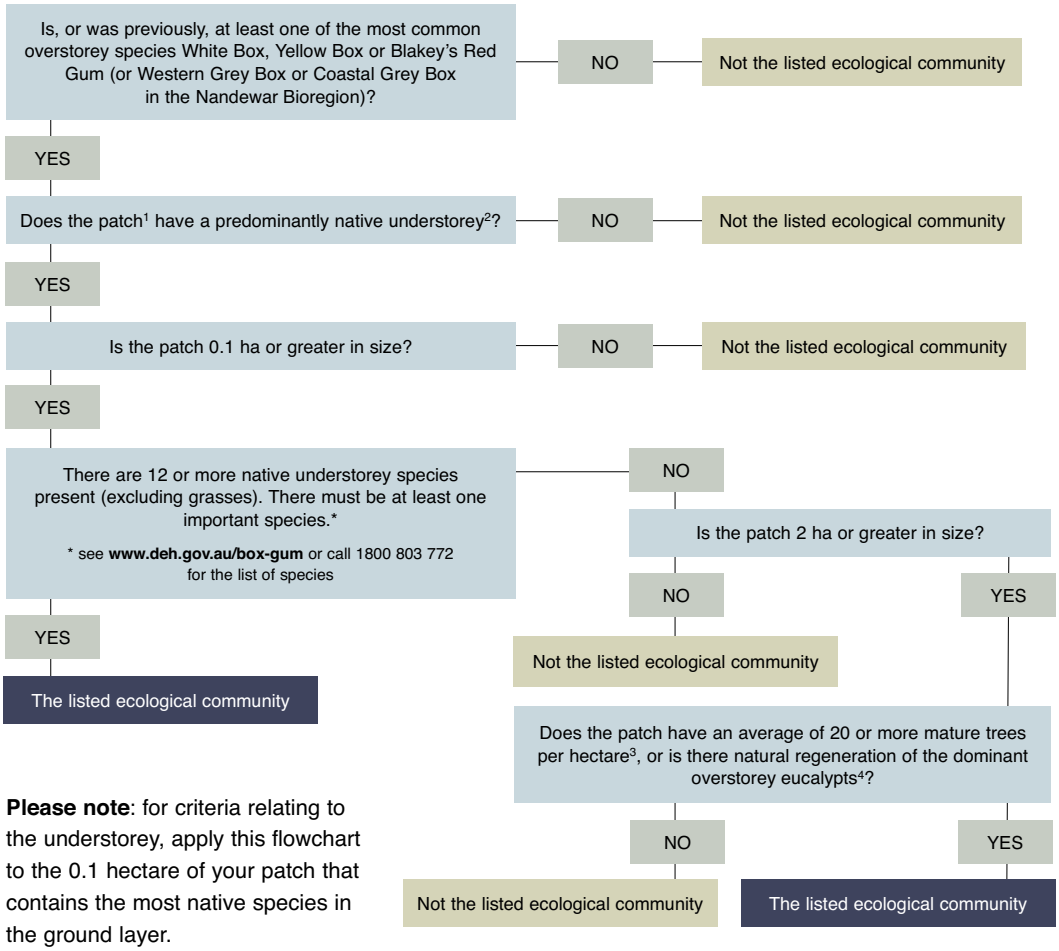
The following flow chart will help you determine if an area on your land is part of the ecological community.

Giant Bullfrog (C. Slatyer)



The flowchart below represents the lowest condition at which patches are included in the listed ecological community. This is not the ideal state of the ecological community. Large patches, those that link remnants in the landscape, those that occur in highly cleared areas, those that contain rare, declining or threatened species, and those that represent the entire range of the ecological community, are important for the long-term future of the ecological community.

Determining if your land has an area of the listed ecological community



Please note: for criteria relating to the understorey, apply this flowchart to the 0.1 hectare of your patch that contains the most native species in the ground layer.

1 Patch – a patch is a continuous area containing the ecological community (areas of other ecological communities such as woodlands dominated by other species are not included in a patch). In determining patch size it is important to know what is, and is not, included within any individual patch. The patch is the larger of:
- an area that contains five or more trees in which no tree is greater than 75 m from another tree, or
- the area over which the understorey is predominantly native.

Patches must be assessed at a scale of 0.1 ha (1000m^2) or greater.

2 A predominantly native ground layer is one where at least 50 per cent of the perennial vegetation cover in the ground layer is made up of native species. The best time of the year to determine this is late autumn when the annual species have died back and have not yet started to regrow. (At other times of the year, you can determine whether something is perennial or not is if it is difficult to pull out of the soil. Annual species pull out very easily.)

3 Mature trees are trees with a circumference of at least 125 cm at 130 cm above the ground.

4 Natural regeneration of the dominant overstorey eucalypts when there are mature trees plus regenerating trees of at least 15 cm circumference at 130 cm above the ground.

Can degraded areas be rehabilitated?

Many areas that were formerly part of the ecological community are now too degraded to be included in the listed ecological community. Many of these degraded areas may respond to assisted regeneration, and may still provide important habitat for birds and other animals. Degraded areas that should be given priority for regeneration include:

- large patches,
- patches containing mature trees (especially those with hollows),
- areas of vegetation that link together patches of the ecological community in the landscape,
- patches that occur in those regions in which the ecological community has been most heavily cleared and degraded, and
- patches that contain rare, declining or threatened species.



Showy Parrot-pea (P. Komidar)

What is being done to assist the recovery of the Box–Gum Woodlands and Derived Grasslands?

The good news is that community and government awareness of the plight of this ecological community is increasing. Community groups and landholders are getting together to conserve and rehabilitate patches of Box–Gum Woodlands and Derived Grasslands. More than $3,500,000 of the Australian Government's Natural Heritage Trust (NHT) has been spent so far on projects to manage, conserve and rehabilitate patches of Box–Gum Woodlands and Derived Grasslands.

One of the NHT-funded initiatives has been the establishment of Conservation Management Networks (CMN). Two networks have been set up in NSW and the ACT (see details below) to support landholders and community groups in the management of their land and to share knowledge and to provide a link between researchers, government and land managers.

>> To contact the Grassy Box Woodlands Conservation Management Network or the Southern Tablelands Grassy Ecosystems Conservation Management Network call the CMN Project officers on 02 6298 9700.

Kyamba Travelling Stock Reserve contains Box–Gum Grassy Woodlands, and is a component of the Grassy Box Woodlands CMN. The reserve is leased to a neighbouring landholder to run sheep in order to manage annual weeds, maintain inter-tussock spaces in the ground layer, and control the regeneration of the overstorey. To achieve these management goals, but not compromise the biodiversity of the site, only a small number of sheep are grazed on the property for the majority of the year, with a short episode of heavy grazing in autumn/winter, after the perennial native grasses have dropped their seed.



CMN property near Cootamundra (T. McLeish).

What can I do to assist the recovery of the Box–Gum Grassy Woodlands and Derived Grasslands?

If you manage either a patch of the listed ecological community, or a degraded area, funding may be available to assist you to undertake projects to maintain and improve your patch.

For information about funding available for projects to recover threatened species and ecological communities, see:

- Threatened Species Network Community grants **www.wwf.org.au/tsn**
- Australian Government Envirofund **www.nht.gov.au/envirofund**

To assist in the recovery of the ecological community you can:

- protect patches of the listed ecological community through the development of conservation agreements and covenants,
- protect patches from weeds by preventing soil disturbance in and around patches, and through the speedy eradication of any new invasion,
- avoid the use of fertilisers in or near patches,
- avoid planting trees in very small derived grassland sites, as they may reduce the floral diversity through competition for light, nutrients and water,
- expand patches by planting/seeding at the edges, rather than within the patches,
- expand and connect existing patches,
- implement strategic grazing, such as by resting pastures at appropriate times, e.g. when native perennial grasses are seeding, and
- undertake burning or slashing where native tussock grasses have built up to a high level to open inter-tussock spaces for tree seedlings, ground layer species and shrubs to establish.

What does listing of the Box–Gum Woodlands and Derived Grasslands under the EPBC Act mean for land managers?

Listing means that any new or intensified activities that are be likely to have a significant impact upon the listed ecological community should be referred to the Australian Minister for the Environment and Heritage for assessment and approval.

Examples of activities that could have a significant impact include:

- clearing trees or understorey vegetation in patches of the ecological community or vegetation next to the ecological community,
- inappropriate grazing regimes (see discussion below),
- introducing potentially invasive pasture species, such as Phalaris, into the proximity of patches,
- introducing or increasing the amount of nutrients in patches, such as through fertiliser run-off or spray drift, and
- firewood collection and inappropriate burning practices.



Top to bottom:
High quality understorey (J. Vranjic), Fringed Lily (P. Komidar), Regent Honeyeater (G. Dabb), Daphne Heath (P. Komidar), Wallaby Grass (P. Komidar).

Nationally threatened species and ecological communities









Above (top to bottom): Billybutton with beetle (P. Komidar), Box-Gum woodland (J. Vranjic), Kangaroo Grass with wasp (P. Komidar), Eastern Stone Gecko (C. Slatyer).

Front cover (clockwise from top left): Common Buttercup (S. Maas), Box-Gum woodland (H. Mills), Early Nancy (P. Komidar), Superb Parrot (G. Dabb), Clustered Everlasting (P. Komidar).

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Department of the Environment and Heritage

It is important to note that the management of areas adjacent to a patch of the ecological community can indirectly impact upon the ecological community itself.

The grazing of domestic stock does not necessarily degrade the Box–Gum Woodlands and Derived Grasslands and can in fact provide a useful management tool for patches. However, if grazing pressure is increased by running more stock, changing the time of year of grazing or increasing the time stock spend in a patch then a referral may be required.

The EPBC Act allows for some exemptions to the requirement for assessment and approval. This means that some activities may not need to be referred for an assessment or approval under certain conditions. Information on exemptions can be found online at **www.deh.gov.au/epbc/publications/exemptions.html**.

What is the process if I need to refer a project for approval?

The process for making a referral under the EPBC Act is simple. If you think your activity is likely to have significant impact, you need to complete a referral form, which is available at **www.deh.gov.au/epbc/assessmentsapprovals/referrals**. The Department will advise you within 20 business days whether or not an approval from the Minister is required.

Where can I go for further information?

There are a number of sources of information on grassy woodland management and conservation. Some good starting points are:

- Sharp, S., Dorrough, J., Rehwinkel, R., Eddy, D. and Breckwoldt, A., 2005. Grassy Ecosystems Management Kit: A Guide to Developing Conservation Management Plans. Environment ACT, Canberra.
- McIntyre, S., McIvor, J.G. and Heard, K.M., 2002. Managing and Conserving Grassy Woodlands. CSIRO, Collingwood.
- Grassy Box Woodland Conservation Management Network web site **www.gbwcmn.net.au**.

For general information:

- EPBC Act web site **www.deh.gov.au/epbc**.
- Farmers and the EPBC Act – Information and relevant links **www.deh.gov.au/epbc/farmers/index.html**
- Department of the Environment and Heritage Community Information Unit, email ciu@deh.gov.au or free-call 1800 803 772.

ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT

Appendix I

Assessments of Significance

This appendix contains formal tests of significance (Commonwealth and State) according to Section 5a of the EP&A Act, known as Assessments of Significance. There is no legal requirement to perform State assessments for projects that are to be assessed under Part 3A of the EP&A Act, as they are generally performed to determine the need for the preparation of a Species Impact Statement (SIS) – a document that is not part of the Part 3A assessment process.

However, the Assessments of Significance provide a means by which to gauge the significance of predicted impacts to threatened species, populations and ecological communities and so they have been prepared to help determine the magnitude of the Project's impacts to local occurrences of threatened biota. Although an EPBC Act Referral has been sought for the Project some major changes have occurred since lodgement in relation to impacts to Commonwealth listed species and communities. For this reason current Assessments of Significance for EPBC Act listed species and communities have been re-produced and updated below.

Each Assessment of Significance is a series of questions (shown as italicised text below) for which a response has been supplied beneath in plain text. The responses have been prepared under the scenario that no mitigation or compensatory measures are applied. That is, to determine the significance of impacts, the Assessments of Significance consider the impacts without amelioration.

I.1 Assessment of Significance (EPBC Act)

I.1.1 Ecological Communities

i. Box Gum Woodland

White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Woodland and Derived Grasslands) is listed as a Critically Endangered Ecological Community (CEEC) under the EPBC Act. It is listed as an Endangered Ecological Community (EEC) under the TSC Act.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- *reduce the extent of an ecological community*

The action will remove 16.48 ha of Box Gum Woodland and Derived Native Grassland which conforms to the EPBC Act.

- *fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines*

The action will fragment some of the remaining areas of Box Gum Woodland proposed for retention within the Project Boundary. These remnants will mostly be surrounded by other vegetation communities, which will reduce edge effects to the CEEC.

- *adversely affect habitat critical to the survival of an ecological community*

The action will remove 16.48 ha of Box Gum Woodland habitat. Approximately 30 ha of habitat will remain in the Project Boundary. The Project will not adversely affect critical habitat to the survival of

the ecological community as the 16.48 ha will be rehabilitated and large areas (221.7 ha) will be conserved in offsets.

- *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 or surface water drainage patterns*

The action will remove 16.48 ha of habitat. Indirect impacts are likely to occur to some areas of the remaining 30 ha of habitat. However, most the remaining areas of CEEC will continue to be surrounded by native vegetation.

- *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 action will remove 16.48 ha of habitat. Indirect impacts are likely to occur to some areas of the remaining 30 ha of habitat. However, most the remaining areas of CEEC will continue to be surrounded by native vegetation. Mining operations may decrease the functionality through noise and light impacts.

- *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 mobilization 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*

There is potential for weeds to invade the remaining areas of habitat, particularly as the habitat soil is nutrient rich. Most of the CEEC to be retained will not be fragmented, but surrounded by native vegetation, which will reduce indirect impacts from edge effects.

- *interfere with the recovery of an ecological community*

Without considering compensatory measures through offsetting, the action would interfere with the recovery of the ecological community.

Conclusion

The action will result in the direct loss of 16.48 ha of Box- Gum Woodland and Derived Native Grassland. Without considering mitigation and compensatory measures the action is expected to have a significant impact of this listed community that conforms to the legislated definition for Box-Gum Woodland under the EPBC Act. This will also directly and indirectly affect a range of flora and fauna, including threatened species, by removing potential forage, roosting and breeding habitat.

I.1.2 Flora

i. Eucalyptus cannonii

The Capertee Stringybark *(Eucalyptus cannonii*) is listed as Vulnerable under both the TSC Act and EPBC Act. There are 129 records of the species within Lithgow LGA (OEH 2011b). This species has been recorded during previous and current field surveys and occurs sporadically over much of the Project Boundary.

The Capertee Stringybark is a tree restricted to an area of approximately 100 km by 60 km in the central tablelands of NSW, where it is known from 55 locations. The western border aligns generally between Bathurst and Mudgee, while the eastern locations occur approximately between Lithgow and the town of Bylong. Within this area the species is often locally frequent (DEC (NSW), 2005a). Seed viability appears to be high and seed is spread by wind or gravity, generally in close proximity to the parent plant (<30m). The altitude range of *Eucalyptus cannonii* is from approximately 460 m to 1040 m (DEC (NSW), 2005a). The species mostly occurs on rocky, usually poor, steep ridges in dry sclerophyll forest, although it can also be found in valleys and on gentle slopes (Threatened Species Scientific Committee , 2008a), but less commonly on valley floors (DEC (NSW), 2005a).

Associated tree species include Red Stringybark (*E. macrorhyncha*), Thin-leaved Stringybark (*E. eugenioides*), Red Box (*E. polyanthemos*) and Scribbly Gum (*E. rossii*). On the intermediate slopes there may also be Narrow-leaved Red Ironbark (*E. crebra*), *E. blakelyi*, *E. melliodora*, *E. bridgesiana*, *E. dalrympleana* and *E. viminalis,* whilst on the on lower slopes it may occur with *E. mannifera* subsp. *praecox*, *E. laevopinea*, *E. oblonga*, *E. sparsifolia*, *E. dives* and *E. goniocalyx.* On rocky areas *Angophora intermedia* has been recorded co-existing. *E cannonii* is also known to hybridise with *E. macrorhyncha.* (Threatened Species Scientific Committee , 2008a).

The species has undergone a significant decline in distribution. Population sizes now vary from stands of a few scattered trees in paddocks and along roadsides to over 6,000 individuals in Winburndale Nature Reserve (Hunter 1998).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of an important population of a species*

The population of *Eucalyptus cannonii* found on the Project Boundary is considered to be important. The action will result in the removal of 278 ha of known and potential habitat which will lead to a short term decrease in the size of the important population. However, with the implementation of mitigation measures (inclusion of the species in rehabilitation of mined areas and avoidance of 630 ha) and the inclusion of compensatory measures, the population is unlikely to decrease in size in the long term.

- *reduce the area of occupancy of an important population*

The action will reduce the area of occupancy of *Eucalyptus cannonii* in the Project Boundary.

- *fragment an existing important population into two or more populations*

There is potential for the action to fragment the population if the action was to remove the entire habitat at once. This is not the case, the action proposes to progressively remove habitat whilst

concurrently rehabilitating mine areas by replanting these areas with similar densities of *E. cannonii* prior to clearing.

- *adversely affect habitat critical to the survival of a species*

The action will not adversely affect habitat critical to the survival of the species. It is important to note that once areas of habitat have been cleared and mined, replanting of *E. cannonii* will occur. Further, the species has been found in Project offsets nearby. This will ensure the species is conserved in its natural habitat as well as replanted in potential habitat currently managed as grasslands. The Project will ultimately increase the population through rehabilitation of mine areas and offsets as well as conserve intact natural habitat.

- *disrupt the breeding cycle of an important population*

The action is unlikely to disrupt the breeding cycle. The Project proposes to retain 630 ha of habitat within the Project Boundary and 776 ha in offsets as potential and known habitat.

- *modify, destroy, move, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The action is will remove 278 ha of potential and known habitat.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

Assessments of the existing rehabilitation recorded less than 10% weed cover. Typically sandstone habitats are quite resilient as indicated by the results. Providing best practice guidelines are followed during rehabilitation including weed control, the Project is not expected to result in invasive species becoming established in *E. cannonii* habitat.

- *introduce disease that may cause the species to decline, or*

There is potential for the action to introduce *Phytophthora cinnamomi* from outside areas which may be already contaminated i.e. importing trucks and earthmoving equipment. Currently, there are no reports of the disease on the Project Boundary. Provided the Project follows best practice guidelines, no disease is expected to cause the species to decline.

- *interfere substantially with the recovery of the species*

The action will remove 278 ha of habitat which without mitigation measures and compensatory measure would substantially interfere with the recovery.

Conclusion

The Project proposes to remove approximately 278 ha of known and potential habitat for *E. cannonii.* This includes areas known to contain individuals, and areas of habitat that provide suitable habitat in which the species has potential to occur. The Project will remove an estimated approximately half of the entire population of *E. cannonii* in the Project Boundary. While the other half will be retained, the removal of an estimated 19,219 individuals is a significant reduction in the population of this threatened species.

Without mitigation measures and compensatory measures, the Project will result in a significant impact to the local and overall occurrence, of *Eucalyptus cannonii.*

ii. Persoonia marginata

Persoonia marginata (Clandulla Geebung) is listed as Vulnerable under both the TSC Act and EPBC Act. There are 29 records of the species within Lithgow LGA (OEH 2011b). This species was recorded during current field surveys.

Persoonia marginata is a decumbent shrub that grows to 20-60cm and has yellow flowers. It is known from disjunct populations on the central tablelands and central coast of NSW (DEWHA 2008 conservation advice, DECC, 2005). The species occurs within the Central West, Hawkesbury–Nepean and Hunter–Central Rivers (NSW) Natural Resource Management Regions (DECC, 2005). The core of its distribution is within Clandulla State Forest, with four disjunct populations occurring to the north at Dingo Creek and Mount Dangar within the Wollemi and Goulburn River National Parks; to the south within Ben Bullen State Forest, south-east of Capertee; and to the south-east at Devils Hole within the Parr State Recreation Area (DECC, 2005).

Persoonia marginata is known to inhabit dry sclerophyll forest and woodland on low ridges of sandstone and heavy clay or gravelly loams derived from Permian geologies at altitudes of approximately 700m. Commonly occurring co-dominant canopy species include *Eucalyptus punctata, E. sparsifolia, E. rossii, E. fibrosa* and *E. crebra*. The understorey is typically shrubby with a medium density, and the grassy understorey is of low to medium density (DEWHA, 2008).

The species appears to respond well to disturbance, with greater densities found along the edges of tracks and in areas disturbed by forestry activities (DECC, 2005).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of an important population of a species*

The action will not lead to a long-term decrease in size of an important population as the action will impact on 3.29 ha of habitat from a total area of 49.77 ha.

- *reduce the area of occupancy of an important species*

The action will remove 3.09 ha and impact further 0.19 ha of habitat through edge effects.

- *fragment an existing important population into two or more populations*

The population comprises of three disjunct populations. The Project will remove the southern extent of one sub-population. The action will not fragment the important population.

- *adversely affect habitat critical to the survival of a species*

The population occupies 49.77 ha. Of this total area, the action will remove 3.09 ha and impact further 0.19 ha of habitat through edge effects. The action will not adversely affect habitat critical to the survival of a species as the majority of the habitat will not be impacted.

- *disrupt the breeding cycle of an important population*

The population occupies 49.77 ha. Of this total area, the action will remove 3.09 ha and impact further 0.19 ha of habitat through edge effects. The action will not disrupt the breeding cycle of the important population.

- *modify, destroy, move, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The population occupies 49.77 ha. Of this total area, the action will remove 3.09 ha and impact further 0.19 ha of habitat through edge effects. The action will not modify, destroy, move, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

Being a low shrub preferring an open canopy and relatively sparse shrub cover, the species is susceptible to weed invasion. Provided best practice guidelines are followed and impacts are mitigated to areas being impacted, the action is not expected to result in invasive species becoming established in *E. cannonii* habitat.

- *introduce disease that may cause the species to decline, or*

The action is not expected to introduce disease that may cause the species to die back.

- *interfere substantially with the recovery of the species*

The population occupies 49.77 ha. Of this total area, the action will remove 3.09 ha and impact a further 0.19 ha of habitat through edge effects. The action will not interfere substantially with the recovery of the species. Further vast amounts of habitat (approx. 86 ha) will be conserved via offsetting.

Conclusion

Approximately 21,088 individuals are predicted to occur within 49.77 ha of habitat that occurs in the Project Boundary and Ben Bullen State Forest. While the majority of the population will not be removed, the Project is expected to impact on an estimated 3.28 ha of habitat known to support *Persoonia marginata.* This population (comprised of three disjunct sub-populations) and its habitat is significant for the species as it represents a previously unknown, disjunct population.

The Project will not result in a significant impact to the local and overall occurrence, of *Persoonia marginata,* especially considering the 86 ha of known habitat found in offsets.

I.1.3 Fauna

i. Swift Parrot

The Swift Parrot is listed as Endangered under the EPBC Act. The parrot breeds in Tasmania only and migrates to south-eastern Australia from March to October. In NSW they are found in dry sclerophyll eucalypt forests and woodlands with a particular liking to spotted gum and swamp

mahogany forest. The species has also been found occasionally in wet sclerophyll forest vegetation. The bird is semi nomadic in winter and generally found in Victoria and New South Wales with other populations found in south-eastern Queensland. The timing of their migration causes a heavy reliance on winter flowering eucalypts: *Eucalyptus robusta, Corymbia maculata, C. gummifera, E. sideroxylon,* and *E. albens*. The species has high site fidelity and returns to sites on a cyclic basis. However, this site fidelity depends on availability of foraging resources.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of a population*

No population has been recorded in the Project Boundary. The Project Boundary provides limited suitable foraging habitat for the species due to a lack of winter flowering eucalypts. There are historic records in the area. The species is expected to use the Project Boundary from time to time for forage on a limited basis.

- *reduce the area of occupancy of the species*

The action will remove 835 ha of limited foraging habitat for the species.

- *fragment an existing population into two or more populations*

No populations have been recorded in the Project Boundary. Having a lack of suitable winter flowering eucalypts indicates the species would not rely heavily on the vegetation communities present. The action is therefore unlikely to fragment an existing population.

- *adversely affect habitat critical to the survival of a species*

The species has not been recorded during past or current surveys of the Project Boundary. The action will remove limited foraging habitat. No breeding habitat will be removed. 835 ha of limited foraging habitat will be retained. Large areas of foraging habitat are conserved in conservation in the area. The action is unlikely to adversely affect habitat critical to the survival of the species.

- *disrupt the breeding cycle of a population*

The Swift Parrot breeds only in Tasmania. Thus, the breeding cycles will not be adversely affected.

- *modify, destroy, move, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The Project Boundary is considered to provide limited foraging habitat for the species. The action will remove 835 ha of potential foraging habitat will remain in the Project Boundary. Large areas of suitable forage are conserved in national parks in the area.

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

Weed invasion is unlikely to affect the species becoming established as mature trees provide hollows for shelter and flowers for food. Weed invasion typically out-competes native species present in mid

and lower stratums. Common more aggressive birds may become established and compete for resources.

- *Introduce disease that may cause the species to decline, or*

Beak and Feather Disease is common among the Psittacidae family. Factors such as habitat alteration and diminishing food supply can increase susceptibility to the disease. The disease is spread from infected avian species via faeces, feather dust, blood and crop contents, even clothing can transfer the disease. It is unlikely that the action will introduce the diseases as the disease is spread from contact with infected carriers.

- *interfere with the recovery of the species*

The action will result in the removal of 835 ha of potential foraging habitat. This is a substantial area when considered stand alone. The Project will also retain substantial areas of potential forage habitat (787 ha). The project will reduce the availability of potential forage. Large areas of suitable habitat exist in conservation tenure in the area.

Conclusion

The action will result in the removal of 835 ha of suitable foraging habitat which likely to be used by the species from time to time.

This species is a non-breeding migrant to the mainland where it occurs in areas with abundant foraging resources. While the Project Boundary supports some flowering resources, they are unlikely to be locally significant for Swift Parrots as no favoured winter feed trees are present. The species is migratory in response to the availability of food, and is considered unlikely to be impacted by the removal of vegetation by the Project, particularly as extensive areas of similar habitat are available elsewhere in the locality.

As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Swift Parrot.

ii. Regent Honeyeater

The Regent Honeyeater is listed as Endangered and Migratory under the EPBC Act. The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. This species is also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years non-breeding flocks converge on flowering coastal woodlands and forests. West of the Great Dividing Range the species relies heavily on box-ironbark eucalypt associations and it seems to prefer wetter, more fertile sites within these associations.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of a population*

No population has been recorded in the Project Boundary. The Project Boundary supports approximately 46 ha of Box Gum Woodland or suitable habitat. Approximately 16.21 ha of suitable habitat will be removed. The remaining 30 ha will serve as habitat for the species in the Project Boundary. There are numerous historic records of the Regent Honeyeater in the area, particularly with proximity to the known Capertee Valley population. The species is expected to use the Project Boundary from time to time. The action is not expected to lead to a long term decrease in the size of the population as habitat will be retained in the Project Boundary.

- *reduce the area of occupancy of the species*

The action will remove 16.21 ha of suitable habitat for the species.

- *fragment an existing population into two or more populations*

No populations have been recorded in the Project Boundary. There are only two estimated populations remaining in NSW, which were not recorded on the Project Boundary. The action is therefore unlikely to fragment an existing population.

- *adversely affect habitat critical to the survival of a species*

The action will remove 16.21 ha of habitat for the species. The species is not considered to rely on the habitats within the Project Boundary and as such the removal of such habitat will not affect habitat critical to the survival of a species.

- *disrupt the breeding cycle of a population*

Regent Honeyeater breeding is confined to two main areas in NSW. The Project Boundary supports 46 ha of habitat suitable for the species. It is unlikely that the population in the Capertee Valley would rely on the 16.21 ha of habitat proposed for removal. Thus, the breeding cycles of this species will not be adversely affected considering 30ha of habitat will remain within the Project Boundary.

- *modify, destroy, move, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The action will remove 16.21 ha of habitat. Approximately 30 ha of habitat will remain in the Project Boundary. The action is therefore unlikely to modify, destroy, move, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

Weed invasion is unlikely to affect the species becoming established as mature trees provide hollows for shelter and flowers for food. Weed invasion typically out-competes native species present in mid and lower stratums. Common more aggressive birds may become established and compete for resources.

- *Introduce disease that may cause the species to decline, or*

It is unlikely that the action will introduce diseases that may cause the species to decline

- *interfere with the recovery of the species*

The action will result in the removal of 16.21 ha of suitable habitat. The Project will retain 30 ha habitat. The Project will reduce the availability of forage in the Project Boundary. Large areas of suitable habitat exist in conservation tenure in the area.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of 16.21 ha of suitable habitat for the Regent Honeyeater.

Given that the Regent Honeyeater is a wide-ranging migratory species, it is possible that it may forage within the Project Boundary during intense blossom periods. However, also because it is migratory, the species will be able to utilise abundant flowering resources that will still be available in the Project Boundary as 30 ha of habitat will remain on top of extensive area in conservation in the locality. As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Regent Honeyeater.

iii. Broad-headed Snake

The Broad-headed Snake (*Hoplocephalus bungaroides)* is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act. There are 8 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary, though one recent record occurs less than 1km of the Project Boundary. Therefore the species is considered to have potential to occur due to the availability of suitable forage habitat and shelter within the sandstone escarpments and vegetation below the these cliffs of the Project Boundary.

It should be noted that although only limited records of this species exist within the LGA, more are considered likely to occur as the species is cryptic and can inhabit a wide range of rock and hollow shelters that are not easily accessible for survey.

The Broad-headed Snake occurs from the coast to ranges of south-eastern Australia, where it is largely confined within an area approximately 250 km of Sydney where Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, occur. This nocturnal species inhabits rock crevices and shelters under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. During summer the species typically migrates about 200m from the sandstone escarpments to hollows in large trees. The species feeds primarily on geckos and small skinks but occasionally also eats frogs and small mammals. Broad-headed Snakes have low fecundity, producing four to 12 live young from January to March.

The Project Boundary provides suitable habitat for the species. These habitats exist as a large ridgeline containing cliff lines, escarpments and pagoda landscapes on the eastern boundary of the Project Boundary. Below this winter habitat, on both sides, suitable summer habitats occur. The action will remove approximately three-quarters of summer habitats on the western side of the ridgeline i.e. open cut mining will be set back a minimum of 50m from all cliff lines. Summer habitats will remain on the eastern side of the ridgeline beyond the Project Boundary within Ben Bullen State Forest and Wollemi National Park.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of an important population of a species*

The Project Boundary is considered to provide suitable habitat for an important population. This is because the Project Boundary is located on the western edge of its known distribution. Winter habitats will not be removed by the Project. Further, set backs of 50m for open cut operations have been implemented to further reduce the likelihood of indirect impacts to stability and winter habitats. The Project will remove areas of summer habitat below the cliff lines and escarpments. Summer habitats will be progressively removed. Vast areas of summer habitat will remain below winter habitat on the eastern side of the cliff line, beyond the Project Boundary within Ben Bullen State Forest, Wollemi National Park etc.

- *reduce the area of occupancy of an important population*

The species is known to migrate about 200m from its winter habitat to summer habitat and vice versa. The Project will progressively remove approximately three-quarters of the available summer habitat in the Project Boundary. No winter habitats will be removed. Extensive areas of summer habitats below winter habitats will remain east of the Project Boundary.

- *fragment an existing important population into two or more populations*

The closest record of the species was found less than 1 km south-east of the Project Boundary. The species would likely be restricted to areas that contain both summer and winter habitats in proximity to each other. This habitat is situated along the eastern extent of the Project Boundary. The majority of mining will occur to the west of this habitat and extend into summer habitat adjacent winter habitats. It is unlikely to fragment the existing population, particularly as suitable habitats exist further east within Ben Bullen State Forest, Wollemi National Park etc.

- *adversely affect habitat critical to the survival of a species*

The Project will remove areas of summer habitat which is considered critical to the survival of the species. No winter habitats will be removed. Extensive areas of summer habitats remain below the rocky outcrops which are located on the eastern side of the ridgelines, beyond the Project Boundary.

- *disrupt the breeding cycle of an important population*

Stages of the breeding cycle happening in winter will not be disrupted. The action has the potential to disrupt parts of the snake's breeding cycle, resulting in the reduction of summer habitats in the Project Boundary. However some limited summer habitats will remain in the Project Boundary, but more importantly vast areas of habitat will remain on the eastern side of the ridgelines.

- *modify, destroy, move, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The Project will remove three-quarters of the species summer habitat available within the Project boundary. No winter habitat will be removed. Vast areas of summer habitat will remain in the area. The action is unlikely to modify, destroy, move, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

The action has the potential to increase weed invasion in the remaining summer habitats in the Project Boundary. A change in flora species may result in a change of prey species. Large areas of intact summer habitat will remain in the surrounding area.

- *introduce disease that may cause the species to decline, or*

The Project is unlikely to introduce disease that may cause the species to decline.

- *interfere substantially with the recovery of the species*

Without the existence of vast areas of habitat remaining in the protected areas, the Project would have the potential to interfere with the recovery of the species due to the removal of summer habitat in the Project Boundary.

Conclusion

Approximately three-quarters of the species' summer habitat will be removed in the Project Boundary. A strip (at least 50m) of summer habitat will remain in the Project Boundary.

There are very few records of the Broad-headed Snake in the Lithgow LGA. All eight records are located east of the Project Boundary (one in close proximity) within large areas of protected high quality habitat within Ben Bullen State Forest, Wollemi National Park and Blue Mountains National Park. It is possible that these seven known individuals have the potential to utilise habitats within the Project Boundary; however there are also vast areas of suitable habitat within the nearby Wollemi National Park and the Blue Mountains National Park that would adequately support the small population known to occur in the LGA. The Project will reduce summer habitat available in the Project Boundary, however large areas will remain for the known populations.

The Project will not directly impact the plateaus, ridges and upper slopes, which contain the sandstone outcropping and the pagoda landscapes suitable for the Broad-headed Snake. These habitat features will be retained in the Project Boundary, and also within protected conservation areas including Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve, Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

iv. Large-eared Pied Bat

The Large-eared Pied Bat (*Chalinolobus dwyeri*) is listed as Vulnerable under both the EPBC and TSC Acts. There are 62 records of the species within Lithgow LGA (OEH 2011b). This species was tentatively recorded during current field surveys of the Project Boundary; anabat calls could not positively identify the species. As such, this species is considered to have potential to occur due to the availability of suitable forage, roosting and breeding habitat and proximity of OEH records (within several kilometres).

The Large-eared Pied Bat is an insectivorous species with poorly known population densities and distribution. It is considered to be patchily distributed from mid-Queensland to southern NSW (DECC (NSW) 2005). Little is known about the habitat requirements of the species, but natural roosts are typically dependent on extensive sandstone outcrops, cliffs and caves, and old mine workings. The species appears to prefer low to mid-elevation dry open forest and woodland close to these roost features, particularly areas containing gullies. They typically exist in small colonies consisting of less than 50 individuals and use the same cave over many years (SEWPaC 2011a).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of an important population of a species*

The Project is likely to provide roosting and foraging habitat for the species. The Project will not result in the removal of roosting habitat; however 835 ha of foraging habitat will be removed in the Project Boundary. Approximately 787 ha of foraging habitat will remain in the Project Boundary, on top of vast areas of known habitat within Wollemi National Park and Blue Mountains National Park.

- *reduce the area of occupancy of an important population*

The Project will remove 835 ha of foraging habitat.

- *fragment an existing important population into two or more populations*

Two populations are known within Wollemi National Park and Blue Mountains National Park. Further, historical records in the LGA indicate the species frequency within these parks. There are no known records west of the Project Boundary. Large areas of habitat remain in the surrounding area. It is unlikely that the Project will fragment an existing important population.

- *adversely affect habitat critical to the survival of a species*

No roosting habitat will be removed by the Project. The Project will remove 835 ha of foraging habitat within the Project Boundary. Approximately 787 ha will remain in the Project Boundary, on top of vast areas within protected national parks nearby. The Project is not expected to adversely affect habitat critical to the survival of a species.

- *disrupt the breeding cycle of an important population*

No roosting or breeding habitat will be removed. The Project has the potential to decrease the suitability of suitable habitats outside of the Project Disturbance Boundary during operation from noise, vibration and light impacts.

- *modify, destroy, move, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The Project will remove 835 ha of foraging habitat in the Project Boundary. Large areas of habitat will remain in the Project Boundary and in nearby National Parks.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

The Project has the potential to alter flora diversity. This may have the potential to alter foraging resources; however large areas will remain in the Project Boundary. It is unlikely that the Project will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.

- *introduce disease that may cause the species to decline, or*

The Project is unlikely to introduce disease that may cause the species to decline.

- *interfere substantially with the recovery of the species*

No breeding or roosting habitat will be removed. Without the existence of vast areas of habitat remaining in the Project Boundary and nearby protected reserves, the Project would have the potential to interfere with the recovery of the species due to the removal of summer habitat in the Project Boundary.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat for the Large-eared Pied Bat. This includes the removal of potential foraging habitat for this species.

This bat is cave-roosting species that tend to have large foraging ranges and can thus still forage in habitat that will remain available elsewhere in the Project Boundary and surrounding conservation areas. The long-term viability of the species in the locality is unlikely to be impacted; however as a precautionary measure, and when considered without mitigation, local populations of the Large-eared Pied Bat have potential to be significantly affected by the Project.

v. Spotted-tailed Quoll

The Spotted-tailed Quoll (*Dasyurus maculatus maculatus*) is listed as Vulnerable under the TSC Act and Endangered under the EPBC Act. There are 29 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable forage, den and breeding habitat and proximity of OEH records (within several kilometres).

The Spotted-tailed Quoll is rare across its range in south-eastern Australia. It has been recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest (Van Dyck and Strahan 2008). They require forest with suitable den site features including rock crevices, caves, large hollow logs, burrows and tree hollows (NSW NPWS 1999b). This is a nocturnal, solitary species with a large home range. Females occupy home ranges up to about 750 ha and males up to 3500 ha, and they have been known to travel more than 6km a night, usually traversing their ranges along densely vegetated creek lines (DEC (NSW) 2005j). The species hunts medium-sized reptiles and mammals including possums and rabbits, and carrion.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of a population*

The Project will remove potential foraging, den and breeding habitat for the Spotted-tail Quoll. Despite the absence of records during current and previous surveys, the Spotted-tail Quoll is considered to have potential to occur in the Project Boundary based on the availability of suitable habitat. However, this is unlikely to lead to a long-term decrease in the size of population, due to the availability of habitat remaining in the Project Boundary and within nearby connected reserves.

- *reduce the area of occupancy of the species*

The action will remove 835 ha of potential habitat for the species.

- *fragment an existing population into two or more populations*

No populations have been recorded in the Project Boundary. It is likely that a population may use the Project Boundary from time to time. There is a lack of evidence to suggest that the species relies heavily on the Project Boundary. The action is therefore unlikely to fragment an existing population.

- *adversely affect habitat critical to the survival of a species*

The action will remove 835 ha of potential habitat for the species. The species is not considered to rely on the habitats within the Project Boundary and as such, the removal of such habitat will not affect habitat critical to the survival of a species.

- *disrupt the breeding cycle of a population*

The action will remove 835 ha of potential habitat for the species, however the species is not considered to rely on the habitats within the Project Boundary for breeding. As such, the removal of such habitat will not impact the breeding cycles of this species will not be adversely affected considering large areas of habitat will remain.

- *modify, destroy, move, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The action will remove 835 ha of potential habitat. Approximately 787 ha of potential habitat will remain in the Project Boundary. The action is unlikely to modify, destroy, move, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

The Project has the potential to alter the natural flora diversity of the remaining habitat through weed invasion. This change in biodiversity could alter prey abundance and composition. Large areas of intact habitat will remain in nearby protected reserves.

- *Introduce disease that may cause the species to decline, or*

It is unlikely that the action will introduce diseases that may cause the species to decline

- *interfere with the recovery of the species*

The action will result in the removal of 835 ha of potential habitat. The Project will retain 787 ha potential habitat. The Project will reduce the availability of potential habitat in the Project Boundary. Large areas of suitable habitat exist in conservation tenure in the area.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat, potential habitat for the Spotted-tail Quoll. This includes the removal of potential foraging, den and breeding habitat for the Spotted-tailed Quoll.

The long-term viability of the species in the locality is unlikely to be impacted as the Spotted-tailed Quoll is not a frequent visitor; is highly mobile; has a large home range and naturally sparse distribution; and will be able to disperse to extensive areas of habitat elsewhere in the locality. Important den habitat in rocky outcrops and caves will not be removed by the Project, and prey species will remain available elsewhere in the locality.

As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Spotted-tailed Quoll.

I.2 Assessment of Significance (TSC Act)

The following terms have been used within the Assessments:

Local population: the population that occurs in the Project Boundary. The assessment of the local population may be extended to include individuals beyond the Project Boundary if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the Project Boundary, according to the following definitions.

The *local population* of a threatened *plant* species comprises those individuals occurring in the Project Boundary or the cluster of individuals that extend into habitat adjoining and contiguous with the Project Boundary that could reasonably be expected to be cross-pollinating with those in the Project Boundary.

The *local population* of *resident fauna* species comprises those individuals known or likely to occur in the Project Boundary, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the Project Boundary.

The *local population* of *migratory or nomadic fauna* species comprises those individuals that are likely to occur in the Project Boundary from time to time.

I.2.1 Ecological Communities

i. Box-Gum Woodland

White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Woodland and Derived Grasslands) is listed as an Endangered Ecological Community (EEC) under the TSC Act.

Capertee Rough-barked Apple, Red Gum, Yellow Box Woodland conforms to the TSC Act listing as it meets the following determining criteria:

- Falls within the area defined in the NPWS Scientific Determination for Box Gum Woodland EEC;

- Contains, or historically was likely to support, at least one of the characteristic canopy tree species White Box, Yellow Box or Blakely's red gum;
- Supports a predominantly grassy understorey; and
- Is in good condition and there is potential for assisted regeneration in all areas containing Blakely's Red Gum.

Current vegetation mapping indicates that an area of the Project Boundary conforms to the TSC Act. Thus, approximately 1.96 ha of this community is potentially found within Project Boundary. An estimated 1.96 ha of Box-Gum Woodland is proposed to be impacted by the Project.

Box-Gum Woodland and Derived Grasslands was once a widespread and floristically diverse community that extended from Victoria to Queensland. In NSW the community is found on relatively fertile soils on the tablelands and western slopes which are preferred landscapes for agriculture; as a result, most of the community was historically cleared. It now exists as isolated and fragmented remnant paddock trees or patches with reduced structural complexity and little evidence of regeneration (NSW DECCW, 2010). This community now supports a low diversity of flora and fauna species.

Historically, the community was a floristically diverse complex of communities that occupied a range of landscape positions on a gradation of semi-fertile to fertile soils. These communities are dominated by one or a combination of the following pure or intergrade tree species: *Eucalyptus albens* (White Box), *E. melliodora* (Yellow Box) and *E. blakelyi* (Blakely's Red Gum). The understorey is characterised by native grasses and wild flowers.

> *(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*

Not applicable to ecological communities.

> *(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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

And

(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, and

(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

(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

The Project Boundary lies within the known range of Box-Gum Woodland. Due to the already reduced extent and degraded nature of this community, and as the community remains poorly represented in the national conservation reserve system (being situated largely on fertile, arable land), the conservation of remaining remnants are critical to the recovery of the community. As a result, any clearance of Box-Gum Woodland is considered likely to result in a significant loss of the community within the locality and adversely impact on overall conservation efforts.

Box-Gum Woodland has suffered a large decline in the past and remaining remnants (an estimated 250,729 hectares (NSW DECCW, 2010)) and this community is recognised to be under continued threat from further land clearing due to ongoing land use for agriculture, horticulture, urban expansion and public infrastructure (NSW DECCW, 2010). The removal of EEC may also introduce edge effects and exacerbate weed and feral animal invasion. As remnant patches become more fragmented and isolated, they become even less resilient to damaging forces and will require active management to counter the effects of continued degradation.

Box-Gum Woodland is recognised to be highly fragmented across its former range. Approximately 1.96 ha of this grassland community is proposed to be removed which will reduce the overall extent of the community in the locality by a minuscule amount.

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

No critical habitat for Box-Gum Woodland has been identified by the Director-General of OEH under the TSC Act.

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

Commonwealth conservation advice for this ecological community was prepared by the Threatened Species Scientific Community in 2006.

A Draft National Recovery Plan has been prepared for the (C)EEC White Box – Yellow Box – Blakely's Red Gum grassy Woodland and Derived Native Grassland (Box-Gum Grassy Woodland as listed under EPBC Act legislation). The Plan considers the conservation requirements of the ecological

community across its known range and identifies actions to be undertaken to ensure the long-term viability of the ecological community.

Twenty-nine priority actions have been identified to promote the recovery of this ecological community and the abatement of key threatening processes affecting its occurrence.

The Project is therefore inconsistent with these plans and priority actions.

(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

The following Key Threatening Processes are relevant to Box-Gum Woodland:

- Clearing of native vegetation, as this directly removes and reduces the extent of this ecological community, reduces the area of forage and nesting habitat available for various flora and fauna species, and correlated to a general decline in biodiversity;
- Loss of hollow-bearing trees, as this directly removes remnant trees of this community and reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees, as this removes structural components of the community and reduces the abundance of important ground foraging and nesting habitat;
- Invasion and establishment of exotic vines and scramblers as this impacts on the community structure and increases competition;
- Invasion of native plant communities by exotic perennial grasses as this impacts regeneration capabilities and results in loss of structural complexity and of key food plants and habitat;
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands as this can significantly reduce the ecological function of the community;
- Degradation of native riparian vegetation along NSW water courses as this removes and alters the community;
- Competition and grazing by the feral European rabbit *Oryctolagus cuniculus* as they alter the structure and composition of vegetation, and degrade the land;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project will result in the direct loss of 1.96 ha of Box- Gum Woodland Derived Native Grassland. Further degradation of the remaining areas of this community is expected without active management. The community is recognised to have suffered a large reduction in extent through past clearing. The

Project is no considered likely to have a significant impact on the long-term viability of the community in the locality by further fragmenting remaining Box-Gum Woodland. This will also directly and indirectly affect a range of flora and fauna, including threatened species, by removing potential foraging, roosting and breeding habitat.

As approximately 1.96 ha of Capertee Rough-barked Apple – Red Gum – Yellow Box Woodland Derived Native Grasslands are proposed to be removed, the Project is not expected to have a significant impact on this listed community that conforms to the legislated definition for Box-Gum Woodland under the TSC Act.

I.2.2 Threatened Flora

*i. Eucalyptus cannonii (*Capertee Stringybark*)*

The Capertee Stringybark *(Eucalyptus cannonii*) is listed as Vulnerable under both the TSC Act and EPBC Act. There are 129 records of the species within Lithgow LGA (OEH 2011b). This species has been recorded during previous and current field surveys and occurs sporadically over much of the Project Boundary.

The Capertee Stringybark is a tree restricted to an area of approximately 100 km by 60 km in the central tablelands of NSW, where it is known from 55 locations. The western border aligns generally with between Bathurst and Mudgee, while the eastern locations occur approximately between Lithgow and the town of Bylong. Within this area the species is often locally frequent (DEC (NSW), 2005a). Seed viability appears to be high and seed is spread by wind or gravity, generally in close proximity to the parent plant (<30m). The altitude range of *Eucalyptus cannonii* is from approximately 460 m to 1040 m (DEC (NSW), 2005a). The species mostly occurs on rocky, usually poor, steep ridges in dry sclerophyll forest, although it can also be found in valleys and on gentle slopes (Threatened Species Scientific Committee , 2008a), but less commonly on valley floors (DEC (NSW), 2005a).

Associated tree species include Red Stringybark (*E. macrorhyncha*), Thin-leaved Stringybark (*E. eugenioides*), Red Box (*E. polyanthemos*) and Scribbly Gum (*E. rossii*). On the intermediate slopes there may also be Narrow-leaved Red Ironbark (*E. crebra*), *E. blakelyi*, *E. melliodora*, *E. bridgesiana*, *E. dalrympleana* and *E. viminalis,* whilst on the on lower slopes it may occur with *E. mannifera* subsp. *praecox*, *E. laevopinea*, *E. oblonga*, *E. sparsifolia*, *E. dives* and *E. goniocalyx.* On rocky areas *Angophora intermedia* has been recorded co-existing. *E cannonii* is also known to hybridise with *E. macrorhyncha.* (Threatened Species Scientific Committee , 2008a).

The species has undergone a significant decline in distribution. Population sizes now vary from stands of a few scattered trees in paddocks and along roadsides to over 6,000 individuals in Winburndale Nature Reserve (Hunter 1998).

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

The Project will remove a significant number of *E. cannonii* estimated to occur in the Project Boundary and suitable habitat for the species.

However, the viability of the local population is not expected to be greatly reduced as a large number of individuals, ranging from seedlings to mature remnant trees, will remain within the Project Boundary

and continue to reproduce. Seed viability and natural propagation of the species is high; seeds are spread by wind or gravity, generally in close proximity to the parent plant (<30m) (NPWS 2000).

Appropriately timed fire regime of suitable intensity is important to the maintenance of the life cycle of this species by encouraging natural regeneration. The Project is not expected to increase the likelihood of fire events; however it may decrease the likelihood of fire which may impact on regeneration capabilities such that in the short term, populations consist of mainly mature or senescent plants. However, natural regeneration at disturbed sites is still likely as it has been shown that the proportion of immature plants increases in disturbed areas. This corresponds to the species' seed viability and ability to re-establish from the soil or canopy seed bank.

The Project will reduce the current abundance and distribution of *E. cannonii* in the locality; however it will not place the local population 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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

> *(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, and*
>
> *(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*
>
> *(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, and*

Approximately 37,602 *E. cannonii* individuals are predicted to occur within the Project Boundary. Of these, an estimated 19,219 individuals occur within the Project Disturbance Boundary.

Numbers were estimated by multiplying a count of the species recorded in each quadrat to provide an estimate of density per hectare. A count of *E. cannonii* individuals was estimated by multiplying the average density per hectare by the area of each vegetation community, with the tree present, in the Project Boundary and within the Project Disturbance Boundary. A total of 908 ha of known and potential habitat have been calculated to occur within the Project Boundary.

The Project will remove approximately 51% of *E. cannonii* individuals in the Project Boundary. This is considered to be a significant impact to the overall distribution and abundance of the species,

particularly as population sizes are typically small and comprised of remnant scattered trees. As specified in the NPWS Environmental Impact Assessment Guidelines (2000), considering the species' current distribution and area of remaining habitat, any habitat supporting a population of this species should be considered significant.

From records of conservation reserves, *E. cannonii* is present in lower numbers than those estimated to occur in the Project Boundary; the total reserved population is estimated to exceed 20,000 plants in at least 14 separate populations. *E. cannonii* is present in Winburndale Nature Reserve (Hunter 1998), Avisford Nature Reserve, Wollemi National Park and Gardens of Stone National Park. Over 6,000 individuals are estimated to occur in Winburndale Nature Reserve, which is considered the largest population (Hunter 1998). This is substantially less than the estimated 37,602 *E. cannonii* individuals predicted to occur within the Project Boundary.

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

No critical habitat for *E. cannonii* has been identified by the Director-General of OEH under the TSC Act.

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

SEWPaC has identified a number of regional and local priority actions to promote the recovery of *E. cannonii* and the abatement of key threatening processes affecting its occurrence.

The Gardens of Stone National Park Draft Plan of Management (DEC, 2004), and the Winburndale Nature Reserve Draft Plan of Management (DEC, 2005) are existing plans and have management prescriptions relevant to *E. cannonii*.

> *(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*

Land clearing and open-cut coal mining are considered the primary threats to *E. cannonii*. Inappropriate fire regimes (frequent fires); agriculture and grazing; logging; genetic and stochastic threats, such as disease; and population isolation are also serious threats to this species.

Conclusion

The Project is proposed to remove a calculated 278 ha of known and potential habitat for *E. cannonii.* This includes areas known to contain individuals, and areas of habitat that provide suitable habitat in which the species has potential to occur. The Project will remove an estimated 51% of *E. cannonii* known to occur within the Project Boundary. While over 18,382 individuals will remain within the Project Boundary, the removal of an estimated 19,219 individuals is a significant reduction in the population of this threatened species.

Without mitigation measures and compensatory measures, the Project will result in a significant impact to the local and overall occurrence, of *Eucalyptus cannonii.*

ii. Persoonia marginata (Clandulla Geebung)

Persoonia marginata (Clandulla Geebung) is listed as Vulnerable under both the TSC Act and EPBC Act. There are 29 records of the species within Lithgow LGA (OEH 2011b). This species was recorded during current field surveys.

Persoonia marginata is a decumbent shrub that grows to 20-60cm and has yellow flowers. It is known from disjunct populations on the central tablelands and central coast of NSW (DEWHA 2008 conservation advice, DECC, 2005). The species occurs within the Central West, Hawkesbury–Nepean and Hunter–Central Rivers (NSW) Natural Resource Management Regions (DECC, 2005). The core of its distribution is within Clandulla State Forest, with four disjunct populations occurring to the north at Dingo Creek and Mount Dangar within the Wollemi and Goulburn River National Parks; to the south within Ben Bullen State Forest, south-east of Capertee; and to the south-east at Devils Hole within the Parr State Recreation Area (DECC, 2005).

Persoonia marginata is known to inhabit dry sclerophyll forest and woodland on low ridges of sandstone and heavy clay or gravelly loams derived from Permian geologies at altitudes of approximately 700m. Commonly occurring co-dominant canopy species include *Eucalyptus punctata, E. sparsifolia, E. rossii, E. fibrosa* and *E. crebra*. The understorey is typically shrubby with a medium density, and the grassy understorey is of low to medium density (DEWHA, 2008).

The species appears to respond well to disturbance, with greater densities found along the edges of tracks and in areas disturbed by forestry activities (DECC, 2005).

> *(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*

Prior to current surveys, *Persoonia marginata* was known from only four disjunct locations on the Central Tablelands and Central Coast (DEC (NSW), 2005). Two of these disjunct populations occur close to the Project Boundary, within the Wollemi National Park and within Ben Bullen State Forest (DEC (NSW), 2005c) and Gardens of Stone. Known populations have been recorded to date on flat ground within dry sclerophyll forest and woodland on sandy loam, clayey, and/or rocky soils derived from Permian rock (Threatened Species Scientific Committee , 2008b).

A new population was recorded at three locations within the Project Boundary and is estimated to comprise of approximately 21,088 individuals, as three subpopulations. The Project will impact approximately 3.28 ha of habitat known to support *Persoonia marginata.* The individuals recorded in the Project Boundary form part of a previously unknown population, and while the Project will reduce the current abundance and distribution of *Persoonia marginata* in the locality, it will not place the local population at risk of extinction as it is spread over three subpopulations and the majority of individuals will not be removed.

The 4 known, disjunct populations will not be impacted by the Project, or their life cycle adversely affected. These populations will continue to be able to regenerate naturally. Although few seedlings have been seen in natural populations (Blombery & Maloney, 1992), the species has a persistent soil seed bank (DECC, 2005). Fruit is likely to be dispersed by large birds such as currawongs and large mammals such as kangaroos and possums (DECC, 2005).

(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

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

(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

Not applicable to threatened species.

(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, and

(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

(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, and

The Project is expected to impact on approximately 3.28 ha of habitat for this species through direct and indirect impacts. Portions of the Project Boundary represent significant habitat for *Persoonia marginata* as it supports a previously unknown population of the species.

A new population was recorded at three locations within the Project Boundary. These three subpopulations occur: (1) in the north of the approved footprint of Cullen Valley Mine (but within the Cullen Valley Mining Exclusion Zone), which extends beyond the Project Boundary into Ben Bullen State Forest; (2) within Cullen Valley Mine's existing Habitat Compensation Area no. 5; and (3) in the northern extent of the Project Boundary to the east of occurrence found within the approved Cullen Valley Mine footprint.

The total size of the *Persoonia marginata* population is estimated at approximately 21,088 individuals occurring within approximately 49.77 ha of habitat within the Project Boundary and the neighbouring Ben Bullen State Forest. Of this significant population, approximately 16.27 ha occur within the Project Boundary, the majority of the occurrence belonging to the Cullen Valley Mine subpopulation.

Examination of the geological profile at each subpopulation occurrence suggests that this population is closely associated with the Upper Irondale Seam, which is comprised of coal, oil shale, minor shale and sandstone; and the Irondale Seam, which contains coal and minor shale. The populations were rarely found above these seams within the skeletal sandstone soil along the plateaus or at lower landscape positions such as in gullies containing deeper wetter soils. The population may also be strongly influenced by aspect, with individuals in the Project Boundary subpopulations recorded exclusively on western slopes and none on eastern slopes. All three subpopulations were also recorded on sloping and relatively flat land facing west in dry sclerophyll forest or woodland with a

sparse understorey. The vegetation in which these subpopulations have been recorded has been classified as Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Forest.

Of the total 49.77 ha of habitat, 3.28 ha of the southern portion of the North-eastern subpopulation will be impacted by the Project. This will include the removal of approximately 3.09 ha of habitat that will be directly impacted and a further 0.19 ha of habitat that is expected to be indirectly affected by secondary impacts of habitat removal such as edge effects.

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

No critical habitat for *Persoonia marginata* has been identified by the Director-General of OEH under the TSC Act.

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

SEWPaC has identified a number of regional and local priority actions to promote the recovery of *Persoonia marginata* and the abatement of key threatening processes affecting its occurrence.

It has also identified existing plans and management prescriptions that are relevant to *Persoonia marginata:*

- Wollemi National Park Fire Management Strategy (DEC, 2005) and Management Plan (NSW NPWS, 2001a);
- Goulburn River National Park Fire Management Plan (DEC, 2004) and Management Plan (NSW NPWS, 2003a);
- Parr State Conservation Area Plan of Management (NSW NPWS, 2001b) and Fire Management Strategy (NSW NPWS, 2003b); and
- Threat Abatement Plan for Dieback Caused by the Root-Rot Fungus *Phytophthora cinnamomi* (EA, 2001).

(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

Habitat loss and degradation due to forestry activities, road/trail construction and maintenance, recreational activities, frequent fire, weed invasion (DECC, 2005) and spread of fungal pathogens (NSW NPWS, 2000) are considered the primary threats to *Persoonia marginata*.

Conclusion

Approximately 21,088 individuals are predicted to occur within 49.77 ha of suitable habitat that occurs in the Project Boundary and Ben Bullen State Forest. While the majority of the population will not be removed, the Project is expected to impact on an estimated 3.28 ha of habitat known to support *Persoonia marginata.* This population (comprised of three subpopulations) and its habitat is significant for the species as it represents a previously unknown, disjunct population.

The Project will not result in a significant impact to the local and overall occurrence, of *Persoonia marginata.*

I.2.3 Threatened Insects

i. Bathurst Copper Butterfly (Paralucia spinifera)

The Bathurst Copper Butterfly (*Paralucia spinifera*) is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act. There are 88 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary. It is considered to have some potential to occur based on proximity of existing OEH records and due to the limited availability of suitable habitat in the form of *Bursaria spinosa* subsp. *lasiophylla.*

The Bathurst Copper Butterfly occurs on the Central Tablelands of NSW at elevations greater than 900m. The species is found at 35 locations within an area approximately bounded by Oberon, Hartley and Bathurst, although more locations are likely. Habitat requirements include vegetation structure of open eucalypt woodland or open forest with a sparse understorey dominated by the shrub Blackthorn (*Bursaria spinosa* subsp. l*asiophylla)* on which larvae depend for food and from which adults are rarely observed more than 10m away from the plant. Known habitat sites are south-west to north-west facing aspects where direct sunlight reaches the habitat, and with cold extremes, including regular snowfalls or heavy frosts. The species emerge between August and November with a two-week peak of activity in September. Eggs are laid on or in the immediate vicinity of Blackthorn and hatched larvae are attended by the ant *Anonychomyra itinerans* in a mutualistic relationship. Pupation occurs between December and August in the ants' underground nest at the base of the host plant.

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

The Project will not remove potential forage and breeding habitat suitable for the Bathurst Copper Butterfly as no suitable habitat was recorded in the Project Boundary. The Project is not considered likely to affect the life cycle of the species such that a viable local population will be placed at risk of extinction.

During habitat assessments, no Blackthorn (*Bursaria spinosa subsp. lasiophylla)* shrubs, food critical to the lifecycle of the Bathurst Copper Butterfly, were observed on south-west or north-west aspects above 850m. As the species relies on this specific habitat the Project Boundary indicates a low likelihood of the butterflies occurring.

> *(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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

(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, and

(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

(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, and

No suitable habitat was recorded in the Project Boundary.

According to NSW Atlas records, the closest records of the Bathurst Copper Butterfly to the Project Boundary are approximately 5km away at the Pinedale Mine. This record represents the northern limit of the species' known distribution within the Lithgow LGA.

The species has a specific set of habitat requirements which renders much of the habitat within the Project Boundary unsuitable. Land which has a north-east to south-east aspect and habitat under 850 m elevation can typically be discounted as offering suitable habitat. Blackthorn, a feed tree critical to the lifecycle of the species, has been recorded on east facing slopes during field surveys of the Project.

Due to the lack of suitable habitat containing all of the elements required by the species and no records of individuals during field surveys, the Project Boundary is not considered to form core habitat for a local population. This species has low dispersal capabilities and is unlikely to recolonise isolated habitat fragments. However, as the species is not considered likely to occur within the Project Boundary, the removal of patches of native vegetation that do not contain Blackthorn is not considered likely to fragment or isolate habitat for this species. The long-term genetic viability of the Bathurst Copper Butterfly in the region will not be reduced as known populations and habitat locations will not be affected by the Project.

Despite the proposed removal of woodland and open forest, extensive areas of vegetation will remain in the Project Boundary (787 ha of treed habitat) and the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

The Project is not expected to have a significant impact on the Bathurst Copper Butterfly.

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

No critical habitat for the Bathurst Copper Butterfly has been identified by the Director-General of OEH under the TSC Act.

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

The Recovery Plan for the Bathurst Copper Butterfly (*Paralucia spinifera)* 2001-2006 was prepared by the NSW National Parks and Wildlife Service and Environment Australia in June 2001.

OEH has identified 21 priority actions to promote the recovery of the Bathurst Copper Butterfly in New South Wales and the abatement of key threatening processes affecting its occurrence.

(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

The TSC Act does not list specific key threatening processes that affect the Bathurst Copper Butterfly. However, the Recovery plan identifies clearing of habitat (associated with grazing by stock or feral animals, development or land use activities), isolation of habitat, weed invasion, inappropriate fire regimes, disturbance to soils and vegetation by feral animals, loss of attendant ant, and dust generated by traffic as threats to the species.

Conclusion

No suitable habitat was recorded in the Project Boundary. A combination of habitat requirements, restricted dispersal capabilities and a lack of known populations within the vicinity of the Project are considered, the species is not considered likely to occur within the Project Boundary. As such, the Project is not considered likely to have a significant impact on the local occurrence of the Bathurst Copper Butterfly.

I.2.4 Threatened Woodland Birds

- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- Diamond Firetail (*Stagonopleura guttata*);
- Flame Robin (*Petroica phoenicea*);
- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*);
- Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*);
- Hooded Robin (*Melanodryas cucullata cucullata*);
- Scarlet Robin (*Petroica boodang*);
- Speckled Warbler (*Pyrrholaemus saggitatus);*
- Superb Parrot (*Polytelis swainsonii*);
- Turquoise Parrot (*Neophema pulchella*); and
- Varied Sittella (*Daphoenositta chrysoptera*).

i. Brown Treecreeper (eastern subspecies) (Climacteris picumnus victoriae)

The Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) is listed as Vulnerable under the TSC Act. There are 67 records of the species within Lithgow LGA (OEH 2011b). This species was recorded during current field surveys of the Project Boundary.

The Brown Treecreeper is an insectivorous woodland species endemic to eastern NSW. They are a sedentary species most commonly found in open woodlands and dry forest with an open grassy

understorey for foraging, and in grasslands with scattered mature trees (Birds Australia, 2011; Garnett & Crowley, 2000). Suitable nesting and foraging habitat typically contains a high abundance of important habitat components such as fallen timber, hollows in stags and live trees (NSW Scientific Committee, 2004l; Garnett & Crowley, 2000). The species is dependent on the availability of small tree hollows for nesting, and as such, prefers patches of remnant vegetation which contain trees of hollow-bearing age of at least 150 years old. Home ranges for this species typically range from 1.1 ha to 10.7 ha.

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

The Project will remove known and potential forage and breeding habitat for the Brown Treecreeper. This is likely to have a short-term effect on the life cycle of individuals known to occur within the Project Boundary (the local population); however it is unlikely to place the local population at risk of extinction.

Despite the area of woodland and open forest proposed to be removed, the species will be able to disperse to large extents of suitable habitat that will remain with the Project Boundary. These areas will continue to provide important forage, nesting and breeding habitat features for the species including structurally intact habitat and complexity.

> *(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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

> *(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, and*
>
> *(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*
>
> *(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, and*

The Project lies within the known distributional range of the Brown Treecreeper. The species was recorded during current field surveys of the Project Boundary, which indicates that habitat within the Project Boundary may form part of the territorial range of at least one pair.

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes known and potential foraging, breeding and nesting habitat for local populations of the Brown Treecreeper. Based on field observations, the Project is likely to displace a resident population of Brown Treecreepers. This has potential to impact on local population dynamics in the short-term, most likely by affecting the emigration and nest relocation of some individuals.

However, the long-term viability of the species is not likely to be impacted and the Project is unlikely to place the local population or species at risk of extinction. Despite the species' sedentary nature, they are capable of dispersing across treed landscapes and are able to maintain viable populations in areas of habitat that are at least 300 ha (DECC (NSW) 2007); the areas of habitat that will remain within the Project Boundary alone are 787 ha and contain important habitat features for the Brown Treecreeper such as hollows and woody ground debris.

Extensive areas of surrounding habitat make it unlikely that the Project will affect connectivity or inhibit fauna movement and dispersal of this species within the wider locality. Connectivity will remain within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Brown Treecreeper has been identified by the Director-General of OEH under the TSC Act.

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

Recovery plans have not been prepared for the Brown Treecreeper. No threat abatement plans are relevant to this species. Seven recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

> *(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*

The following Key Threatening Processes are relevant to the Brown Treecreeper:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Competition and grazing by the feral European rabbit *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk;

- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources;
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland habitat. This includes the removal of known and potential foraging, nesting and breeding habitat for locally occurring populations of the Brown Treecreeper. This is likely to result in the short-term displacement of some individuals; however it will not result in long-term, adverse impacts to the species. The Brown Treecreeper is a woodland bird likely to occur elsewhere in the locality and despite the proposed removal of vegetation associated with the Project, extensive areas of good quality habitat will still be available elsewhere within the Project Boundary and in surrounding conservation areas.

Without mitigation measures, and as a precautionary approach, the Project is considered likely to have a significant impact on the local occurrence of the Brown Treecreeper.

ii. Diamond Firetail (Stagonopleura guttata)

The Diamond Firetail (*Stagonopleura guttata*) is listed as Vulnerable under the TSC Act. There are 99 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable grassy woodland habitat.

The Diamond Firetail is a woodland species endemic to south-eastern Australia with scattered distribution in NSW (NSW Scientific Committee, 2010f). This species occurs predominantly west of the Great Dividing Range, although populations are known from drier coastal areas such as the Cumberland Plain of western Sydney and the Hunter, Clarence, Richmond and Snowy River valleys. They are a mainly sedentary, ground-foraging species most commonly found in or on the edge of lightly timbered open eucalypt forest and woodlands including box-ironbark and casuarina associations (NSW Scientific Committee, 2010f). They also occur in farmland and grassland with remnant trees and a sparse understorey, and along watercourses (Birds Australia, 2011). The species nests and roosts mainly in dense shrubs.

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

The Project will remove potential foraging, nesting and breeding habitat for the Diamond Firetail. However, it is considered unlikely to have an adverse effect on the life cycle of potentially occurring individuals or place a viable local population at risk of extinction.

This species has not been recorded in the Project Boundary despite multiple field surveys. The species has potential to occur as suitable habitat in the form of woodland and open forest with grassy

understorey is available in the Project Boundary. However, the Project Boundary is considered unlikely to currently support a local population of Diamond Firetails. As such, the Project is considered unlikely to displace or otherwise impact on population dynamics within the locality.

In general, the species is vulnerable to fragmentation and genetic isolation due to its sedentary nature, and dispersal capacity is restricted to local movements (Lindenmayer and Cunningham 2011). Despite the area of woodland and open forest proposed to be removed, the species will be able to disperse to large extents of suitable habitat that will remain within the Project Boundary. These areas will continue to provide important forage, nesting and breeding habitat features for the species including structurally intact habitat and complexity. Surrounding conservation areas will continue to support any local populations which require areas of remnant native vegetation larger than 200ha (NSW Scientific Committee 2004a) to remain viable.

> *(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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

> *(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, and*
>
> *(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*
>
> *(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, and*

The Project lies within the known distributional range of the Diamond Firetail. The species has not been recorded during field surveys of the Project Boundary, but has potential to occur.

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes suitable forage, breeding and nesting habitat for the Diamond Firetail.

Due to a lack of observations despite multiple surveys, resident populations are not expected to occur within the Project Boundary. As such, the Project is considered unlikely to lead to social consequences such as smaller group size; reduced breeding success and nesting success; or place the local population at risk of extinction. Any local populations that do occur are considered to have a high capacity to disperse and successfully relocate to adjacent habitat due to the proximity of habitat within the Project Boundary that will not be removed and that contain important habitat features required by the Diamond Firetail such as woody ground debris.

Extensive areas of habitat suitable for this species will also remain available within both the Project Boundary and the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Diamond Firetail has been identified by the Director-General of OEH under the TSC Act.

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

Recovery plans have not been prepared for the Diamond Firetail. No threat abatement plans are relevant to this species. Eight recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Diamond Firetail:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of suitable forage, nesting and breeding habitat for the Diamond Firetail.

This species has not been recorded during field surveys but has potential to occur within the Project Boundary and elsewhere in the locality based on the availability of suitable habitat. Despite the proposed removal of vegetation associated with the Project, extensive areas of good quality habitat will still be available elsewhere within the Project Boundary and surrounding conservation areas.

The Project is considered unlikely to have a significant impact on the local occurrence of the Diamond Firetail.

iii. Flame Robin (Petroica phoenicea)

The Flame Robin (*Petroica phoenicea*) is listed as Vulnerable under the TSC Act. There are 57 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable grassy woodland habitat.

The Flame Robin is a small, insectivorous bird found in a broad coastal band across the south-east corner of the Australian mainland and in Tasmania (Birds Australia, 2011). In NSW it breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains. The species forages on the ground for insects and arthropods and forages in scattered flocks in non-breeding seasons. They construct small cup nests in tree cavities or rock faces.

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

The Project will remove potential foraging, nesting and breeding habitat for the Flame Robin. However, it is considered unlikely to have an adverse effect on the life cycle of individuals potentially occurring in the Project Boundary or place a viable local population at risk of extinction.

This species has not been recorded during field surveys but has potential to occur as suitable habitat in the form of woodland and open forest with grassy understorey and ground debris is available in the Project Boundary. Despite the area of woodland and open forest proposed to be removed, the species will be able to disperse to extensive areas of adjacent habitat that will remain with the Project Boundary. These remaining habitat areas will continue to provide important habitat features for the Flame Robin including trees and rock cavities for nesting and an open understorey that supports foraging activities.

> *(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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

(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

Not applicable to threatened species.

(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, and

(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

(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, and

The Project lies within the known distributional range of the Flame Robin. The species has not been recorded during field surveys of the Project Boundary, but has potential to occur.

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes suitable forage, breeding and nesting habitat for the Flame Robin.

Due to a lack of observations despite multiple surveys, local winter-populations are not expected to occur within the Project Boundary. As such, the Project is considered unlikely to lead to social consequences such as smaller group size; reduced breeding success and nesting success; or place the local population at risk of extinction. The Project is unlikely to result in a loss of connectivity due to the proximity of similar, extensive habitat elsewhere within the Project Boundary that will not be removed. Any local populations that do occur are considered to have a high capacity to disperse to this adjacent habitat and successfully relocate due to the presence of important features required by the Flame Robin such as woody ground debris and small tree hollows.

Extensive areas of habitat suitable for this species will also remain available in the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest. It is thus considered that the Project will not place the species at risk of extinction.

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

No critical habitat for the Flame Robin has been identified by the Director-General of OEH under the TSC Act.

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

Recovery plans have not been prepared for the Flame Robin. No threat abatement plans are relevant to this species. Three recommended actions have been identified to promote the recovery of this population and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Flame Robin:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Competition and grazing by the feral European rabbit *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of suitable forage, nesting and breeding habitat for the Flame Robin.

This species has not been recorded during field surveys but has potential to occur within the Project Boundary and elsewhere in the locality based on the availability of suitable habitat and the species' irregular migratory movements. Despite the proposed removal of vegetation associated with the Project, the species has a high capacity for dispersal and can relocate to extensive areas of good quality habitat that will still be available elsewhere within the Project Boundary and surrounding conservation areas.

The Project is considered unlikely to have a significant impact on the local occurrence of the Flame Robin.

iv. Gang-gang Cockatoo (Callocephalon fimbriatum)

The Gang-gang Cockatoo (*Callocephalon fimbriatum*) is listed as Vulnerable under the TSC Act. There are 229 records of the species within Lithgow LGA (OEH 2011b). This species has been

recorded during surveys of the Project Boundary on a number of occasions. Suitable forage, nesting and breeding habitat is available within the Project Boundary.

The Gang-gang Cockatoo is endemic to south-eastern Australia, with distribution along the coast and tablelands of NSW. The species breed in heavily timbered and mature wet sclerophyll mountain forests (DEC (NSW), 2005f)(DEC (NSW) 2005e), then migrate to open forest and woodland such as box-ironbark in the lower valleys and coastal regions for the winter (Schodde and Tidemann 1986, NSW Scientific Committee 2005). They form close monogamous pairs with high nest fidelity and often breed semi-colonially where densities are high. Breeding usually occurs in tall mature sclerophyll forests that have a dense understorey (DEC (NSW), 2005f)(DEC (NSW) 2005e) and nest territories range from 7-22km^2. The Gang-gang Cockatoo feeds primarily on the seeds of native shrubs and trees, including eucalypts, acacias and cypress pine (Schodde and Tidemann, 1986).

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

The Project will remove known and potential forage and breeding habitat for the Gang-gang Cockatoo. This is likely to have a short-term effect on the life cycle of some individuals known to occur within the Project Boundary (the local population); however it is unlikely to place the local population at risk of extinction.

Despite the area of woodland and open forest proposed to be removed, the species will be able to disperse to large extents of suitable habitat that will remain with the Project Boundary. These remaining areas will continue to provide important forage, nesting and breeding habitat features for the species including structurally intact habitat and complexity.

(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

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

(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

Not applicable to threatened species.

(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, and

(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

(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, and

The Project lies within the known distributional range of the Gang-gang Cockatoo. The species has been recorded on multiple occasions from a number of field surveys within the Project Boundary. During current surveys, groups of up to 4 individuals were observed at any one time. This indicates that habitat within the Project Boundary forms part of the territorial range of a local, semi-colonially breeding population. The majority of field records within the Project Boundary were from during the October 2009 survey, where individuals were observed examining hollows in tall trees. This suggests that suitable breeding habitat is present in the Project Boundary and that the species may occupy the Project Boundary, primarily in Spring and Summer months when breeding occurs.

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes known and potential forage, breeding and nesting habitat for local populations of the Gang-gang Cockatoo. Based on frequent field observations of a number of individuals, the Project is likely to displace a resident breeding population of Gang-gang Cockatoos. This has the potential to impact on local population dynamics in the short-term by reducing breeding and nesting success, particularly as the species shows high nest fidelity. Despite the availability of extensive adjacent habitat and dispersal capacity of the species, clearance and forced emigration may affect the short-term capacity of some individuals to successfully relocate depending on the availability of suitable tree hollows and likely inter and intraspecific competition. However, these are not considered likely to result in long-term impacts that would place the local population at risk of extinction.

Most of the local population is expected to have the capacity to disperse and successfully relocate to remaining areas of connected, good quality habitat (787 ha) within the Project Boundary. Extensive areas of surrounding habitat will facilitate movement of this species within the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Gang-gang Cockatoo has been identified by the Director-General of OEH under the TSC Act.

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

The “Threat Abatement Plan for Beak and Feather Disease affecting endangered psittacine species” is relevant to the Gang-gang Cockatoo. The Project is unlikely to increase the likelihood of extinction or escalate the threatened status of psittacine birds and is therefore consistent with the objectives of this plan.

(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

The following Key Threatening Processes are relevant to the Gang-gang Cockatoo:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;

- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Infection by *Psittacine Circoviral* (beak and feather) Disease affecting endangered psittacine species and populations as this can lead to a severe reduction in populations;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources;
- Predation by the feral cat (*Felis catus*) as this directly reduces species abundance, particularly as they predate on nests and nesting females; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of known and potential forage, nesting and breeding habitat for local Gang-gang Cockatoo populations.

The Gang-gang Cockatoo is a woodland bird likely to occur elsewhere in the locality and extensive areas of good quality habitat will still be available within the Project Boundary and surrounding conservation areas. However, the proposed removal of vegetation associated with the Project is likely to result in the displacement of some individuals and short-term impacts to nesting and breeding success.

Without mitigation, the Project is considered likely to have a significant impact on the local occurrence of the Gang-gang Cockatoo.

v. Glossy Black-Cockatoo (Calyptorhynchus lathami)

The Glossy Black-Cockatoo (*Calyptorhynchus lathami*) is listed as Vulnerable under the TSC Act. There are 88 records of the species within Lithgow LGA (OEH 2011b). This species has not been

recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable habitat and the proximity of existing OEH records.

The Glossy Black-Cockatoo was previously widely distributed across most of south-eastern Australia (Higgins 1999). In NSW the species now has patchy distribution along the coast and tablelands in eucalypt open forest and woodland with hollow-bearing trees and stands of she-oak species. The species tends not to live in country where extensive clearing has taken place, and they prefer to fly over intact habitat rather than open country (NSW Scientific Committee 2004c). The species feeds almost exclusively on the seeds of several species of she-oak (Casuarina and Allocasuarina species) (Garnett and Crowley 2000). It generally nests in tree hollows of approximately 26 cm wide and up to 1.4 m deep in live trees or stags. Pairs defend the immediate area surrounding the nest hollow and have extensive forage ranges (NSW NPWS 1999a).

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

The Project lies within the known distributional range of the Glossy Black Cockatoo. The Project will remove potential nesting and breeding habitat for the Glossy Black Cockatoo. The species has not been recorded despite numerous field surveys of the Project Boundary.

The Glossy Black Cockatoo has potential to occur as suitable nesting habitat in the form of woodland and open forest is available in the Project Boundary and surrounds, and due to the proximity of numerous NSW Atlas records. Despite the area of habitat proposed to be removed, the species will be able to disperse to extensive areas of adjacent habitat that will remain within the Project Boundary and locality. These areas will continue to provide important habitat features for the Glossy Black Cockatoo.

Although the species has potential to occur given the availability and extent of suitable breeding and nesting habitat, the absence of records suggests that the Project Boundary does not constitute core habitat or form part of the territorial range of a local population, and the Project is thus considered unlikely to place a local population 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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

> *(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, and*

(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

(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, and

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. Critical forage resources, in the form of *Allocasuarina* sp., are limited in the Project Boundary and considered unlikely to support resident populations. However, Glossy Black Cockatoos have the potential to nest in the Project Boundary and, as they are highly mobile, undertake long-distance commutes of up to 60km to find suitable forage trees in wooded areas elsewhere in the locality.

The species has specific nesting requirements and generally nests in tree hollows of approximately 26cm wide by 1.4m deep in live trees or stags. Hollows of these dimensions are limiting resources and the potential displacement of individuals may lead to short term competition for nests and reduced breeding success. However, extensive areas of habitat suitable for this species will also remain available in the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Glossy Black-Cockatoo has been identified by the Director-General of OEH under the TSC Act.

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

The "Threat Abatement Plan for Beak and Feather Disease affecting endangered psittacine species" is relevant to the Glossy Black-Cockatoo. The Proposal is unlikely to increase the likelihood of extinction or escalate the threatened status of psittacine birds and is therefore consistent with the objectives of this plan.

Three recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Glossy Black-Cockatoo:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;

- Infection by *Psittacine Circoviral* (beak and feather) Disease affecting endangered psittacine species and populations as this can lead to a severe reduction in populations;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources;
- Predation by the feral cat (*Felis catus*) as this directly reduces species abundance, particularly as they predate on nests and nesting females; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of potential nesting and breeding habitat for the Glossy Black Cockatoo.

The Glossy Black Cockatoo is a woodland bird known from multiple records in the proximity of the Project Boundary and elsewhere in the locality. The species has not been recorded in the Project Boundary and no local populations are known to occur. Based on habitat requirements, the Project Boundary is likely to offer some nesting habitat in the form of large hollow-bearing trees, however it does not support sufficient forage resources.

The Project is considered unlikely to have a significant impact on the local occurrence of the Glossy Black Cockatoo.

vi. Grey-crowned Babbler (eastern subspecies) (Pomatostomus temporalis temporalis)

The Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) is listed as Vulnerable under the TSC Act. There are 14 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable grassy woodland habitat.

The Grey-crowned Babbler (eastern subspecies) is a woodland insectivorous species endemic to eastern Australia. The species is abundant and widespread in northern Queensland, but is in considerable decline in the southern part of its range in Victoria and NSW. It is a ground-dwelling, sedentary species most commonly found in open forest and woodland dominated by acacias or eucalypt box-ironbark associations where they live in extended family groups (NSW Scientific

Committee, 2010g). Flight is laborious for the species and birds are generally unable to cross large open areas. The species forages for insects on trunks and branches of eucalypts and other woodland trees, and on the ground amongst litter and tussock grasses (Garnett & Crowley, 2000). Several dome-shaped stick nests are built and maintained for roosting each night and are usually located in shrubs or sapling eucalypts.

The species is only found in habitat containing all of the following elements: woodland or open forest on fertile or heavy soils; abundant trees, with a high proportion of large, mature eucalypts with a trunk measuring >90 cm DBH; an understorey of shrubs with DBH of 10–30 cm, for nesting and sheltering; and an open ground layer with much leaf litter and fallen timber debris, and sparse grass cover (Birds Australia, 2011). Once lost from a habitat fragment, natural re-colonisation is unlikely (Garnett & Crowley, 2000).

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

The Project lies within the known distributional range of the Grey-crowned Babbler. The Project will remove potential forage, nesting and breeding habitat for the Grey-crowned Babbler. This species has not been recorded during field surveys but has potential to occur as suitable habitat in the form of woodland and open forest with grassy understorey and ground debris are available in the Project Boundary. Extensive areas of habitat will remain within the Project Boundary and surrounds and will continue to provide important habitat features for the Grey-crowned Babbler and allow the species to disperse within the locality.

As no individuals have been recorded despite multiple surveys, and due to the low LGA count, the Project is considered unlikely to have an adverse effect on the life cycle if the species or place a viable local population 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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

> *(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, and*
>
> *(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*

(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, and

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes suitable forage, breeding and nesting habitat for the Grey-crowned Babbler.

Despite multiple surveys, the species has not been recorded in the Project Boundary. This suggests that the Project Boundary does not constitute core habitat or form part of a territorial range of a local population. As such, the Project and associated loss of habitat is considered unlikely to lead to social consequences such as smaller group size; reduced breeding success and nesting success; or place the local population at risk of extinction.

The long-term genetic viability of the species in the locality is unlikely to be impacted by the Project. Extensive areas of woodland and forest will remain within the Project Boundary and surrounds and continue to provide suitable habitat greater than 100 ha for the Grey-crowned Babbler. This is considered the minimum area of habitat required to support and maintain viable populations of the species (Higgins & Peter 2002). Potentially occurring individuals are considered to have a high capacity to disperse to adjacent habitat and successfully relocate due to the availability of large areas of structurally intact treed habitat that will continue to facilitate this species' dispersal across the landscape.

Extensive areas of habitat suitable for this species will also remain available in both the Project Boundary and the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Grey-crowned Babbler has been identified by the Director-General of OEH under the TSC Act.

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

Recovery plans have not been prepared for the Grey-crowned Babbler. No threat abatement plans are relevant to this species. Nine recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Grey-crowned Babbler:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;

- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of suitable forage, nesting and breeding habitat for the Grey-crowned Babbler.

The Grey-crowned Babbler is a woodland bird considered to have the potential to occur within the Project Boundary and elsewhere in the locality based on the availability of extensive areas of suitable habitat that are structurally intact and contain important features such as mixed age vegetation and ground debris. However, this species has not been recorded during field surveys of the Project Boundary and a low count in the Lithgow LGA suggests that the species does not frequent the locality.

The Project is considered unlikely to have a significant impact on the local occurrence of the Grey-crowned Babbler.

vii. Hooded Robin (Melanodryas cucullata cucullata)

The Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*) is listed as Vulnerable under the TSC Act. There are 8 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable grassy woodland habitat.

The Hooded Robin (south-eastern form) is a woodland species with a sparse distribution in south-eastern Australia. It is a mostly sedentary species that prefers open and lightly timbered acacia or eucalypt woodlands, particularly box-ironbark, that are structurally diverse, have moderately tall native grasses and are often at the edges of clearings and grassland (Birds Australia, 2011). The species forages on the ground, perching on fallen timber and low-lying branches to feed on insects. The species breeds between July and November, building nests in tree forks, hollows or crevices at heights between one – five metres (NSW Scientific Committee, 2010d). Territories range from approximately 10 ha during breeding season to 30 ha in the non-breeding season.

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

The Project area lies within the known distributional range of the Hooded Robin. The Project will remove potential forage, nesting and breeding habitat for the Hooded Robin. This species has not been recorded during field surveys but has potential to occur as suitable habitat in the form of woodland and open forest with grassy understorey and ground debris is available in the Project Boundary.

The Project is considered unlikely to have an adverse effect on the life cycle of the species or place a viable local population at risk of extinction. Extensive areas of habitat that remain within the Project Boundary and surrounding conservation areas will continue to provide important habitat features for the Hooded Robin and allow the species to disperse within the locality.

(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

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

(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

Not applicable to threatened species.

(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, and

(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

(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, and

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes suitable forage, breeding and nesting habitat for the Hooded Robin.

Due to a lack of observations despite multiple surveys, resident populations are not expected to occur within the Project Boundary. As such, the Project is considered unlikely to lead to social consequences such as smaller group size; reduced breeding success and nesting success; or place the local population at risk of extinction. The Project is unlikely to result in a loss of connectivity due to the proximity of large areas of habitat elsewhere within the Project Boundary; approximately 787 ha of treed habitat will not be removed. Any local populations that do occur are considered to have a high capacity to disperse to this adjacent habitat and successfully relocate due to the presence of important habitat features including structurally diverse vegetation, woody ground debris and tall native grasses.

Extensive areas of habitat suitable for this species will also remain available in the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Hooded Robin has been identified by the Director-General of OEH under the TSC Act.

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

Recovery plans have not been prepared for the Hooded Robin. No threat abatement plans are relevant to this species. Seven recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Hooded Robin:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of suitable forage, nesting and breeding habitat for the Hooded Robin.

This species has not been recorded during field surveys but has potential to occur within the Project Boundary and elsewhere in the locality based on the availability of suitable habitat. Despite the proposed removal of vegetation associated with the Project, the species has a high capacity for dispersal and can relocate to extensive areas of good quality habitat that will still be available elsewhere within the Project Boundary and surrounding conservation areas.

The Project is considered unlikely to have a significant impact on the local occurrence of the Hooded Robin.

viii. Scarlet Robin (Petroica boodang)

The Scarlet Robin (*Petroica boodang*) is listed as Vulnerable under the TSC Act. There are 175 records of the species within Lithgow LGA. This species has been recorded during multiple surveys of the Project Boundary on a number of occasions. Suitable forage, nesting and breeding habitat is available within the Project Boundary.

The Scarlet Robin is an insectivorous, woodland species endemic to south-eastern NSW and south-western WA. Core bioregions for the species are on the slopes and tablelands of NSW. It is a mainly sedentary species that does not undertake movements greater than 10km (Higgins and Peter, 2002). The species is most commonly found in drier open woodland and forest of mature and regrowth eucalypts with an open understorey, although it may also use paddocks with scattered remnant trees (Birds Australia, 2011). Abundant logs and fallen timber are critical habitat features, allowing the species to forage for insects on the ground. The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude. In NSW, the species breeds between July – January and builds nests in tree forks (DECCW (NSW) 2010b).

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

The Project will remove known and potential breeding, nesting and forage habitat for the Scarlet Robin. This is likely to have a short-term adverse effect on the life cycle of individuals known to occur within the Project Boundary by displacing a local population of Scarlet Robins.

This may impact on the capacity of some individuals to disperse and relocate to surrounding habitat within the locality. However, based on the species' high record count in the LGA and the availability of suitable habitat elsewhere in the locality, this is considered unlikely to result in long-term impacts to local population dynamics within the area such that it would place the species at risk of extinction. The species will be able to disperse to large extents of suitable habitat that will remain both within the Project Boundary and extensive conservation areas. These areas will continue to provide important forage, nesting and breeding habitat features for the species including habitat complexity and features such as logs and woody ground debris.

(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

Not applicable to threatened species.

(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

Not applicable to threatened species.

(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, and

(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

(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, and

The Project lies within the known distributional range of the Scarlet Robin. The species has been recorded on multiple occasions during various field surveys of the Project Boundary. This suggests that suitable forage and breeding habitat is present in the Project Boundary and that the area forms part of the territorial range of a local population of the species.

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes known and potential forage, breeding and nesting habitat for the Scarlet Robin. Based on multiple field observations, the Project is likely to displace a resident breeding population of Scarlet Robins. This has the potential to impact on local population dynamics in the short-term by reducing breeding and nesting success. Despite the availability of extensive adjacent habitat, clearance and forced emigration may affect the short-term capacity of some individuals to successfully relocate depending on the availability of suitable tree nesting sites and likely inter and intraspecific competition. However, these are not considered likely to result in long-term impacts that would place the local population at risk of extinction.

As the species can undertake movements of up to 10 km (Higgins and Peter, 2002), the species is unlikely to have difficulty relocating to adjacent areas of connected, good quality habitat (787 ha) that will still remain within the Project Boundary, or to the extensive conservation areas in the vicinity of the Project. These areas of woodland will continue to facilitate movement of this species within the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Scarlet Robin has been identified by the Director-General of OEH under the TSC Act.

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

Recovery plans have not been prepared for the Scarlet Robin. No threat abatement plans are relevant to this species. Seven recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Scarlet Robin:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of known and potential forage, nesting and breeding habitat for local Scarlet Robin populations.

As suggested by the high number of LGA records, the Scarlet Robin is a woodland bird likely to occur elsewhere in the locality. Extensive areas of good quality habitat will still be available to this species within the Project Boundary and surrounding conservation areas and will thus allow the continued viability of the species in the region. However, the proposed removal of habitat associated with the

Project is likely to result in the displacement of some locally occurring individuals and will potentially result in short-term impacts to nesting and breeding success.

Without mitigation, the Project is considered likely to have a significant impact on local Scarlet Robin populations.

ix. Speckled Warbler (Pyrrholaemus saggitatus)

The Speckled Warbler (*Chthonicola saggitatus)* is listed as Vulnerable under the TSC Act. There are 56 records of the species within Lithgow LGA (OEH 2011b). This species was recorded during current field surveys of the Project Boundary.

The Speckled Warbler is a woodland species endemic to south-eastern Australia. The species is most commonly found in eucalypt-dominated dry sclerophyll forest and woodland with a grassy understorey (NSW Scientific Committee, 2010e) particularly on the western slopes and tablelands of the Great Dividing Range and along the drier sections of the coast (Garnett & Crowley, 2002). Large, relatively undisturbed remnants are required for the species to persist in an area. It is a territorial, sedentary species with a typical home range of approximately 10 ha (NSW Scientific Committee, 2010e). It forages on the ground for seeds and insects around tussocks and under shrubs and trees, and nests on the ground in undergrowth and thick litter.

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

The Project will remove known and potential breeding, nesting and forage habitat for the Speckled Warbler. This is likely to have a short-term adverse effect on the life cycle of individuals known to occur within the Project Boundary by displacing a local population of Speckled Warblers.

Due to their sedentary nature, this may impact on the capacity of some individuals to disperse and relocate to surrounding habitat within the locality. However, this is considered unlikely to result in long-term impacts to local population dynamics within the area such that it would place the species at risk of extinction. The species will be able to disperse to large extents of suitable habitat that will remain both within the Project Boundary and extensive conservation areas. These areas will continue to provide important forage, nesting and breeding habitat features for the species including habitat complexity and features such as logs and woody ground debris.

> *(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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

(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, and

(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

(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, and

The Project lies within the known distributional range of the Speckled Warbler. The species has been recorded once in the Project Boundary during current field surveys. As this is a territorial, sedentary species that tends not to undertake movements outside of its 10 ha home range (Higgins and Peter, 2002), it is likely that habitat within the Project Boundary supports suitable habitat and forms part of the home range of a local Speckled Warbler population.

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes known and potential forage, breeding and nesting habitat for the Speckled Warbler. Although the species has only been observed once during field surveys, the Project is considered likely to remove important habitat for the Speckled Warbler which may displace local populations. This has the potential to impact on local population dynamics in the short-term by reducing breeding and nesting success. Despite the availability of extensive adjacent habitat, clearance and forced emigration may affect the short-term capacity of some individuals to successfully relocate depending on the availability of suitable tree nesting sites and ground debris, and likely inter- and intraspecific competition. However, these are not considered likely to result in long-term impacts that would place the local population at risk of extinction.

Suitable habitat for the Speckled Warbler will still remain within the Project Boundary (787 ha) and in numerous conservation areas in the vicinity of the Project. These extensive areas of woodland will continue to facilitate movement of this species within the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Speckled Warbler has been identified by the Director-General of OEH under the TSC Act.

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

Recovery plans have not been prepared for the Speckled Warbler. No threat abatement plans are relevant to this species. Seven recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Speckled Warbler:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of potential forage and shelter habitat;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of known and potential forage, nesting and breeding habitat for local Speckled Warbler populations.

The Speckled Warbler is a woodland bird likely to occur elsewhere in the locality, particularly as extensive areas of good quality habitat are available in surrounding conservation areas which will allow the continued viability of the species in the region. However, as low LGA records suggest they are not common in the locality, the loss of habitat known to be utilised by a local population is likely to result in the displacement of individuals and will potentially result in short-term impacts to nesting and breeding success.

Without mitigation, the Project is considered likely to have a significant impact on the local occurrence of the Speckled Warbler.

x. Superb Parrot (Polytelis swainsonii)

The Superb Parrot (*Polytelis swainsonii*) is listed as Vulnerable under both the TSC and EPBC Acts. No records exist for this species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary. Despite the lack of records, this species is considered to have low potential to occur due to the availability of suitable habitat.

The Superb Parrot is a partly migratory woodland species endemic to eastern inland Australia. Regular seasonal movements are undertaken, and are attributable to the availability of forage resources between breeding and non-breeding seasons. The species typically inhabits Box-Gum, Box-Cypress pine and River Red Gum forest and woodlands, and scattered paddock trees near water. The species' core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. The other main breeding sites are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round. (DEC (NSW) 2005). The species breeds between September and January and nests in small colonies sometimes in the same tree hollow. Superb Parrots feed on grass seeds, herbaceous plants, fruits, berries and flowers and may forage up to 10km from nesting sites, primarily in grassy box woodland. It is estimated that there are less than 5000 breeding pairs left in the wild.

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

The Superb Parrot has not been recorded within the Project Boundary during field surveys and is not known to occur within the LGA. The species is being assessed as a precautionary measure as suitable habitat exists within the Project Boundary and because the species is partly migratory in response to food availability.

The Project is not likely to have an adverse effect on the life cycle of the species such that a viable population of the species will be placed at risk of extinction.

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

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

> *(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, and*

(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

(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, and

The Superb Parrot has not been recorded in the Project Boundary or elsewhere within the LGA. As such, no local resident populations are considered as being likely to occur, although they may potentially visit the locality during seasonal movements or when seeking alternative sources of food. While the Project Boundary supports suitable habitat for this species, it does not represent core habitat and the removal of approximately 835 ha of woodland and open forest is not likely to impact the viability of the species.

Suitable habitat for the Superb Parrot will still remain available within the Project Boundary (787 ha) and in numerous conservation areas in the vicinity of the Project, should individuals begin to frequent the region. These extensive areas of woodland include the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Superb Parrot has been identified by the Director-General of OEH under the TSC Act.

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

The Project is consistent with the objectives and actions of the National Recovery Plan for the Superb Parrot (*Polytelis swainsonii*), published by the VIC Department of Sustainability and Environment, 2011. The draft NSW Recovery Plan for the Superb Parrot (Baker-Gabb D, 2011) accords with and complements this national Recovery Plan.

The "Threat Abatement Plan for Beak and Feather Disease affecting endangered psittacine species" is relevant to the Swift Parrot. The Proposal is unlikely to increase the likelihood of extinction or escalate the threatened status of psittacine birds and is therefore consistent with the objectives of this plan.

(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

The following Key Threatening Processes are relevant to the Superb Parrot:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of potential forage and shelter habitat;

- Infection by *Psittacine Circoviral* (beak and feather) Disease affecting endangered psittacine species and populations as this can lead to a severe reduction in populations;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of habitat suitable for the Superb Parrot.

The Superb Parrot has not been recorded within the LGA and is not considered likely to occur. It was assessed as a precautionary measure based on the availability of suitable habitat and fact that it is irruptive in response to food resources. The Project is unlikely to have a significant impact on the Superb Parrot.

xi. Turquoise Parrot (Neophema pulchella)

The Turquoise Parrot (*Neophema pulchella*) is listed as Vulnerable under the TSC Act. There are 57 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have the potential to occur due to the availability of suitable grassy woodland habitat.

The Turquoise Parrot is a woodland species endemic to south-eastern Australia, with patchy distribution in NSW. It occurs on the western side of the tablelands and inland slopes, plains and some dry coastal valleys in eastern NSW (Pizzey & Knight, 2003). The species is most commonly found in open, grassy woodland composed of mixed assemblages of eucalypt species, including box-ironbark, with abundant hollow-bearing trees and stags for nesting (NSW Scientific Committee, 2010h). The Turquoise Parrot occurs solitarily, in pairs, in family groups, or in small flocks. It breeds in solitary pairs, though pairs are possibly clumped in favoured nesting patches. Turquoise Parrots are generally resident in an area, but some local seasonal movement occurs. Foraging is typically ground-based among seeding grasses and weeds, and sometimes near cropland (Birds Australia, 2011).

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

The Project area lies within the known distributional range of the Turquoise Parrot. The Project will remove potential forage, nesting and breeding habitat for the Turquoise Parrot. This species has not been recorded during field surveys but has potential to occur as suitable habitat in the form of woodland and open forest with grassy understorey is available in the Project Boundary.

The Project is considered unlikely to have an adverse effect on the life cycle of the species or place a viable local population at risk of extinction. Extensive areas of habitat that remain within the Project Boundary and surrounding conservation areas will continue to provide important habitat features for the Turquoise Parrot and allow the species to disperse within the locality.

(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

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

(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

Not applicable to threatened species.

(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, and

(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

(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, and

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes suitable forage, breeding and nesting habitat for the Turquoise Parrot.

The Turquoise Parrot has not been observed within the Project Boundary but is considered to have the potential to occur as suitable habitat is available. However, the lack of records, despite multiple field surveys, suggests that habitat in the Project Boundary does not constitute core habitat or form part of the territorial range of a local population. Turquoise Parrots are generally a sedentary, territorial species with limited home territories ranging up to 1.4km.

The removal of habitat is considered unlikely to lead to social consequences such as smaller group size; reduced breeding success and nesting success; or place the species at risk of extinction. The Project is unlikely to result in a loss of connectivity due to the proximity of large areas of habitat elsewhere within the Project Boundary, where approximately 787 ha of treed habitat will not be

removed. Extensive areas of habitat suitable for this species will also remain available in the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Turquoise Parrot has been identified by the Director-General of OEH under the TSC Act.

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

The "Threat Abatement Plan for Beak and Feather Disease affecting endangered psittacine species" is relevant to the Turquoise Parrot. The Proposal is unlikely to increase the likelihood of extinction or escalate the threatened status of psittacine birds and is therefore consistent with the objectives of this plan.

(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

The following Key Threatening Processes are relevant to the Turquoise Parrot:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of potential forage and shelter habitat;
- Infection by *Psittacine Circoviral* (beak and feather) Disease affecting endangered psittacine species and populations as this can lead to a severe reduction in populations;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and

- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of potential forage, nesting and breeding habitat for the Turquoise Parrot.

The Turquoise Parrot has not been recorded during field surveys but has the potential to occur within the Project Boundary based on the availability of good quality habitat. However, as extensive areas of habitat will still be available to the species elsewhere in the Project Boundary and locality, the Project is considered unlikely to have a significant impact on the local occurrence of the Turquoise Parrot.

xii. Varied Sittella (Daphoenositta chrysoptera)

The Varied Sittella (*Daphoenositta chrysoptera)* is listed as Vulnerable under the TSC Act. There are 69 records of the species within Lithgow LGA (OEH 2011b). The species was previously recorded during 2003 field surveys, but has not been recorded in the Project Boundary since.

The species is considered likely to occur due to proximity of OEH records (within several kilometres) and the availability of suitable habitat which may form a component of a much larger home-range.

The Varied Sittella is an insectivorous woodland species endemic and widespread in across mainland Australia. They are a sedentary species most commonly found in eucalypt woodlands and dry forest, and acacia woodland containing mature trees and dead branches (Birds Australia, 2011). The species feeds on arthropods and insects on stags, dead branches, in decorticating bark and in the canopy. The Varied Sittella often re-uses the same fork or living tree to build its nest in successive years (NSW Scientific Committee, 2010c).

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

The Project will remove potential forage, nesting and breeding habitat for the Varied Sittella. No recent observations have been made within the Project Boundary; however the species is likely to occur as suitable habitat is present and as records exist in the near vicinity. Also, the Project Boundary is known to have previously supported a local population of Varied Sittellas when the species was recorded during 2003 surveys by AES.

The Project is considered unlikely to have an adverse effect on the life cycle of the species or place a viable local population at risk of extinction as extensive areas of habitat that will remain within the Project Boundary and surrounding conservation areas will continue to provide important habitat features for the Varied Sittella and allow the species to disperse within the locality.

> *(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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

(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

Not applicable to threatened species.

(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, and

(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

(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, and

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes suitable forage, breeding and nesting habitat for the Varied Sittella.

Even though the species was last recorded in the Project Boundary in 2003. The Varied Sittella should still be considered to occur based on the proximity of existing OEH records and availability of suitable habitat, including eucalypt forest and woodland containing diversity in all strata, stags and ground debris, and it is likely to form part of a larger territorial range of a local population.

The Project is unlikely to increase the species' susceptibility to decline as it will not reduce habitat quality of remaining woodland or result in habitat isolation or fragmentation. The loss of potential habitat in the Project Boundary is considered unlikely to lead to social consequences such as smaller group size; reduced breeding and nesting success; or place the local population at risk of extinction. The area of vegetation proposed to be removed is unlikely to result in these impacts as it is on the edge of already cleared land. The species' capacity for dispersal within the locality will not be impacted as extensive areas of woodland habitat will remain within the Project Boundary and surrounds and will continue to provide important habitat features for the Varied Sittella. The long-term viability of the species is unlikely to be impacted by the Project.

Extensive areas of habitat suitable for this species will also remain available in the wider area, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Varied Sittella has been identified by the Director-General of OEH under the TSC Act.

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

Recovery plans have not been prepared for the Varied Sittella. No threat abatement plans are relevant to this species. Six recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Varied Sittella:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of known and potential forage, nesting and breeding habitat for the Varied Sittella.

The Varied Sittella is a woodland bird known to occur in the area. It has potential to disperse through treed areas and utilise habitat within the Project Boundary as part of a larger home range. While suitable habitat is available, a local population of Varied Sittellas could be considered to occur within the Project Boundary. The Project is considered unlikely to have a significant impact on the local occurrence of the Varied Sittella.

I.2.5 Threatened Nectarivorous Birds

- Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*);
- Little Lorikeet (*Glossopsitta pusilla*);
- Painted Honeyeater (*Grantiella picta*);
- Honeyeater (*Anthochaera phrygia*); and
- Swift Parrot (*Lathamus discolor*).

i. Black-chinned Honeyeater (eastern subspecies) (Melithreptus gularis gularis)

The Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*) is listed as Vulnerable under the TSC Act. There are 65 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable habitat and proximity of OEH records (within several kilometres).

The eastern subspecies of the Black-chinned Honeyeater is endemic to eastern Australia from inland slopes of the Great Dividing Range to the coast (Pizzey & Knight, 2003). The species is declining in the wheat-belt region of western NSW where large areas would have once contained suitable habitat.

The species is most commonly found in the upper levels of dry open eucalypt woodlands and forest containing box-ironbark associations where they build suspended nests and feed on insects, nectar and lerps (NSW Scientific Committee, 2010k). Feeding territories are large, at least 5 ha, making the species locally nomadic in response to the availability of forage resources.

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

The Project will remove potential forage, nesting and breeding habitat for the Black-chinned Honeyeater. This species has not been recorded during field surveys; however records exist within close proximity to the Project Boundary. As such, the species has potential to occur and habitat in the Project Boundary may form part of a foraging territory for a local population as suitable habitat in the form of woodland and open forest containing eucalypt feed tree species is present.

As no individuals have been recorded despite multiple surveys, the Project is considered unlikely to have an adverse effect on the life cycle of the species or place a viable local population at risk of extinction. Although some forage habitat may be removed, extensive areas of habitat will remain within the Project Boundary and surrounds and will continue to provide important habitat features for the Black-chinned Honeyeater and allow the species to disperse within the locality.

> *(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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

(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

Not applicable to threatened species.

(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, and

(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

(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, and

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes suitable forage, breeding and nesting habitat for the Black-chinned Honeyeater.

Despite multiple surveys, the species has not been recorded in the Project Boundary. The location of records within the locality suggests that the species may occasionally utilise habitat within the Project Boundary as part of a larger foraging range.

The Project Boundary and surrounding habitat support canopy species preferred by the Black-chinned Honeyeater, including Yellow Box and various smooth-barked gums and stringy-barks. Approximately 787 ha of this habitat will still be available to the Black-chinned Honeyeater within the Project Boundary.

As the Black-chinned Honeyeater is locally nomadic in response to food availability, the loss of habitat associated with the Project is not considered likely to impact the species and considered unlikely to lead to social consequences such as smaller group size; reduced breeding success and nesting success; or place the local population at risk of extinction. The long-term genetic viability of the Black-chinned Honeyeater in the locality is unlikely to be impacted as the species is mobile and has the capacity to disperse to surrounding areas of extensive habitat that will also remain available in the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Black-chinned Honeyeater has been identified by the Director-General of OEH under the TSC Act.

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

Recovery plans have not been prepared for the Black-chinned Honeyeater. No threat abatement plans are relevant to this species. Six recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Black-chinned Honeyeater:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of suitable forage, nesting and breeding habitat for the Black-chinned Honeyeater.

The Black-chinned Honeyeater is a nectarivorous bird known to occur elsewhere in the locality. It has potential to disperse through treed areas and forage within the Project Boundary as part of a larger home range. While suitable habitat and feed trees are available, a resident population of Black-chinned Honeyeaters is not known to occur within the Project Boundary. As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Black-chinned Honeyeater.

ii. Little Lorikeet (Glossopsitta pusilla)

The Little Lorikeet (*Glossopsitta pusilla*) is listed as Vulnerable under the TSC Act. There are 104 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during

field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable habitat and proximity of OEH records (within several kilometres).

The Little Lorikeet is a nectarivorous species endemic to eastern mainland Australia. In NSW, the species is most commonly found in dry, open sclerophyll forests and woodlands dominated by eucalypts, from the coast to the western slopes of the Great Dividing Range and extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri (Pizzey & Knight, 2003). The species has been found in both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes, where it forages in the canopy. It is generally thought to be nomadic in response to food availability, though in some areas it is considered resident, particularly during breeding season from April to December (NSW Scientific Committee, 2010j). The species feeds on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts. It breeds in tree hollows with openings of approximately 3cm at heights of 2-15m in living trees, occupying the same hollow over many years.

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

The Project will remove potential forage, nesting and breeding habitat suitable for the Little Lorikeet. This species has not been recorded during field surveys; however records exist in the vicinity of the Project Boundary (distance?).

As the Little Lorikeet is nomadic is response to food availability, the species has potential to utilise habitat in the Project Boundary which supports important feed trees such as Yellow Box.

As no individuals have been recorded despite multiple surveys, the Project is considered unlikely to have an adverse effect on the life cycle of the species or place a viable local population at risk of extinction. Although some forage habitat may be removed, extensive areas of habitat will remain within the Project Boundary and surrounds and will continue to provide important habitat features for the Little Lorikeet and allow the species to disperse within the locality.

> *(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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

> *(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, and*

(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

(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, and

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes suitable forage, breeding and nesting habitat for the Little Lorikeet.

The species has not been recorded in the Project Boundary despite multiple surveys, and despite the species being gregarious, generally foraging in the canopy in large flocks and tending to occupy the same hollow for many years. This suggests that habitat within the Project Boundary does not constitute core habitat. However, as the species is partly nomadic in response to food availability, it may occasionally form part of a larger forage range of a local population. 787 ha of this habitat will still be available to the Little Lorikeet within the Project Boundary.

The loss of habitat associated with the Project is not considered likely to impact the species and is considered unlikely to lead to social consequences such as smaller group size; reduced breeding success and nesting success; or place the local population at risk of extinction. The long-term genetic viability of the Little Lorikeet in the locality is unlikely to be impacted as the species is mobile and has the capacity to disperse to surrounding areas of extensive habitat that will also remain available in the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Little Lorikeet has been identified by the Director-General of OEH under the TSC Act.

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

The "Threat Abatement Plan for Beak and Feather Disease affecting endangered psittacine species" is relevant to the Little Lorikeet. The Proposal is unlikely to increase the likelihood of extinction or escalate the threatened status of psittacine birds and is therefore consistent with the objectives of this plan.

No other recovery plans have been prepared for this species. Six recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Little Lorikeet:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;

- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources;
- Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations as this can lead to a severe reduction in populations; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of suitable forage, nesting and breeding habitat for the Little Lorikeet.

The Little Lorikeet is a nectarivorous bird that is partly nomadic in response to food availability. This species has the potential to occur within the Project Boundary and elsewhere in the locality based on the availability of extensive areas of suitable habitat including feed trees and hollows. While suitable habitat is available, a resident population of Little Lorikeets is not known to occur within the Project Boundary. As such, the Project is not considered likely to have a significant impact on the local occurrence of the Little Lorikeet.

iii. Painted Honeyeater (Grantiella picta)

The Painted Honeyeater (*Grantiella picta*) is listed as Vulnerable under the TSC Act. There are 3 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable habitat and proximity of OEH records (within several kilometres).

The Painted Honeyeater is a nectarivorous bird endemic to eastern Australia. It is rare throughout its range and has sparse distribution in south-east NSW (NSW Scientific Committee, 2010i). The species often occurs singly or in pairs and is most commonly found in dry open woodland and forest, such as box-ironbark, which support parasitic *Amyema* mistletoe species. The Painted Honeyeater is closely associated with mistletoes and is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias (Pizzey & Knight, 2003). The species has a general north-south seasonal movement linked to the fruiting of mistletoe. It also feeds on nectar and insects in tree canopies.

Breeding occurs south of Queensland on inland slopes of the Great Dividing Range. The species nests from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.

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

The Project will remove some suitable forage, nesting and breeding habitat for the Painted Honeyeater. This species has not been recorded during field surveys and has a low LGA count. This is consistent with the nomadic and low-density distribution of the species. It also suggests a resident population does not occur in the Project Boundary and that the species does not regularly frequent the locality.

The species is considered to have low potential to occur as mistletoe forage resources, upon which the Painted Honeyeater is dependent, are limited within the Project Boundary. As no individuals have been recorded despite multiple surveys, the Project is considered unlikely to have an adverse effect on the life cycle of the species or place a viable local population 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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

> *(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, and*
>
> *(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*
>
> *(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, and*

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes suitable breeding and nesting habitat and some limited forage habitat for the Painted Honeyeater.

Despite multiple surveys, the Painted Honeyeater has not been recorded in the Project Boundary and low LGA records indicate the species is not a regular visitor during migratory movements. This is likely due to the limited availability of mistletoes, on which the species depends; only one mistletoe species

has been recorded within the Project Boundary and it is not abundant. LGA records also suggest that important forage resources are not widely available elsewhere in the locality.

The loss of habitat associated with the Project is not considered likely to impact the viability of the species and is considered unlikely to lead to social consequences such as smaller group size; reduced breeding success and nesting success; or place the local population at risk of extinction. Should the species occur within the locality, it has the capacity to utilise 787 ha of habitat that will remain within the Project Boundary and also extensive habitat that will remain available in the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Painted Honeyeater has been identified by the Director-General of OEH under the TSC Act.

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

Recovery plans have not been prepared for the Painted Honeyeater. No threat abatement plans are relevant to this species. Recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Painted Honeyeater:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;

- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of some suitable habitat for the Painted Honeyeater.

The Painted Honeyeater is a specialist nectarivorous bird that feeds primarily on the fruits of mistletoes. The species is considered to have low potential to occur in the Project Boundary as mistletoe are limited in abundance. Should the species visit the locality during migratory movements, remaining habitat within the Project Boundary and within local conservation areas will continue to provide habitat for the species.

The Project is considered unlikely to have a significant impact on the local occurrence of the Painted Honeyeater.

iv. Regent Honeyeater (Anthochaera phrygia)

The Regent Honeyeater (*Anthochaera phrygia*) is listed as Endangered under both the TSC and EPBC Acts. It is also listed as Migratory under the EPBC Act. There are 596 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur during migratory movements due to the availability of suitable forage habitat and number and proximity of OEH records.

The Regent Honeyeater is a nectarivorous migratory species endemic to south-eastern Australia where it is widespread but sparsely scattered in temperate woodlands and open forests. In NSW the species mainly occurs around the Great Dividing Range, but has been recorded in the Hunter Valley and Pilliga regions (Pizzey & Knight, 2003; Birds Australia, 2011). They prefer box-ironbark associations in wet, fertile sites along creeklines and river valleys, or dry open forest and woodland which have large numbers of mature trees, high canopy cover and an abundance of mistletoes. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), in NSW at Capertee Valley and the Bundarra-Barraba region (DEC (NSW), 2005a1). Numbers fluctuate greatly between years and sites, and movement outside of breeding season is poorly understood. Only 1500 individuals are thought to make up the single Capertee Valley subpopulation of this species. Regent Honeyeaters are generalist foragers that mainly feed on nectar from a variety of eucalypts and mistletoes in the canopy tops of mature feed trees. The species roosts in saplings (Oliver, 1998), suggesting they require a more extensive area of habitat than other similar nectarivorous species.

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

The Project will remove potential forage habitat for the Regent Honeyeater. The species has not been recorded during field surveys but is considered to have potential to occur during migrations. However, Regent Honeyeaters are unlikely to make significant recurrent use of the Project Boundary and as the

species is migratory, the Project is unlikely to displace any populations or place the species 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

Not applicable to threatened species.

(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

Not applicable to threatened species.

(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, and

(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

(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, and

Approximately 835 ha of forest and woodland are proposed to be removed as part of the Project. This includes 16.21 ha of ox Gum Woodland, potential forage habitat for the Regent Honeyeater. The Project Boundary lies within the known migratory range of the Regent Honeyeater. The species has not been recorded in the Project Boundary despite targeted surveys; however 596 records exist from the LGA, including some within several kilometres of the Project Boundary.

Regent Honeyeaters forage in the canopy tops of taller trees and thus mature trees are an important component of the forest and woodland matrix (Oliver, 2000). The species has been observed to roost in saplings of a variety of tree species and rarely use roost trees for feed trees (Oliver, 1998). This suggests that the area of habitat required by the Regent Honeyeater could be more extensive than for some other similar species.

The long-term genetic viability of the Regent Honeyeater is unlikely to be impacted by the Project as the species is highly mobile and has the capacity to disperse to extensive areas of suitable habitat both within the Project Boundary and in surrounding conservation areas. In the wider locality, this includes within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Regent Honeyeater has been identified by the Director-General of OEH under the TSC Act.

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

The Regent Honeyeater (*Xanthomyza phrygia*) Recovery Plan 1999-2003 was prepared by the Commonwealth government in 1999 (Department of Environment and Conservation NSW 2004). The general aims of the plan included the protection and enhancement of key breeding and foraging habitats for this species. The Project area does not occur in any key breeding or foraging areas for the Regent Honeyeater and is therefore consistent with recovery plans.

Ten recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Regent Honeyeater:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of 16.21 ha of potential habitat for the Regent Honeyeater.

Given that the Regent Honeyeater is a wide-ranging migratory species, it is possible that it may forage within the Project Boundary during intense blossom periods. However, also because it is migratory, the species will be able to utilise abundant flowering resources that will still be available in the Project Boundary, as 30 ha of Box Gum Woodland habitat will remain on top of extensive area in conservation in the locality. As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Regent Honeyeater.

v. Swift Parrot (Lathamus discolor)

The Swift Parrot (*Lathamus discolor)* is listed as Endangered under both the TSC and EPBC Acts. There are 30 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable forage habitat and proximity of OEH records (within several kilometres).

The Swift Parrot only breeds in Tasmania and migrates to south-eastern Australia from March to October (Pizzey & Knight, 2003). In NSW they are found in dry sclerophyll eucalypt forests and woodlands such as box-gum woodlands (DSEWPC, 2011a). The species is semi nomadic in winter and generally found in Victoria and New South Wales with other populations found in south-eastern Queensland. The timing of their migration causes a heavy reliance on abundant lerp infestations and winter flowering eucalypts: *Eucalyptus robusta, Corymbia maculata, C. gummifera, E. sideroxylon,* and *E. albens* (Kennedy & Tzaros, 2005; Saunders & Heinsohn, 2008). The species has high site fidelity and returns to sites on a cyclic basis. However, this site fidelity depends on availability of foraging resources.

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

The Project will remove potential forage habitat for the Swift Parrot. This species has not been recorded during field surveys and targeted searches, however it has potential to occur based on the availability of some forage habitat.

Swift Parrots are unlikely to make significant recurrent use of the Project Boundary and as the species is migratory and does not breed on the mainland, the Project is unlikely to displace any populations or place the species at risk of extinction. The Project is also unlikely to reduce forage availability as extensive areas of similar habitat are present in close proximity to the Project Boundary and elsewhere in the locality.

> *(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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

> *(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, and*

(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

(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, and

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes some potential forage habitat for the Swift Parrot.

Some winter-forage habitat for Swift Parrots occurs in the Project Boundary in the form of mature and regenerating eucalypt species that produce abundant nectar and support lerps. However, favoured winter feed-trees have not been recorded within the Project Boundary. The species has not been recorded in the Project Boundary and has relatively few records within the LGA. This indicates that while habitat in the locality may occasionally be visited during migrations, it is not locally significant for the species or a return foraging site.

The long-term genetic viability of the Swift Parrot is unlikely to be impacted by the Project as the species infrequently visits the region, is highly mobile; and has the capacity to disperse to extensive areas of habitat that will remain available in the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Swift Parrot has been identified by the Director-General of OEH under the TSC Act.

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

The Project is consistent with the objectives of the Swift Parrot (*Lathamus discolor*) Recovery Plan 2001-2005 prepared by the Tasmanian Department of Primary Industries, Water and Environment for the Commonwealth government in 2001. The general aims of this plan include the protection and enhancement of key breeding and foraging habitats for the 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

The following Key Threatening Processes are relevant to the Swift Parrot:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;

- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest. This includes potential forage habitat for the Swift Parrot.

This species is a non-breeding migrant to the mainland where it occurs in areas with abundant forage resources. While the Project Boundary supports some flowering resources, they are unlikely to be locally significant for Swift Parrots as no favoured winter feed trees are present. The species is migratory in response to the availability of food, and is considered unlikely to be impacted by the removal of vegetation by the Project, particularly as extensive areas of similar habitat are available elsewhere in the locality.

As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Swift Parrot.

I.2.6 Threatened Diurnal Raptors and Large Owls

- Barking Owl (*Ninox connivens*);
- Little Eagle (*Hieraaetus morphnoides*);
- Masked Owl (*Tyto novaehollandiae*);
- Powerful Owl (Ninox strenua); and
- Square-tailed Kite (*Lophoictinia isura*).

All of these raptor species require relatively large home ranges (measured in square kilometres) to obtain adequate prey. For the purposes of the following Assessments of Significance, for such widely dispersed raptorial birds with relatively large territories, it is assumed that a viable local population may be as little as a single nesting pair of birds.

i. Barking Owl (Ninox connivens)

The Barking Owl (*Ninox connivens*) is listed as Vulnerable under the TSC Act. There are 31 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable forage, roosting and breeding habitat and proximity of OEH records (within several kilometres).

The Barking Owl is a sedentary, medium-sized owl widespread on the mainland. The species is most commonly found in dry open sclerophyll woodland and open forest dominated by eucalypts such red gums (Birds Australia, 2011). It also inhabits fragmented remnant patches, partly cleared farmland and casuarinas along watercourses which contain large roost trees (NSW NPWS, 2003b). The species roosts in shaded portions of dense tree canopies, including tall mid-storey trees with dense foliage such as *Acacia* and *Casuarina* species. Habitat preference is strongly biased towards areas that provide a high density of large trees greater than 60cm diameter and a high density of hollow trees of a range of sizes, including large hollows greater than 15cm diameter which are suitable nesting places for Barking Owls. The species nests alone or in pairs, in hollows of large, old eucalypt trees and requires very large permanent territories in most habitats due to sparse prey densities. Monogamous breeding pairs hunt over as much as 6000 ha, with 2000 ha being more typical in NSW habitats (NSW Scientific Committee, 2004m). Barking Owls primarily feed on invertebrates, however during breeding season, birds and small mammals are also preyed upon.

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

The Project lies within the known distributional range of the Barking Owl and will remove potential forage, nesting and breeding habitat for the species.

Barking Owls are thought to be sedentary, probably remaining in the same territory all year around and from year to year. However, this species has not been recorded during field surveys of the Project Boundary. While the Barking Owl is considered to have potential to occur based on the availability of suitable habitat and availability of prey, the species has not been recorded during field surveys and is known from a low number of records in the LGA. The Project Boundary is not considered likely to currently support a local population of this species. It is unlikely that the Project will have an adverse effect on the life cycle of the species or place a viable local population of the Barking Owl at risk of extinction.

Should the species frequent the locality, they will still be able to utilise large extents of suitable habitat that will remain both within the Project Boundary and extensive conservation areas. These areas will continue to provide important forage, nesting and breeding habitat features for the species.

> *(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*

There are currently no endangered populations of these species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

(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, and

(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

(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.

The Project area lies within the distributional range of the Barking Owl. Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This is unlikely to affect connectivity or the species' movement and dispersal within the locality as they are highly mobile species with naturally sparse distribution and extensive home ranges.

The species has not been recorded in the Project Boundary despite multiple surveys. The species has specific roosting requirements that depend on hollow abundance, size and depth, and they typically continue to use the same site. While potential roost sites may be present, none were identified; suggesting habitat within the Project Boundary does not constitute core nesting or breeding habitat for local populations of the Barking Owl.

The Project Boundary supports varied and abundant forage resources (mammal and bird prey) and is likely to form part of the home range for individuals or pairs that may occur within the LGA. This is unlikely to impact on overall prey resources as the Barking Owl is highly mobile and has a large permanent range. The species can continue to use 787 ha of suitable forage habitat that will remain available within the Project Boundary and extensive areas of habitat in the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Barking Owl has been identified by the Director-General of OEH under the TSC Act.

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

The Project will remove remnant hollow-bearing trees and is therefore not consistent with the objectives and actions of the 2003 Draft "Recovery Plan for the Barking Owl". No Threat Abatement Plans apply to this species.

Ten recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Barking Owl:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat. This includes the removal of potential roosting, breeding and forage habitat for the Barking Owl, including the removal of suitable habitat for prey species. However, this species is an infrequent visitor to the locality, is highly mobile with a large home range and can readily migrate to extensive areas of woodland elsewhere in the locality in response to local conditions.

The Project is not considered likely to have a significant impact on the local occurrence of the Barking Owl.

ii. Little Eagle (Hieraaetus morphnoides)

The Little Eagle (*Hieraaetus morphinoides*) is listed as Vulnerable under the TSC Act. There are 26 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable grassy woodland habitat.

The Little Eagle is a small, territorial raptor, uncommon but with widespread distribution across mainland Australia (Pizzey & Knight, 2003). The species is considered partly migratory, with adults generally resident and sedentary, while the juvenile birds tend to disperse. The species is most

commonly found in open eucalypt forest and woodland with abundant prey availability, she-oak or acacia woodlands and riparian woodlands (Debus, 1984). The species is tolerant of agricultural landscapes provided woodland habitat is available for nesting (Marchant & Higgins, 1993), where they require a tall living tree within a remnant patch.

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

The Project will remove potential forage, nesting and breeding habitat for the Little Eagle. This species has not been recorded during field surveys but has potential to occur as suitable habitat in the form of woodland and open forest with a grassy understorey, and adjacent open agricultural land are available within and adjacent to the Project Boundary.

This species has not been recorded during field surveys and is known from a low number of records in the LGA. The Project is considered unlikely to have an adverse effect on the life cycle of the species or place a viable local population at risk of extinction. The species has sparse but widespread distribution across most of Australia; as a higher order predator, the species naturally occurs in low numbers. The species is highly mobile and has the capacity to disperse and relocate to surrounding habitat that will remain both within the Project Boundary and extensive conservation areas within the locality. These areas will continue to provide important forage, nesting and breeding habitat features for the species including open forest and woodland habitat and hollow-bearing trees for nesting.

> *(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*

There are currently no endangered populations of this species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

> *(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, and*
>
> *(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*
>
> *(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, and*

The Project Boundary lies within the known range of the Little Eagle. Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes potential forage, breeding and nesting habitat for the Little Eagle.

The Little Eagle requires tall, mature living trees in open eucalypt woodland in which to build nests, which will be removed by the Project. However, the species has not been recorded in the Project Boundary despite multiple surveys, and no roosting sites were identified. The Project will also remove habitat for prey species. This is unlikely to impact on forage resources available to the Little Eagle as it is a highly mobile species with a large home range in which it searches for prey. 787 ha of suitable habitat that can support both prey species and roost sites will still be available within the Project Boundary. In the wider locality, extensive areas of suitable habitat are located within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Little Eagle has been identified by the Director-General of OEH under the TSC Act.

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

Recovery plans have not been prepared for the Little Eagle. No threat abatement plans are relevant to this species. Four recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Little Eagle:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;

- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of habitat for the Little Eagle. This includes the removal of potential roosting, breeding and forage habitat, including the removal of suitable habitat for prey species. The long-term viability of the species in the locality is unlikely to be impacted as the species is highly mobile, has a large home range and naturally sparse distribution, and will be able to disperse to woodland margins and surrounding agricultural land elsewhere in the locality.

As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Little Eagle.

iii. Masked Owl (Tyto novaehollandiae)

The Masked Owl (*Tyto novaehollandiae*) is listed as Vulnerable under the TSC Act. There are 6 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have the potential to occur due to the availability of suitable forage, roosting and breeding habitat and proximity of OEH records (within several kilometres).

The Masked Owl is restricted to the coast of NSW and Victoria (Pizzey & Knight, 2003). The species is found within a diverse range of habitats that provide large hollow-bearing trees for roosting and nesting, typically in riparian vegetation, and adjacent open areas for foraging. The Masked Owl is also tolerant of disturbed areas and has a close association with drier, unlogged, or selectively logged forests (Kavanagh, 2002). It is most commonly found within dry eucalypt forests and woodland from sea level to 1100m. Pairs of Masked Owls have a large home range of 500-1000 ha (NSW Scientific Committee, 2010l). The species is threatened by clearing which reduces habitat availability, particularly by limiting nesting resources, and because regrowth after logging makes the habitat less suitable for foraging on key prey such as terrestrial mammals.

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

The Project will remove potential forage habitat for the Masked Owl; however this is unlikely to affect the life cycle or overall viability of the species.

This species has not been recorded during field surveys of the Project Boundary. The Masked Owl is considered to have potential to occur based on the availability of suitable habitat. However, as the species has not been recorded during field surveys and is known from only 4 records in the LGA, the Project Boundary is not considered likely to currently support a local population of this species. Given the species' large home range (pairs maintain and hunt throughout a home range that may be up to 500-1000 ha), it is unlikely that the Project will have an adverse effect on the life cycle of the species or place a viable local population of the Masked Owl at risk of extinction.

Should the species frequent the locality, they will still be able to utilise large extents of suitable habitat that will remain both within the Project Boundary and extensive conservation areas in the locality. These areas will continue to provide important forage, nesting and breeding habitat features for the species including habitat for key prey.

> *(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*

There are currently no endangered populations of these species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

> *(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, and*
>
> *(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*
>
> *(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, and*

The Project area lies within the known range of the Masked Owl. The removal of patches of native vegetation and scattered trees is unlikely to affect connectivity or the species' movement and dispersal within the locality as they are highly mobile species with naturally sparse distribution and extensive home ranges.

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. The species has not been identified in the Project Boundary and no roost sites were identified. Combined with a low LGA count, this suggests the Masked Owl is not a regular visitor to the locality. However, the Project area supports forage resources (mammal and bird prey) and has potential to form part of a much larger home range for individuals or pairs that may occur within the LGA.

Extensive areas of habitat suitable for this species will remain available in the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Masked Owl has been identified by the Director-General of OEH under the TSC Act.

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

The Approved Recovery Plan for the Large Forest Owls was prepared by DEC (NSW) in 2006, the objectives and actions of which cover the Masked Owl.

Three recommended actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Masked Owl:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox*, Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of habitat for the Masked Owl. This includes the removal of potential forage habitat with the removal of suitable habitat for prey species. The long-term viability of the species in the locality is unlikely to be impacted as the species is an infrequent visitor

to the locality; is highly mobile; has a large home range and naturally sparse distribution; and will be able to disperse to extensive areas of habitat elsewhere in the locality.

As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Masked Owl.

iv. Powerful Owl (Ninox strenua)

The Powerful Owl (*Ninox strenua*) is listed as Vulnerable under the TSC Act. There are 67 records of the species within Lithgow LGA (OEH 2011b). This species was not recorded during current field surveys of the Project Boundary; however it was recorded during 1996 surveys. Suitable forage, roosting and breeding habitat is available for this species in the Project Boundary, particularly in taller forest communities.

The Powerful Owl occurs in the eastern quarter of NSW, from the coast to the inland slopes where it inhabits eucalypt forests and woodlands and inland riverine woodland (Barrett et al., 2003). It requires large tracts of native vegetation but can survive in fragmented landscapes. The species requires dense vegetation and large hollows up to 1 m wide and 2 m deep in large remnant trees for nesting (NSW Scientific Committee, 2004o). It feeds on arboreal mammals, particularly ringtail possums. Breeding pairs usually maintain a territory of between 300 and 1500 ha, although size is dependent on the availability of suitable prey densities and habitat quality.

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

The Project will remove suitable forage, roosting and breeding habitat for the Powerful Owl.

This species was not recorded during current field surveys, though it was recorded during previous surveys by Wildsearch (1996) of the Project Boundary. The Powerful Owl is considered to occur based on the availability of suitable habitat and a historical record within the Project Boundary. The species was not recorded during current surveys, despite being detected in 1996. Therefore it can be assumed that Project Boundary forms part of the species habitat. Given the large home range of the species (pairs maintain and hunt throughout a home range that may be up to 1000 ha), and the amount of remaining habitat in the area, it is unlikely that the viability of a local Powerful Owl population will be adversely affected by the Project or place the species at risk of extinction.

When the species frequent the locality, they will still be able to utilise large extents of suitable habitat that will remain both within the Project Boundary and extensive conservation areas. These areas will continue to provide important forage, nesting and breeding habitat features for the species including large tracts of dense vegetation and large hollows.

> *(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*

There are currently no endangered populations of these species listed under Part 2 of Schedule 1 of the TSC Act.

(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

Not applicable to threatened species.

(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, and

(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

(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, and

The Project area lies within the known range of the Powerful Owl. The removal of patches of native vegetation is unlikely to affect connectivity or the species' movement and dispersal within the locality as they are highly mobile species with naturally sparse distribution and extensive home ranges.

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. The species has not been recorded in the Project Boundary since 1996 and no roost sites were identified during current surveys. The Powerful Owl's roosting and nesting habitat is restricted to the sheltered gullies in the Project Boundary. The species has specific roosting requirements; hollows of the size and depth (approximately 1m wide and 2m deep) required for the species are a severely limited resource and depend on remnant trees that are at least 150 years old. The Project Boundary supports large, mature trees with hollows; however those of the required size are limited in abundance due to historical clearing in some of the gully habitats.

Individuals may visit the Project Boundary on occasion as habitat supports forage resources in the form of arboreal and terrestrial prey. The Project Boundary may form part of a much larger home range for individuals or pairs that may occur within the LGA.

Extensive areas of habitat suitable for this species will remain available in the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Powerful Owl has been identified by the Director-General of OEH under the TSC Act.

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

The Approved Recovery Plan for the Large Forest Owls was prepared by DEC (NSW) in 2006, the objectives and actions of which cover the Powerful Owl.

Twenty-one priority actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

> *(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*

The following Key Threatening processes are relevant to the Powerful Owl:

- Clearing of native vegetation as this destroys populations of the species and their habitats;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of habitat for the Powerful Owl. This includes the removal of largely forage habitat, but also some nesting and breeding habitat. The long-term viability of the species in the locality is unlikely to be impacted as the species is highly mobile; has a large home range and naturally sparse distribution; and will be able to disperse to extensive areas of habitat elsewhere in the locality.

As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Powerful Owl.

v. Square-tailed Kite (Lophoictinia isura)

The Square-tailed Kite (*Lophoictinia isura*) is listed as Vulnerable under the TSC Act. There are 6 records of the species within Lithgow LGA (OEH 2011b). This species has been recorded foraging during field surveys of the Project Boundary.

The Square-tailed Kite is a raptor endemic to Australia, with widespread but sparse distribution in coastal and sub-coastal areas (Birds Australia, 2011). The species is most commonly found in open forests and woodlands associated with ridge and gully forests, with particular preference for timbered watercourses; it is a regular resident along the major west-flowing river systems of NSW (NSW NPWS, 1999b; Marchant & Higgins, 1993). The Square-tailed Kite has a large home range of over 100 square kilometres. The species is specialist hunter of passerines (particularly honeyeaters) and foliage insects, with most prey taken from the outer foliage of the tree canopy (NSW NPWS, 1999b).

Except when breeding, this species tends to be a solitary bird, usually seen hunting alone high in, or just above the tree canopy in coastal or sub-coastal rainforest, forest or woodland. Breeding occurs from July to February. Nest sites are usually located near watercourses in a high fork or large horizontal branches of eucalypts (Birds Australia, 2011; Debus & Czechura, 1989) and made from a platform of sticks up to 90cm across.

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

The Project will remove known forage and potential roosting habitat for the Square-tailed Kite; however this is unlikely to affect the life cycle or overall viability of the species.

This species has been recorded during field surveys of the Project Boundary. Given the species' large home range (pairs maintain and hunt throughout a home range that may be up to 10000 ha), it is unlikely that the Project will have an adverse effect on the life cycle of the species or place a viable local population of Square-tailed Kites at risk of extinction.

Should the species frequent the locality, they will still be able to utilise large extents of suitable habitat that will remain both within the Project Boundary and extensive conservation areas. These areas will continue to provide important forage, nesting and breeding habitat features for the species.

> *(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*

There are currently no endangered populations of these species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

> *(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, and*

(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

(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, and

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. The Project lies within the known range of the Square-tailed Kite. As the Square-tailed Kite has been recorded in the wider locality, it is considered likely to at least forage over the Project Boundary as a component of a much larger home range as the Project Boundary supports habitat for arboreal and terrestrial prey. The Square-tailed Kite requires a large hunting range of forest/woodland habitat, particularly containing timbered watercourses.

The removal of patches of native vegetation is unlikely to affect connectivity or the species' movement and dispersal within the locality as they are highly mobile species with naturally sparse distribution and extensive home ranges of over 10,000 ha. Large areas of suitable habitat will remain in the Project Boundary (787 ha of treed habitat) and the wider locality for the Square-tailed Kite, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Square-tailed Kite has been identified by the Director-General of OEH under the TSC Act.

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

Priority actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening processes are relevant to the Square-tailed Kite:

- Clearing of native vegetation as this destroys populations of the species and their habitats;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Competition and grazing by the feral European rabbit *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;

- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of habitat for the Square-tailed Kite. This includes the removal of known forage habitat. The long-term viability of the species in the locality is unlikely to be impacted as the species is not a frequent visitor to the locality; is highly mobile; has a large home range and naturally sparse distribution; and will be able to disperse to extensive areas of habitat elsewhere in the locality.

As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Square-tailed Kite.

I.2.7 Threatened Microchiropteran Bats

Composite Assessments of Significance have been prepared that consider impacts to the following species of microchiropteran bats (microbats) that are known to occur or have the potential to occur in the Project Boundary due to the availability of suitable forage, breeding or roosting habitat and proximity of existing OEH records. They are separated by habitat requirements into hollow-roosting species and cave-roosting species:

- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*);
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Eastern Freetail-bat (*Mormopterus norfolkensis*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Little Bent-wing Bat (*Miniopterus australis*); and
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

i. Hollow-roosting Microbats

The following Assessment of Significance has been prepared as a composite test for a number of hollow-roosting microbat species considered to have potential to occur within the Project Boundary.

a. Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)

The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) is listed as Vulnerable under the TSC Act. There are 49 records of the species within Lithgow LGA (OEH 2011b). This species was not recorded during recent field surveys of the Project Boundary. It was recorded during 1996 surveys, although calls could not be positively identified. The species is considered to have potential to occur due to the

availability of suitable forage, roosting and breeding habitat and proximity of OEH records (within several kilometres).

The Eastern False Pipistrelle is an insectivorous, hollow-roosting species endemic to south-eastern Australia. The species is most commonly found in open forest, wet sclerophyll and coastal forest and mallee, with trees greater than 20m in height and a dense understorey (Churchill, 2008). The species has a home range of up to 136 ha and generally roosts in colonies of three to 80 in the hollow trunks of old eucalypt trees; different roosts are used each night, typically 750m-3.5km apart (Van Dyck & Strahan, 2008). They are absent from small patches of remnant forest, preferring continuous forest where they can forage along tracks, creeks and river.

b. Eastern Freetail-bat (*Mormopterus norfolkensis*)

The Eastern Freetail-bat (*Mormopterus norfolkensis syn. Micronomus norfolkensis*) is listed as Vulnerable under the TSC Act. There are 10 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable forage, roosting and breeding habitat and proximity of OEH records (within several kilometres).

The Eastern Freetail-bat is a solitary, insectivorous bat most commonly found in open spaces in dry sclerophyll forests, woodland and swamp forests in eastern NSW. The species mainly roost in spout hollows of large mature trees and sometimes under bark or in man-made structures (NSW NPWS 2004). They tend to forage in gaps in upper-slope vegetation and over larger waterways.

c. Greater Broad-nosed Bat (*Scoteanax rueppellii*)

The Greater Broad-nosed Bat (*Scoteanax rueppellii*) is listed as Vulnerable under the TSC Act. There are 10 records of the species within Lithgow LGA (OEH 2011b). This species was tentatively recorded during current field surveys of the Project Boundary, however anabat calls could not positively identify the species. This species is considered to have potential to occur due to the availability of suitable forage, roosting and breeding habitat and proximity of OEH records (within several kilometres).

The Greater Broad-nosed Bat is a large insectivorous species with limited distribution along the east coast of Australia. They are found in a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest (NSW Scientific Committee 2004d). This species mainly roosts in tree hollows and cracks or fissures in trunks and branches. The species flies slowly and directly along creek and river corridors in open woodland habitat and dry open forest at low altitudes of up to six metres, foraging for beetles and other large, slow-flying insects after sunset (DEC (NSW) 2005f). They are known to prey on other microbat species (Churchill 2008).

d. Yellow- bellied Sheathtail-bat (*Saccolaimus flaviventris*)

The Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) is listed as Vulnerable under the TSC Act. There are 2 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable forage, roosting and breeding habitat and proximity of OEH records (within several kilometres).

The Yellow-bellied Sheath-tail Bat is a tree-hollow roosting species with wide-ranging distribution through tropical Australia, although is considered rare in south-eastern Australia. It is an insectivorous species that primarily forages above the tree canopy in almost all habitats (DEC (NSW), 2005l1). Most records in NSW have been obtained between January and May, leading to speculation that the species may be migratory in the southern portion of its range, although very little is currently known about seasonal movements. This species roosts in large tree-hollows in groups of between two and thirty (Churchill, 2008).

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

The Project will remove potential forage and roosting habitat for the Eastern False Pipistrelle, Eastern Freetail-bat, Greater Broad-nosed Bat and Yellow-bellied Sheathtail-bat. The Eastern False Pipistrelle and Greater Broad-nosed Bat have been tentatively recorded during 1996 and current field surveys, respectively; however the calls were not positively identified. The Eastern Freetail-bat and Yellow-bellied Sheathtail-bat have not been recorded during surveys of the Project Boundary.

These species are considered to have potential to occur based on the availability of suitable forage habitat and hollow-trees for roosting. However, as the species were not recorded during field surveys and as each has low records in the LGA, the Project Boundary is not considered likely to currently support local populations of these species. The Project is considered unlikely to have an adverse effect on the life cycle of the species or place a viable local population at risk of extinction.

However, should these species frequent the locality, they will still be able to utilise large extents of suitable habitat that will remain both within the Project Boundary and extensive conservation areas.

(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

There are currently no endangered populations of these species listed under Part 2 of Schedule 1 of the TSC Act.

(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

Not applicable to threatened species.

(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, and

(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

(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, and

Approximately 835 ha of woodland and forest are proposed to be removed as part of the Project. This includes potential forage and roosting habitat for the Eastern False Pipistrelle, Eastern Freetail-bat, Greater Broad-nosed Bat and Yellow-bellied Sheathtail-bat.

These species have not been confirmed within the Project Boundary but are considered to have potential to occur based on the species preference for larger tracts of vegetated habitat and as the Project Boundary offers suitable features including hollows for roosting and a tall canopy tree layer and dense understorey for foraging. The Greater Broad-nosed Bat is considered to have low potential to occur as it requires creek and river corridors in open woodland habitat and dry open forest to forage.

Due to the small size of these microbats, it is considered likely that any hollow, no matter how small, may provide habitat for these species (Menkhorst and Knight 2001, DEC (NSW) 2005f). However, as these species have low LGA counts and have not been positively identified in the Project Boundary despite multiple surveys, this suggests that the Project Boundary and surrounding habitat does not constitute critical roosting habitat for these species. As such, the Project is considered unlikely to have significant impacts on the long-term viability of the Eastern False Pipistrelle, Eastern Freetail Bat, Greater Broad-nosed Bat and Yellow-bellied Sheathtail-bat in the locality.

These species are also mobile and have the capacity to disperse to surrounding areas of extensive habitat that will remain available in both the Project Boundary and the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Yellow-bellied Sheathtail-bat, Greater Long-eared Bat, Eastern Freetail-bat and Greater Broad-nosed Bat has been identified by the Director-General of OEH under the TSC Act.

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

The Action Plan for Australian Bats recovery plan published in 1999 is applicable to these species and outlines actions to promote the recovery of these species and the abatement of key threatening processes affecting their occurrence.

(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

The following Key Threatening Processes are relevant to hollow-dependent microbats:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for these species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;

- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Competition from feral honey bees (*Apis mellifera*) as they compete with native fauna for tree hollows and floral resources; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat for the Yellow-bellied Sheathtail-bat, Greater Long-eared Bat, Eastern False Pipistrelle, Eastern Freetail Bat and Greater Broad-nosed Bat. This includes the removal of potential forage, roosting and breeding habitat.

Despite the availability of suitable habitat, these microbat species have low record counts within the LGA and have not been positively recorded in the Project Boundary. As such, the Project Boundary is considered unlikely to support resident populations or have a significant impact on the foraging behaviour or roosting capabilities of these species. The long-term viability of the species in the locality is unlikely to be impacted.

ii. Cave-roosting Microbats

The following Assessment of Significance has been prepared as a composite test for a number of cave-roosting microbat species known or considered to have potential to occur within the Project Boundary based on the availability of suitable habitat.

a. Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)

The Eastern Bent-wing Bat (*Miniopterus orianae oceanensis*) is listed as Vulnerable under the TSC Act. There are 31 records of the species within Lithgow LGA (OEH 2011b). This species was recorded during current field surveys of the Project Boundary. Suitable forage, roosting and breeding habitat is available for this species within the Project Boundary.

The Eastern Bent-wing Bat is an insectivorous species that almost exclusively roost in caves and artificial constructions such as mines along the east coast of Australia (Churchill, 2008). The species occurs in large colonies of up to 150,000 individuals and forages above the canopy over forested areas for insects. In south-eastern Australia it hibernates in underground sites in winter (usually large caves with a constant microclimate). It requires very specific conditions in terms of temperature and humidity for maternity sites (Van Dyck & Strahan, 2008). The species changes roosts in response to seasonal needs, and long-distance movements occur occasionally (DECC (NSW), 2005).

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

The Large-eared Pied Bat (*Chalinolobus dwyeri*) is listed as Vulnerable under both the EPBC and TSC Acts. There are 54 records of the species within Lithgow LGA (OEH 2011b). This species was tentatively recorded during current field surveys of the Project Boundary; anabat calls could not positively identify the species. As such, this species is considered to have potential to occur due to

the availability of suitable forage, roosting and breeding habitat and proximity of OEH records (within several kilometres).

The Large-eared Pied Bat is an insectivorous species with poorly known population densities and distribution. It is considered to be patchily distributed from mid-Queensland to southern NSW (DECC (NSW) 2005). Little is known about the habitat requirements of the species, but natural roosts are typically dependent on extensive sandstone outcrops, cliffs and caves, and old mine workings.

The species appears to prefer low to mid-elevation dry open forest and woodland close to these roost features, particularly areas containing gullies. They typically exist in small colonies consisting of less than 50 individuals and use the same cave over many years (SEWPaC 2011a).

c. Little Bent-wing Bat (*Miniopterus australis*)

The Little Bent-wing Bat (*Miniopterus australis*) is listed as Vulnerable under the TSC Act. There is 1 record of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary. This species is being assessed as a precautionary measure; despite only 1 LGA record, suitable forage, roosting and breeding habitat for this species is available in the Project Boundary.

The Little Bent-wing Bat is an insectivorous species that roosts in caves, tunnels, tree hollows, abandoned mines, culverts and other man-made infrastructure. The species prefers well timbered moist eucalypt forest, rainforest, vine thicket and sclerophyll forest where it can forage beneath the dense canopy for small insects. Maternity colonies, of which only five are known in Australia, form in spring and are often associated with those of Common Bent-wing Bats, where larger colonies provide the high temperatures required to rear young. Males and juveniles generally disperse in summer.

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

The Project will remove forage habitat for the Eastern Bent-wing Bat and Large-eared Pied Bat, and potential forage habitat for the Little Bent-wing Bat habitat.

The Little Bent-wing Bat has not been recorded during field surveys of the Project Boundary and is only known from 1 record within the LGA. As such it is not considered likely to occur.

Based on field survey records and LGA counts, it is likely that the Project Boundary supports local populations of the Eastern Bent-wing Bat and Large-eared Pied Bat. The Eastern Bent-wing was recorded during current field surveys; and the Large-eared Pied Bat was tentatively recorded but calls could not be positively identified. While no caves or sandstone 'pagodas' will be removed, vibrations and the proximity of operations may displace local populations. Notwithstanding this, the current mine plan includes a buffer between open cut mining operations and pagoda habitats of between 20-50 metres. The life cycle of these species may be impacted by the Project in the short term; however it is unlikely to place a viable local population of either species at risk of extinction. Sandstone caves and crevices are abundant in the area and any local populations that currently roost within the Project Boundary will be able to relocate to new sites elsewhere in the locality. No maternity sites are known to occur within the LGA.

The removal of vegetation is unlikely to reduce the availability of foraging resources within the locality; these species are unlikely to be adversely impacted as they frequently travel across large distances to find suitable forage habitat. Should the species frequent the locality, they will still be able to utilise large extents of suitable habitat that will remain both within the Project Boundary and extensive conservation areas.

> *(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*

There are currently no endangered populations of these species listed under Part 2 of Schedule 1 of the TSC Act.

> *(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*

Not applicable to threatened species.

> *(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, and*
>
> *(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*
>
> *(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, and*

The Eastern Bent-wing Bat, Large-eared Pied Bat and Little Bent-wing Bat are predominantly cave-roosting species, although bent-wing bat species have also been known to roost in mine shafts, culverts, roof cavities and other artificial structures.

Given current field survey records; the availability of forage habitat and sandstone caves, crevices and outcrops for roosting; and the number of LGA records, local populations of the Eastern Bent-wing and Large-eared Pied Bats are considered likely to occur in the Project Boundary or locality. The species may roost in the Project Boundary or roost elsewhere in the locality but travel to the Project Boundary as part of a larger forage range.

The Project will not remove cave habitat or directly displace local populations. However, the Project has potential to indirectly force the relocation of local populations through noise, vibration and light disturbance. This may cause short term impacts while new roost sites are found. The Project will remove approximately 835 ha of forest and woodland which is likely to include potential forage habitat for these species. However, these species are mobile and regularly travel to find suitable forage resources. They will still be able to disperse to surrounding areas of extensive habitat that will remain available in both the Project Boundary and the wider locality, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants

including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

The Little Bent-wing Bat is not likely to occur within the Project Boundary but is subject to the same potential impacts.

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

No critical habitat for the Eastern Bent-wing Bat, Large-eared Pied Bat and Little Bent-wing Bat has been identified by the Director-General of OEH under the TSC Act.

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

The Action Plan for Australian Bats recovery plan published in 1999 is applicable to these species and outlines actions to promote the recovery of these species and the abatement of key threatening processes affecting their occurrence.

(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

- Clearing of native vegetation as this reduces the area of forage habitat available for these species; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of woodland and open forest habitat for the Eastern Bent-wing Bat, Large-eared Pied Bat and Little Bent-wing Bat. This includes the removal of forage habitat to species considered likely to occur (Eastern Bent-wing Bat, Large-eared Pied Bat).

These microbats are cave-roosting species that tend to have large forage ranges and can thus still forage in habitat that will remain available elsewhere in the Project Boundary and surrounding conservation areas. The long-term viability of the species in the locality is unlikely to be impacted; however as a precautionary measure, and when considered without mitigation, local populations of the Eastern Bent-wing Bat and Large-eared Pied Bat have potential to be significantly affected by the Project.

I.2.8 Threatened Mammals

- Brush-tailed Rock-wallaby (*Petrogale penicillata*);
- Eastern Pygmy-possum (*Cercartetus nanus*);
- Koala (*Phascolarctos cinereus*);
- Spotted-tailed Quoll (*Dasyurus maculatus maculatus*);

- Squirrel Glider (*Petaurus norfolcensis*); and
- Yellow-bellied Glider (*Petaurus australis*).

i. Brush-tailed Rock-wallaby (Petrogale penicillata)

The Brush-tailed Rock-wallaby (*Petrogale penicillata*) is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act. There are 14 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable habitat on the sandstone escarpments within the Project Boundary and proximity of OEH records.

The Brush-tailed Rock-wallaby was historically widespread and abundant in south-eastern Australia; however it is now restricted in its range and comprised of many isolated populations which are genetically different. It is estimated that the total population size is between 15 000 and 30 000 individuals. In NSW, the species has been recorded in central, southern and western regions and up to 80% of the total population occurs in northern NSW alone (DEC 2005). The species is in 'severe decline' in the Sydney Basin Bioregion (NSW NPWS 2002).

The Brush-tailed Rock-wallaby prefers complex rocky habitats, generally with north-facing slopes and cliff lines, including loose boulder-piles, rocky outcrops, steep rocky slopes, cliffs, gorges and isolated rock stacks (Murray et al. 2008; (Short 1982)). It also utilises tree limbs (Maxwell et al. 1996; Sharman & Maynes 1983). The species is closely associated with dense arboreal cover and occurs in dense rainforest, wet sclerophyll forest, vine thicket, dry sclerophyll forest, and open forest. Vegetation on and below cliffs provide important food resources and shelter. Brush-tailed Rock-wallabies typically shelter during the day in rock crevices, caves and overhangs, yet often bask in exposed sunny spots (Sharman & Maynes 1983). Within their home range, rock-wallabies habitually use the same refuges, sunning spots, feeding areas and pathways (Joblin 1983) and these are often defended vigorously (Bayne 1994). The species typically forages at night on a diet primarily consisting of grasses, forbs and some shrubs and ferns (NSW NPWS 2003). Home ranges are estimated to be 6 to 30 ha in size along the cliff line.

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

The Project will remove potential forage, den and breeding habitat for the Brush-tailed Rock-wallaby; however, this is unlikely to affect the life cycle or overall viability of the species such that it would place a local population at risk of extinction.

The Brush-tailed Rock-wallaby is considered to have potential to occur in select areas of the Project Boundary based on the availability of rocky sandstone outcrops and caves on the escarpments and the presence of vegetated areas for foraging. However, the Project will not be removing any sandstone cliffs or pagodas that are critical habitat for this species. The species is known to occur to the east and north of the Project Boundary within Gardens of Stone National Park and Wollemi National Park. It is possible that the species may utilise habitat within the Project Boundary on occasion, but as no sightings, den sites or other evidence of activity (e.g. scats) have been identified despite multiple surveys, the Project is not considered likely to support a local resident colony.

Should the species frequent the locality, individuals will still be able to utilise large extents of suitable habitat that will remain both within the Project Boundary and extensive conservation areas in the locality. These areas will continue to provide important forage, breeding and den habitat features for the species.

> *(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*

Not applicable to threatened species.

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

Not applicable to threatened species.

> *(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, and*
>
> *(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*
>
> *(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, and*

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. The Project lies within the known range of the Brush-tailed Rock-wallaby; however no known colonies have been identified; the species has not been recorded in the Project Boundary despite multiple surveys; and no shelter or breeding sites have been identified.

It is considered to potentially occur within the Project Boundary due to the presence of suitable habitat and known records in the LGA. Fifteen known colonies have been identified within one population in the Yengo National Park and Parr State Recreation Area (Rummery et al. 1995), which are approximately 50km to the east of the Project Boundary. Within a population, 'colony' describes an aggregation of individuals in a patch of suitable habitat, surrounded by unoccupied habitat. As the species is sedentary; has low migration rates between colonies; high site fidelity; and small home ranges of approximately 15ha (700m in length along cliff lines), these known colonies will not be impacted by the Project.

The Project will not directly impact the plateaus, ridges and upper slopes, which contain the sandstone outcropping and the pagoda landscapes suitable for the Brush-tailed Rock-wallaby. These habitat features will be retained and buffered with 20-50m setback from the extent of open cut mining proposed for the Project. Other areas of protected high quality remnants in Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes

State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest will remain in the area.

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

No critical habitat for the Brush-tailed Rock-wallaby has been identified by the Director-General of OEH under the TSC Act.

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

The Project is consistent with the aims and objectives of the 'Recovery Plan for the Brush-tailed Rock-wallaby (*Petrogale penicillata*)', prepared by the then Department of Environment and Climate Change NSW (DECC) in 2008.

The Action Plan for Australian Marsupials and Monotremes, prepared by Wildlife Australia in 1996, is also applicable to the Brush-tailed Rock-wallaby.

Twenty-seven priority actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Brush-tailed Rock-wallaby:

- Clearing of native vegetation as this reduces the area of forage habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of den habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and den habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of vegetation which includes some forage habitat for the Brush-tailed Rock-wallaby in areas below cliff lines.

The Project will not remove important breeding and shelter habitat such as rocky outcrops and sandstone plateaus on which the species depends. Further, the Project open cut footprints will be set back from cliff lines by at least 20-50 metres. The long-term viability of the species in the locality is unlikely to be impacted as no Brush-tailed Rock-wallaby colonies are known to exist within the Project Boundary or near vicinity. A known population occurs within Yengo National Park; however this is approximately 50km away and will not be impacted by the Project. Locally occurring populations or colonies will still be able to utilise extensive areas of habitat elsewhere in the locality, including protected national parks.

As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Brush-tailed Rock-wallaby.

ii. Eastern Pygmy-possum (Cercartetus nanus)

The Eastern Pygmy-possum (*Cercartetus nanus*) is listed as Vulnerable under the TSC Act. There are 7 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable habitat and proximity of OEH records.

The Eastern Pygmy-possum is a small (15 to 43 grams) possum distributed across south-eastern Australia. In NSW, the species extends from the coast to the western slopes and is most commonly found in rainforest, sclerophyll forest and woodland, and heath. The species shelters in tree hollows, rotten stumps, shredding bark, holes in the ground, abandoned bird-nests, Ringtail Possum (*Pseudocheirus peregrinus*) dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females. The species is generally solitary and individuals maintain several nests. The species frequently spends time in torpor in winter. Males have non-exclusive home-ranges of about 0.68 hectares and females about 0.35 hectares (DEC (NSW) 2005c). Forage resources are primarily nectar and pollen collected from banksias, eucalypts and bottlebrushes; soft fruits and insects are important where flowers are less abundant.

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

The Project will remove potential nesting and forage habitat for the Eastern Pygmy-possum; however, this is unlikely to affect the life cycle or overall viability of the species such that it would place a local population at risk of extinction.

No records for the Eastern Pygmy-possum exist within the Project Boundary, despite multiple surveys. No resident population is considered to occur in the Project Boundary; however, as the species is small and cryptic and has been recorded elsewhere in the locality in similar habitat, there is potential for this species to occur in the Project Boundary.

(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

Not applicable to threatened species.

(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

Not applicable to threatened species.

(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, and

(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

(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, and

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes potential nesting and forage habitat for the Eastern Pygmy-possum. No known populations have been identified in the Project Boundary and there are a low number of records in the LGA; however the species is considered to have potential to occur due to the availability of various nesting habitat features and abundance of preferred flowering eucalypts.

This species is adversely impacted by woodland clearing as it removes important forage resources and trees and shrubs that provide suitable nesting habitat. As the species has restricted home ranges (approximately 0.68 ha for males and 0.35 ha for females), the removal of vegetation may increase the vulnerability of potentially occurring individuals by reducing their capacity to move through the landscape and disperse. Eastern Pygmy-possums are generally solitary, so this could potentially lead to isolation and impact on their ability to find mates and reproduce.

Known records for the species are located approximately 25km to the south east of the Project. The viability of these individuals or other potential populations in the LGA will not be impacted or reduced by the Project. Should the species frequent the locality, habitat features will be retained in the Project Boundary, and also within protected high quality remnants of Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Eastern Pygmy-possum has been identified by the Director-General of OEH under the TSC Act.

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

The Action Plan for Australian Marsupials and Monotremes, prepared by Wildlife Australia in 1996, is applicable to the Eastern Pygmy-possum.

Priority actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Eastern Pygmy-possum:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces structural complexity and the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this structural complexity and results in the loss of key food plants and habitat;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of habitat for the Eastern Pygmy-possum. This includes the removal of potential forage and nesting habitat.

This species has a low LGA count and has not been recorded in the Project Boundary despite multiple surveys. The Project is considered unlikely to affect the long-term viability of the species in the locality or place the species at risk of extinction. However, as the species is cryptic; has restricted movement and dispersal capacity; and is adversely affected by fragmentation and possible genetic isolation, it has potential to occur in the Project Boundary. Without mitigation, and as a precautionary measure,

the Project is considered to have potential to impact on the local occurrence of the Eastern Pygmy-possum.

iii. Koala (Phascolarctos cinereus)

The Koala (*Phascolarctos cinereus)* is listed as Vulnerable under the TSC Act. There are 25 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable habitat, including important feed trees *Eucalyptus viminalis,* and proximity of OEH records.

Koalas are large arboreal mammals with wide but fragmented distribution in eastern Australia ranging from the temperate south to the tropical north. The species is most commonly found in eucalypt forests, on the foliage of which the species feeds almost exclusively (Strahan, 1995; Department of Planning, 1995). They are a solitary, sedentary and largely nocturnal species that spend most of the day sleeping in a low fork and climbing into the canopy to feed at dusk (DECC (NSW), 2008b). They often change trees at night and, as favoured trees may be several hundred metres way, they spend a considerable amount of time on the ground. Koala home ranges can vary in size depending on the abundance of local feed trees; in quality habitat, individual home ranges may be as small as 1-2ha and overlap, while in semi-arid country they are generally discrete and around 100ha (Van Dyck & Strahan, 2008). The species is vulnerable to a lack of suitable food and fragmentation which can make them more susceptible to disease and predation (DECC (NSW), 2008b).

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

The Project will remove potential forage and breeding habitat for the Koala; however, this is unlikely to affect the life cycle or overall viability of the species such that it would place a local population at risk of extinction. The Koala has not been recorded within the Project Boundary despite multiple field surveys.

Habitat assessments identified some portions of the Project Boundary that support primary and secondary food trees for the species, including the Grey Gum and Ribbon Gum. However, the absence of records indicates that the Project Boundary is unlikely to support a resident population and, as indicated by relatively low LGA records, that Koala abundance in the locality is low.

Should the species frequent the locality, individuals will still be able to utilise large extents of suitable habitat that will remain both within the Project Boundary and extensive conservation areas. These conservation areas will continue to provide important forage, breeding and den habitat features for the species.

> *(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*

Not applicable to threatened species.

> *(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

Not applicable to threatened species.

(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, and

(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

(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, and

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes the removal of suitable habitat, comprising of some Koala primary and secondary feed trees species (Grey Gums and Ribbon Gums).

The Project lies within the known range of the Koala; however only 25 records exist for the species within the LGA. NSW Atlas records indicate that their distribution within the Lithgow LGA is scattered and restricted to Newnes State Forest and Wollemi National Park. The closest record occurs at Wolgan State Forest, around 8 km north-east of the Project Boundary. Although Koalas have the potential to occur within the Project Boundary, the absence of records during current and previous surveys indicates that abundances would be low. It is possible that the species may utilise habitat within the Project Boundary on occasion, but as no sightings or other evidence of activity (e.g. scats or markings) have been identified despite multiple surveys, the Project is not considered likely to support a local population.

Extensive areas of well-connected vegetation containing feed trees will remain both within the Project Boundary (787 ha) and the locality. Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest will continue to provide good quality, protected habitat for any potentially occurring Koalas.

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

No critical habitat for the Koala has been identified by the Director-General of OEH under the TSC Act.

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

The Project is consistent with the aims and objectives of the 'Recovery Plan for the Koala (*Phascolarctos cinereus*)', prepared by the then Department of Environment and Climate Change NSW (DECC) in 2008.

The 'Action Plan for Australian Marsupial and Monotremes', prepared by Wildlife Australia in 1996, and the 'National Koala Conservation and Management Strategy 2009-2014', prepared by the Natural

Resource Management Ministerial Council in 2009, are strategic conservation actions also applicable to the Koala.

Priority actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

> *(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*

The following Key Threatening Processes are relevant to the Koala:

- Clearing of native vegetation as this reduces the area of forage habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of den habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and den habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of habitat which includes some primary and secondary feed trees for the Koala.

The locality supports some known feed tree species; however, the low number of records within the LGA and the absence of records from field surveys of the Project Boundary indicate the low likelihood for resident populations. Transient individuals have the potential to travel through the Project Boundary infrequently. While the species may occur on occasion, the Project is not likely to impact on the long-term viability of the species in the locality.

As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Koala.

iv. Spotted-tailed Quoll (Dasyurus maculatus maculatus)

The Spotted-tailed Quoll (*Dasyurus maculatus maculatus*) is listed as Vulnerable under the TSC Act and Endangered under the EPBC Act. There are 26 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable forage, den and breeding habitat and proximity of OEH records (within several kilometres).

The Spotted-tailed Quoll is rare across its range in south-eastern Australia. It has been recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest (Van Dyck and Strahan 2008). They require forest with suitable den site features including rock crevices, caves, large hollow logs, burrows and tree hollows (NSW NPWS 1999b). This is a nocturnal, solitary species with a large home range. Females occupy home ranges up to about 750 ha and males up to 3500 ha, and they have been known to travel more than 6km a night, usually traversing their ranges along densely vegetated creek lines (DEC (NSW) 2005j). The species hunts medium-sized reptiles and mammals including possums and rabbits, and carrion.

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

The Project will remove potential forage, den and breeding habitat for the Spotted-tail Quoll. Despite the absence of records during current and previous surveys, the Spotted-tail Quoll is considered to have potential to occur based on the availability of suitable habitat. However, this is unlikely to affect the life cycle or overall viability of the species.

No den sites or evidence of activity (e.g. scats) have been identified during surveys, and the Project Boundary is not considered likely to currently support a local population of this species. Given the species' naturally widespread distribution and low numbers; relatively low LGA count; and large home range (females ranges are up to 750 ha and males maintain and hunt throughout a home range that may be up to 3500 ha), it is unlikely that the Project will have an adverse effect on the life cycle of the species or place a viable local population of the Spotted-tail Quoll at risk of extinction.

Should the species frequent the locality, individuals will still be able to utilise large extents of suitable habitat that will remain both within the Project Boundary and extensive conservation areas. These areas will continue to provide important forage, breeding and den habitat features for the species.

> *(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*

Not applicable to threatened species.

> *(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*

Not applicable to threatened species.

(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, and

(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

(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, and

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. The Project lies within the known range of the Spotted-tailed Quoll; however the species has not been recorded in the Project Boundary despite multiple surveys and no den sites have been identified.

As the Spotted-tailed Quoll has been recorded in the wider locality and the species occupy large home ranges (up to 3,500 ha), habitat within the Project Boundary is not considered critical to a local population; however it is considered likely that individuals would occasionally forage or den in the Project Boundary. The Spotted-tailed Quoll requires a large hunting range of forest/woodland habitat, particularly containing timbered watercourses along which it can traverse landscapes. This species creates dens in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields or rocky-cliff faces which are habitat features available within the Project Boundary, particularly around the sandstone pagoda outcrops.

This species is generally adversely impacted by woodland clearing which can isolate already scattered populations; may restrict the availability and abundance of prey species; or remove or alter den sites. However, these outcomes are unlikely to occur as a result of the Project or to impact any local populations as no cave sites will be removed and as large areas of suitable habitat containing important den features will remain in the Project Boundary (787 ha of treed habitat) and the wider locality. Linkages to the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest will continue to facilitate movement of the Spotted-tailed Quoll across the landscape.

It should be noted that the Spotted-tailed Quoll may be susceptible to indirect impacts of the Project. These include 1080 poisoning used in future pest control strategies, and vehicle strike due to the increase in vehicles in and around the Project Boundary and the fact that the species may feed on carrion on roads.

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

No critical habitat for the Spotted-tailed Quoll has been identified by the Director-General of OEH under the TSC Act.

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

A draft national recovery plan for the Spotted-tailed Quoll is currently being prepared. The Action Plan for Australian Marsupials and Monotremes, prepared by Wildlife Australia in 1996, is applicable to the Spotted-tailed Quoll.

Thirty-three priority actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

> *(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*

The following Key Threatening Processes are relevant to the Spotted-tailed Quoll:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species and its prey;
- Loss of hollow-bearing trees as this reduces the abundance of den habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and den habitat;
- Invasion of native plant communities by exotic perennial grasses as this results in the loss of key food plants and habitat;
- Competition and grazing by the feral European rabbit Oryctolagus cuniculus as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox Vulpes vulpes as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa as wallowing and rooting causes direct disturbance to habitats and may increase erosion; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of habitat for this species through direct and indirect impacts. This includes the removal of potential forage, den and breeding habitat for the Spotted-tailed Quoll.

The long-term viability of the species in the locality is unlikely to be impacted as the Spotted-tailed Quoll is not a frequent visitor; is highly mobile; has a large home range and naturally sparse distribution; and will be able to disperse to extensive areas of habitat elsewhere in the locality. Important den habitat in rocky outcrops and caves will not be removed by the Project, and prey species will remain available elsewhere in the locality.

As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Spotted-tailed Quoll.

v. Squirrel Glider (Petaurus norfolcensis)

The Squirrel Glider (Petaurus norfolcensis) is listed as Vulnerable under the TSC Act. There are 14 records of the species within Lithgow LGA (OEH 2011b). This species was recorded during current field surveys within the East Tyldesley portion of the Project Boundary. Suitable habitat is available throughout the Project Boundary.

The Squirrel Glider is widely, but sparsely distributed in eastern Australia from northern Queensland to western Victoria. It commonly inhabits mature or old growth Box-Gum, Box-Ironbark woodlands and River Red Gum forest as the species requires abundant tree hollows for refuge during the day, and nest sites (NSW Scientific Committee 2004f, DEC (NSW) 2005k). They live in family groups and nest in tree hollows and prefer Eucalypt stands with a shrubby or an Acacia midstorey where they can forage at night. Diet varies seasonally but consists of Acacia gum, eucalypt sap, nectar, pollen and insect material. They prefer stands of mixed forests with at least one species of winter-flowering eucalypt or banksia to provide a reliable food source year round (DEC (NSW) 2005k, Van Dyck and Strahan 2008)

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

The Project will remove known and potential nesting and forage habitat for the Squirrel Glider. Two individuals were detected during 2009 surveys and suitable habitat exists throughout the Project Boundary. As such, the direct loss of habitat, including large, remnant trees that support hollows, is likely to have a short-term adverse effect by displacing a local population of Squirrel Gliders and reducing the availability of potential nesting habitat.

However, the long term viability of the species in the locality is unlikely to be impacted as remaining areas of vegetation known to support records will still be available in the wider locality and will not be affected by the Project.

> *(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*

Not applicable to threatened species.

> *(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*

Not applicable to threatened species.

> *(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, and

(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

(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, and

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes known and potential nesting and forage habitat for the Squirrel Glider.

Two individual Squirrel Gliders were detected while spotlighting in the East Tyldesley portion of the Project Boundary during the April 2009 survey. Although these were the only individuals recorded, habitat assessment indicates that suitable habitat for the Squirrel Glider occurs throughout the Project Boundary. It is therefore likely that this species would occur in other portions of the Project Boundary where suitable habitat, including remnant hollow-bearing trees, occurs. The direct removal of vegetation may remove some important feed trees for the Squirrel Glider; however similar habitat is available elsewhere in adjacent conservation areas.

The removal of patches of native vegetation is unlikely to affect connectivity or the species' movement and dispersal within the locality as they are a highly mobile species with naturally sparse distribution. Large areas of suitable habitat will remain in the Project Boundary (787 ha of treed habitat) and the wider locality for the Squirrel Glider, including within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Squirrel Glider has been identified by the Director-General of OEH under the TSC Act.

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

The Action Plan for Australian Marsupial and Monotremes, prepared by Wildlife Australia in 1996, is applicable to the Squirrel Glider.

Six priority actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Squirrel Glider:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;

- Removal of dead wood and dead trees as this reduces structural complexity and the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this structural complexity and results in the loss of key food plants and habitat;
- Competition and grazing by the feral European rabbit *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of habitat for the Squirrel Glider. This includes the removal of known and potential forage and nesting habitat.

Records from current field surveys indicate the Project Boundary is likely to support a local population of the species, or at least fall within the forage range of recorded individuals. While extensive areas of similar habitat are available within adjacent conservation areas, the Project is likely to displace a local population and remove hollow-bearing nesting trees and potential feeding resources such as blossom-producing trees and shrubs on which the species relies.

Without mitigation measures, the Project is considered to have potential to have a significant short-term impact on the local occurrence of the Squirrel Glider.

vi. Yellow-bellied Glider (Petaurus australis)

The Yellow-bellied Glider (*Petaurus australis*) is listed as Vulnerable under the TSC Act. There are 64 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable forage, den and breeding habitat. OEH records exist within Newnes State Forest and Wollemi National Park.

The Yellow-bellied Glider is widely and sparsely distributed across south-eastern Australia. In NSW, its distribution is generally coastal, extending inland to adjacent ranges. The species is a nocturnal, arboreal mammal found in tall sclerophyll forests and woodlands (Van Dyck and Strahan 2008). During the day the species dens in mature hollow-bearing trees. At night, it feeds on eucalypt nectar, sap, manna and invertebrates found under shedding bark (DECC 2007). Sap is extracted from deep V-notched incisions made in the bark of eucalypts and individuals and families demonstrate preference for repeated use of individual trees for many seasons (Mackowski 1988). Yellow-bellied Gliders are known

to utilise a home range of between 30 and 65 ha (Goldingay 1992, NSW Scientific Committee 2004h), and being highly vocal, are more often heard than observed.

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

The Project will remove suitable nesting, den and forage habitat for the Yellow-bellied Glider. However, the removal of potential habitat is considered unlikely to affect the life cycle or overall viability of the species such that it would place a local population at risk of extinction.

Although suitable habitat is available, the species has not been recorded within the Project Boundary. Despite multiple field surveys no den sites in tree hollows or evidence of activity (e.g. V-notched incisions on trees or calls) have been identified, suggesting the Project Boundary does not support a resident population of Yellow-bellied Gliders. As the species have home ranges of up to 65 ha, it is possible that individuals occasionally utilise habitat within the Project Boundary.

> *(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*

Not applicable to threatened species.

> *(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*

Not applicable to threatened species.

> *(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, and*
>
> *(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*
>
> *(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, and*

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes suitable nesting, den and forage habitat that may potentially be utilised by the Yellow-bellied Glider.

While suitable habitat is available in the Project Boundary the absence of records, despite multiple surveys, suggests the Project Boundary does not currently support a resident population of Yellow-bellied Gliders. The removal of large hollow-bearing trees will reduce the overall availability of hollows and potentially suitable den sites for the species in the locality; however as the species is not considered reliant on habitat within the Project Boundary, the loss of hollows is unlikely to impact on the species.

The closest known records for the species are located approximately 25km to the north and to the east of the Project within Newnes State Forest and Wollemi National Park. The dispersal capacity and viability of known individuals or populations will not be impacted or reduced by the Project, primarily as these areas will remain wooded with gaps less than 140 m wide, the typical maximum gliding distance of this species.

It has been suggested that to maintain a viable population of 500 Yellow-bellied Glider individuals, approximately 15,000 ha of unfragmented habitat containing suitable habitat features is required. Areas of this size are few and far between and as such, many existing conservation areas are unlikely to support large viable populations. However, habitat that will be retained in the Project Boundary and within the adjacent Ben Bullen State Forest, Wollemi National Park, Gardens of Stone National Park, Newnes State Forest, Wolgan State Forest, and nearby Sunny Corner State Forest and Winburndale Nature Reserve, will continue to provide extensive and high quality habitat for the species, the total size of which has the potential to support a large population.

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

No critical habitat for the Yellow-bellied Glider has been identified by the Director-General of OEH under the TSC Act.

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

The Project is consistent with the aims and objectives of the 'Recovery Plan for the Yellow-bellied Glider (*Petaurus australis),* prepared by the NSW National Parks and Wildlife Service in 2003.

The Action Plan for Australian Marsupial and Monotremes, prepared by Wildlife Australia in 1996, is also applicable to the Yellow-bellied Glider.

Priority actions have been identified to promote the recovery of this species and the abatement of key threatening processes affecting its occurrence.

(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

The following Key Threatening Processes are relevant to the Yellow-bellied Glider:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces structural complexity and the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this structural complexity and results in the loss of key food plants and habitat;

- Competition and grazing by the feral European rabbit. *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project is expected to impact on approximately 835 ha of habitat for the Yellow-bellied Glider. This includes the removal of potential forage and nesting habitat.

No evidence of Yellow-bellied Gliders has been identified in the Project Boundary, and no resident populations are expected to occur. The long-term viability of the species in the locality will not be reduced as known populations that exist within national parks approximately 25km from the Project will not be impacted. Surrounding conservation areas are extensive and contain important habitat features that can potentially support a large viable population. The species is also highly mobile with naturally sparse distribution and, should any individuals occur, they will be able to disperse to extensive areas of adjacent wooded habitat.

As such, the Project is considered unlikely to have a significant impact on the local occurrence of the Yellow-bellied Glider.

I.2.9 Threatened Reptiles

i. Broad-headed Snake (Hoplocephalus bungaroides)

The Broad-headed Snake (*Hoplocephalus bungaroides)* is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act. There are 8 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary, though one recent record occurs in close proximity to the Project Boundary. Therefore the species is considered to have potential to occur due to the availability of suitable forage habitat and shelter within the sandstone escarpments and vegetation below the these cliffs of the Project Boundary.

It should be noted that although only limited records of this species exist within the LGA, more are considered likely to occur as the species is cryptic and can inhabit a wide range of rock and hollow shelters that are not easily accessible for survey.

The Broad-headed Snake occurs from the coast to ranges of south-eastern Australia, where it is largely confined within an area approximately 250 km of Sydney where Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, occur. The nocturnal species inhabits rock crevices and shelters under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. During summer the species typically migrates about 200m from the

sandstone escarpments to hollows in large trees below. The species feeds primarily on geckos and small skinks but occasionally also eats frogs and small mammals. Broad-headed Snakes have low fecundity, producing four to 12 live young from January to March.

The Project Boundary provides suitable habitat for the species. These habitats exist as a large ridgeline containing cliff lines, escarpments and pagoda landscapes which roughly follows the eastern boundary of the Project Boundary. Below this winter habitat, on both sides, summer habitats occur. The action will remove approximately three-quarters of summer habitats on the western side of the ridgeline i.e. open cut mining will be set back 20-50m from cliff lines. Summer habitats will remain on the eastern side of the ridgeline beyond the Project Boundary within Ben Bullen State Forest and Wollemi National Park.

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

The Project will remove some summer habitats. No winter habitats will be removed.

The Broad-headed Snake is considered to occur in select areas of the Project Boundary based on the availability of rocky outcrops, crevices and caves on the sandstone escarpments and the presence of vegetation and hollows for summer shelter.

However, the Project will not be removing any sandstone cliffs or pagodas that are critical habitat for this species during winter months. Further, a 20-50 metre buffer will set back open cut mine operations and retain some summer habitat. The quality of summer habitats to be retained adjacent to open cut operations is questionable.

(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

Not applicable to threatened species.

(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

Not applicable to threatened species.

(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, and

(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

(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

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. Approximately three-quarters of the species summer habitat will be removed. More specifically, a strip (20-50m) of summer habitat will remain in the Project Boundary. Preferred prey species (geckos and small skinks) were recorded during current and previous surveys of the Project Boundary.

There are very few records of the Broad-headed Snake in the Lithgow LGA. All seven records are located east of the Project Boundary (one in close proximity) within large areas of protected high quality habitat within Ben Bullen State Forest, Wollemi National Park and Blue Mountains National Park. It is possible that these seven known individuals utilise habitats within the Project Boundary; however there are vast areas of suitable habitat within the nearby Wollemi National Park and the Blue Mountains National Park that would adequately support the small population known to occur in the LGA. The Project will reduce summer habitat available in the Project Boundary, however large areas will remain for the known populations.

The Project will not directly impact the plateaus, ridges and upper slopes, which contain the sandstone outcropping and the pagoda landscapes suitable for the Broad-headed Snake.

These habitat features will be retained in the Project Boundary, and also within protected conservation areas including Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve, Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for the Broad-headed Snake has been identified by the Director-General of OEH under the TSC Act.

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

Recovery plans have not been prepared for this species. No other threat abatement plans are relevant to 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

The following Key Threatening Processes are relevant to the Broad-headed Snake:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Bushrock removal as this removes important habitat for some species;
- Removal of dead wood and dead trees as this reduces structural complexity and the abundance of important ground foraging and nesting habitat;

- Invasion of native plant communities by exotic perennial grasses as this structural complexity and results in the loss of key food plants and habitat;
- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project will impact on approximately 835 ha of habitat for the Broad-headed Snake. This includes the removal of summer forage and shelter habitat.

The Broad-headed Snake was not recorded during the field surveys, though one nearby record occurs in close proximity to the Project Boundary. Suitable habitat for this species occurs in some portions of the Project Boundary along the sandstone escarpments and vegetation below these. The Project will retain winter habitats and some summer habitats, though the suitability of summer habitats in close proximity to mining operations is questionable. Suitable habitat (summer and winter) exist in adjacent conservation areas.

Without mitigation measures, the Project is considered to have potential to have a significant short-term impact on the local occurrence of the Broad-headed Snake.

ii. Rosenberg's Goanna (Varanus rosenbergi)

The Rosenberg's Goanna (*Varanus rosenbergi*) is listed as Vulnerable under the TSC Act. There are 5 records of the species within Lithgow LGA (OEH 2011b). This species has not been recorded during field surveys of the Project Boundary but is considered to have potential to occur due to the availability of suitable forage, shelter and breeding habitat. The species is known from the wider locality including records in Turon and Wollemi National Parks.

Rosenberg's Goanna occurs in heath, open forest and woodland on Sydney Sandstone. It is known from Wollemi National Park, the Goulburn and ACT regions and near Cooma. It also occurs in South Australia and Western Australia (DEC (NSW) 2005i). The species requires large areas of habitat, with home ranges estimated to range from 2-40 ha, and is strongly associated with termites and their nests. The species is not considered territorial as many of these home ranges overlap. Termite mounds are critical habitat for this species as it is where they nest, laying up to 14 eggs from which hatchlings emerge after approximately 4 months. Females typically lay batches of eggs in the same termite mound over consecutive years. Hollow logs, rock crevices and burrows, either self-made or dug by other animals (e.g. rabbit warrens) provide suitable shelter for this species. Young goannas

are cryptic and are believed to spend the majority of time living in trees. The species feeds on carrion and actively preys on birds, eggs, reptiles and small mammals.

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

The Project will remove potential forage, breeding and shelter habitat for Rosenberg's Goanna; however, this is unlikely to affect the life cycle or overall viability of the species such that it would place a local population at risk of extinction.

The Project Boundary is not considered likely to support a local resident population of Rosenberg's Goanna. It is possible that the species may occasionally utilise habitat within the Project Boundary as the species requires large tracts of habitat which contain termite mounds which are habitat features critical for the species' life cycle.

Due to this reliance, it is possible that the four known records within the Lithgow LGA may occasionally utilise habitat within the Project Boundary as the Project falls within the large home range (on average 20 ha) of individuals. Preferred prey species (birds, reptiles and small mammals) were recorded during current and previous surveys of the Project Boundary; however these species are abundant elsewhere in the locality and within the home range of known records.

> *(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*

Not applicable to threatened species.

> *(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*

Not applicable to threatened species.

> *(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, and*
>
> *(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*
>
> *(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*

Approximately 835 ha of woodland and open forest are proposed to be removed as part of the Project. This includes some suitable shelter, nesting and forage habitat that may potentially be utilised by Rosenberg's Goanna.

There are very few records for Rosenberg's Goanna in the Lithgow LGA; only 4 records exist, within large areas of protected high quality habitat, predominately in the Wollemi National Park. Rosenberg's Goanna is considered to have potential to occur in select areas of the Project Boundary based on the presence of scattered termite mounds and the availability of some shelter habitat in portions of the Project Boundary where rocky outcrops and large hollow logs occur. The habitat likely used would include the woodland of the mid to upper slopes and heath within the ridgelines and rocky escarpments more so than the taller gully forests. The Project will not be removing any sandstone cliffs or pagodas that are important habitat for this species. The Project will not reduce the overall habitat or prey species available to known populations.

The Project will not directly impact the plateaus, ridges and upper slopes, which contain the sandstone outcropping and the pagoda landscapes suitable for Rosenberg's Goanna. These habitat features, as well as woody debris and prey habitat, will be retained in the Project Boundary and also within protected conservation areas and will continue to support any local populations. Such areas include Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve, Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of Ben Bullen State Forest.

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

No critical habitat for Rosenberg's Goanna has been identified by the Director-General of OEH under the TSC Act.

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

Recovery plans have not been prepared for this species. No other threat abatement plans are relevant to 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

The following Key Threatening Processes are relevant to Rosenberg's Goanna:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Bushrock removal as this removes important habitat for some species;
- Removal of dead wood and dead trees as this reduces structural complexity and the abundance of important ground foraging and nesting habitat;
- Invasion of native plant communities by exotic perennial grasses as this structural complexity and results in the loss of key food plants and habitat;

- Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus* as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land;
- Predation by the European Red Fox, *Vulpes vulpes* as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk, particularly as they predate on nests and nesting females;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* as wallowing and rooting causes direct disturbance to habitats and may increase erosion; and
- Anthropogenic climate change as this can reduce the geographic range of species and alter the structure and composition of communities.

Conclusion

The Project will impact on approximately 835 ha of potential habitat for Rosenberg's Goanna. This includes the removal of some potential forage, shelter and nesting habitat.

Rosenberg's Goanna has not been recorded during the field surveys and is known from only 4 records within the LGA, mostly in Wollemi National Park. Suitable shelter habitat for this species occurs in some portions of the Project Boundary along the sandstone escarpments. However, termite mounds, which are critical nesting habitat for the species, are scattered and not abundant in the Project Boundary. As the Project will retain rocky outcrop habitat, and as suitable habitat exists in adjacent conservation areas where known records exist, the Project is not considered likely to have a significant impact on the local occurrence of Rosenberg's Goanna.

Appendix J

Existing Rehabilitation Assessment Report EcoBiological (2010)

23 MARCH 2012

Existing Rehabilitation Assessment: Cullen Valley Mine and Invincible Colliery

Vegetation Rehabilitation blocks 2002, 2003, 2004 and 2008

December 2010

Report prepared for Hansen Bailey.

This report was prepared for the sole use of the proponents, their agents and any regulatory agencies involved in the development application approval process. It should not be otherwise referenced without permission.

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23 March 2012

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ecological survey & assessment

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Plate 6: Photograph of quadrat 2. 14

Introduction

Coalpac Ltd Pty has approval to extract coal from the Cullen Valley Mine and Invincible Colliery (the project site), which are located approximately 20km north-west of Lithgow. Coal extraction methods include the use of both open cut and highwall mining. Consent conditions require the vegetative rehabilitation of mined areas following coal extraction. **ecobiological** was appointed by Hansen Bailey in December 2010 to independently assess the progress and quality of the rehabilitation established to date at the Cullen Valley Mine and Invincible Colliery. Performance criteria addressed in this assessment include species diversity, plant density, proportion of each structural layer, height, native and weed foliage cover.

1.1. Rehabilitation Objectives

The primary objective of site revegetation and regeneration is to create a stable final landform with acceptable post-mining land use and capability. Revegetation and regeneration of the backfilled mined areas is conducted generally on a progressive basis over the life of the mines, as an integral component of mining operations. All revegetation and regeneration works are scheduled to commence as soon as practicable after mining disturbance. This approach minimises the disturbed area at any given point in time and hence reduces the potential ecological impact.

Open cut mine areas and overburden emplacement areas, continue to be progressively revegetated and regenerated to self-sustaining indigenous vegetation communities. The proposed final land form aims to emulate the pre-mining environment to enhance local and regional ecological linkages across the site and surrounding areas. Revegetation works utilise local provenance species, wherever possible.

The reinstatement of the majority of the proposed disturbance area to self-sustaining native vegetation communities provides a sustainable final land use option. The principal revegetation technique used has been direct seeding and tubestock planting involving a range of indigenous native tree and shrub species (Global Soil Systems, 2007).

1.2. Scope of Investigation

The 2010 mine vegetation rehabilitation investigation includes an assessment of the following areas:

- 2002 (8 year old) rehabilitation at the Cullen Valley;
- 2003 (7 year old) rehabilitation at the Cullen Valley;
- 2004 (6 year old) rehabilitation at the Cullen Valley; and
- 2008 (2 year old) rehabilitation at Invincible Colliery.

Two baseline quadrats were located in native vegetation adjacent to the rehabilitation areas. One in remnant vegetation surrounding the Invincible Mine coal handling and preparation plant (CHPP) and the other in remnant forest directly south of the Cullen Valley open cut mine haul road. The location of the baseline quadrats is shown in Figure 1.

1.3. Limitations

The native vegetation communities in the surrounding lands has favored specific geologies and hydrological preferences over very long periods of time (eons), and the preparation of the rehabilitation sites after mining is unlikely to support entirely consistent landforms. As such the complexity derived from native vegetation remnant can only be an indicative target.

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2. Method

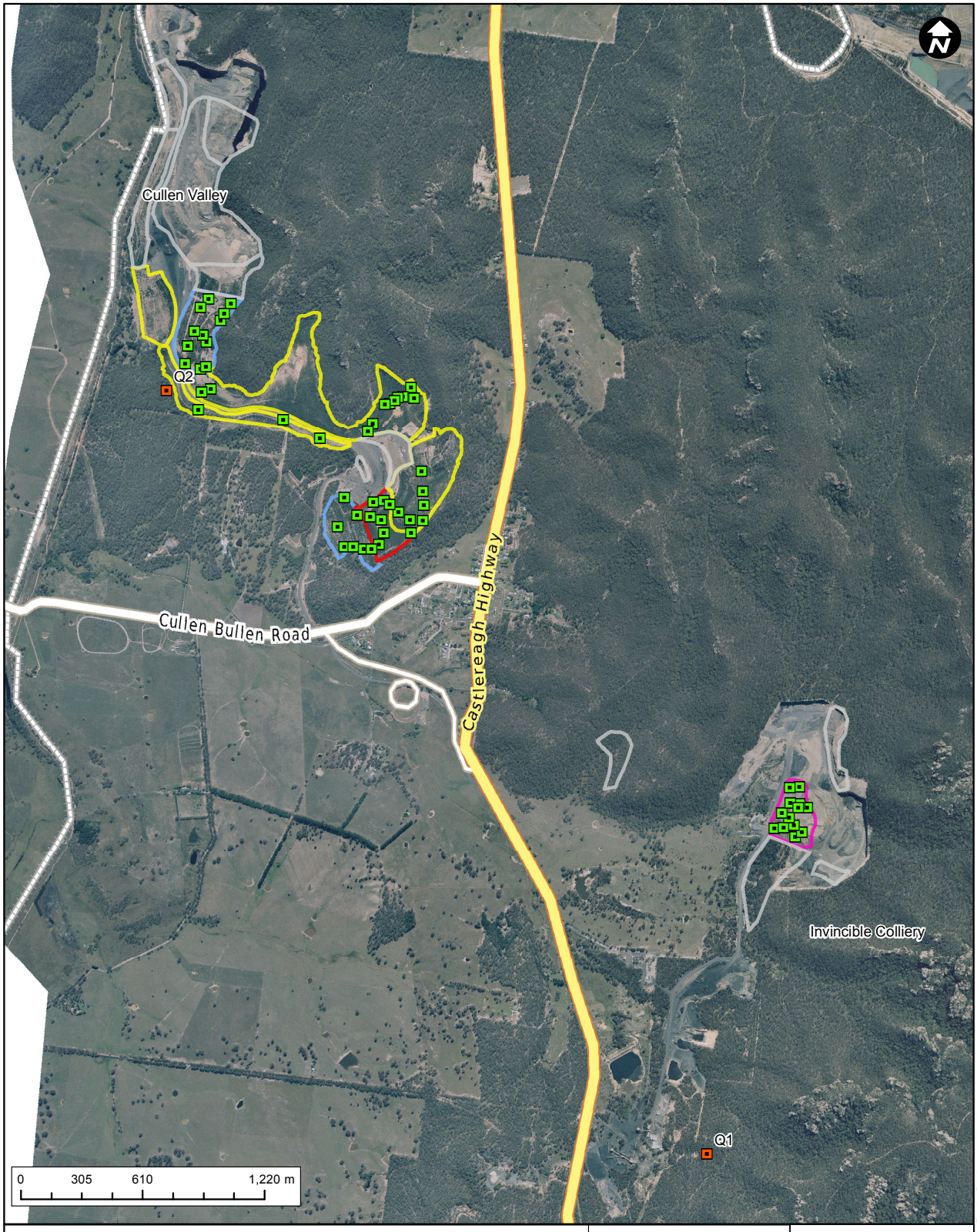
A site inspection occurred between the 13th and 15th of December 2010 by Ryan Parsons and Dan Pedersen. To determine the target level for each of the performance criteria, two 20 m x 20 m floristic quadrats were surveyed in the native vegetation surrounding subject site (Figure 1). Within each of these floristic quadrats, five 2 m x2 m floristic plots were randomly located to determine the target parameters of each performance criteria to assess rehabilitation against. Data collected from each of these plots is presented in Table 1.

To assess the designated growth and development parameters in each of the rehabilitation blocks, 2 m x 2 m floristic plots were located regularly across each block. This method aims to gain an understanding of spatial variability. The location of each plot was recorded with a handheld Global Positioning System (GPS) for later reference (Figure 1). Table 1 indicates the data collected from each plot. A total of 60 2 m x 2 m plots were surveyed over the rehabilitation areas. This is represented by 8, 22, 17 and 13 plots located on the rehabilitation blocks from years 2002, 2003, 2004 and 2008, respectively. The number of plots is proportional to the size of each rehabilitation block, as the size of the rehabilitation increased so too did the number of plots. A photographic record was also taken at locations which best represented the rehabilitation status of each block.

Table 1: Details of data collected from each sample plot.

Performance Criteria	Details	Description
Species Diversity	The total number of plant species present.	A measure of biodiversity.
Plant Density	The total number of plants present.	A measure of plant density.
Stratum proportions – ground, shrub, midstorey and overstorey species	The proportion of species which will become ground, shrub, midstorey and overstorey layers.	A measure of the stage of vegetation development and community structure.
Height	The average height of all structural layers.	An indicator of overall growth.
Foliage Cover	An estimate of the total plot area having plant cover-percentage of area.	A measure of the total green cover for the rehabilitation area, including native and exotic species.

Figure 1 - Flora survey locations & methods



Legend

- 2002 Rehab
- 2003 Rehab
- 2004 Rehab
- 2008 Rehab
- Other Rehab Areas
- Floristic Plots on Rehabilitation
- Floristic Quadrats in Surrounding Native Vegetation

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Project Ref:	405-771
Plot Date:	18/01/2011 1152
Revision:	JRN 002

Map Projection:
NSW Lamberts Conformal Conic

Data Sources:
COALPAC - 2010
ecobiological - 2010
Hansen Bailey - 2010

23 MARCH 2012

3. Results and Discussion

The following section shows the rehabilitation status results and assesses them against the projected target levels as defined from the surrounding native vegetation communities.

Based on the results from the flora quadrats and plots surveyed in undisturbed native vegetation communities, the following target parameters were defined for the rehabilitation areas:

- The targeted level of total species diversity was determined to be 11 flora species per 2 m x 2 m plot;
- The target total plant density value was determined to be 48 plants per 2 m x 2 m plot;
- The target stratum proportions for each stratum was determined to be 76% for ground species, 11% for shrub species, 1% for the midstorey species and 12% for overstorey species;
- The target height values for each stratum was determined to be 0.25 m for the ground stratum, 0.5 m for the shrub stratum, 2.5 m for the midstorey and 13 m for the overstorey;
- The target level of the overall native foliage cover was determined to be 71%; and
- Target for weed cover is 0%, however, this is unlikely to be achievable and a nominal figure should be set. **ecobiological** recommends less than 10% weed cover as a target figure.

3.1.1. Species Diversity

The targeted level of total species diversity was determined to be 11 flora species per 2 m x 2 m plot. The rehabilitation blocks 2003, 2004 and 2008 approached target levels, with an average of 8 -10 total flora species per plot. The 2002 rehabilitation has the lowest species diversity, with a total of 6 flora species per plot (Figure 2).

The number species from different stratums is also illustrated in Figure 2. Shrub, midstorey and overstorey species diversity target levels are generally achieved or exceeded across all the surveyed rehabilitation blocks. In comparison, the ground species diversity is between 2-5 times lower than

targeted levels. This data is further discussed in the stratum proportions section 3.1.3.

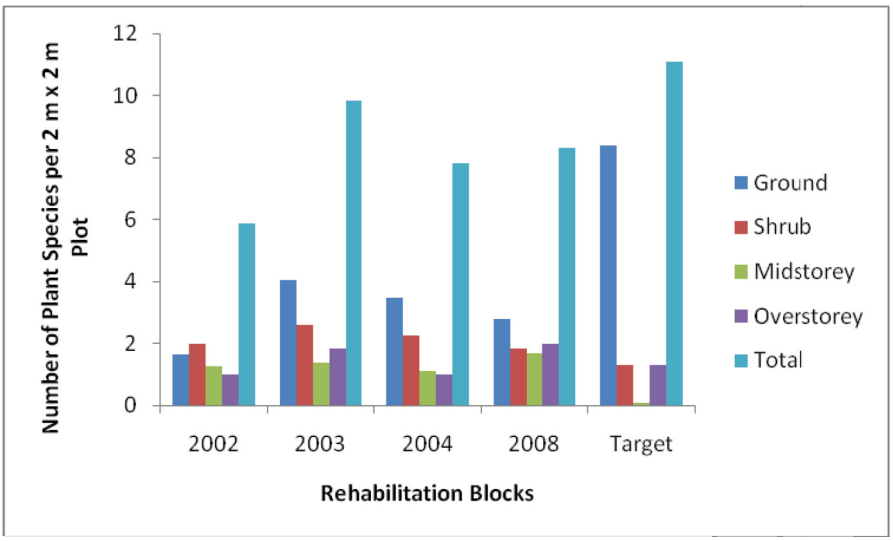


Figure 2: The number of native plant species recorded in each 2 m x 2 m plot from rehabilitation blocks 2002, 2003, 2004 and 2008. The targets values represent levels defined by the native vegetation surrounding the subject site.

The species recorded on the rehabilitation blocks are endemic species, although do not represent a defined vegetation community. The rehabilitation blocks represent a mixture of species from a number of different vegetation communities which occur in the region. Refer to Appendix 1 and 2 for flora species recorded on the rehabilitation and in the surrounding native vegetation.

3.1.2. Plant Density

Figure 3 indicates the number of individual plants recorded in each 2 m x 2 m plot.

The target value was determined to be a total of 48 plants per plot. All surveyed rehabilitation blocks are below this target level, with 12, 27, 13 and 19 total plants per plot on the rehabilitation blocks 2002, 2003, 2004 and 2008, respectively. It is envisaged that over time the number of plants per plot will increase, given that many of the established species are beginning to reproduce (development of reproductive structures and signs of natural spread).

The density of plants on the rehabilitation initially appears to be much greater than the surrounding native vegetation. This density is represented

mainly by shrub, midstorey and overstorey species, with these stratum layers close to or exceeding target levels (Figure 3). In contrast, there is a lack of ground cover species across all surveyed rehabilitation blocks.

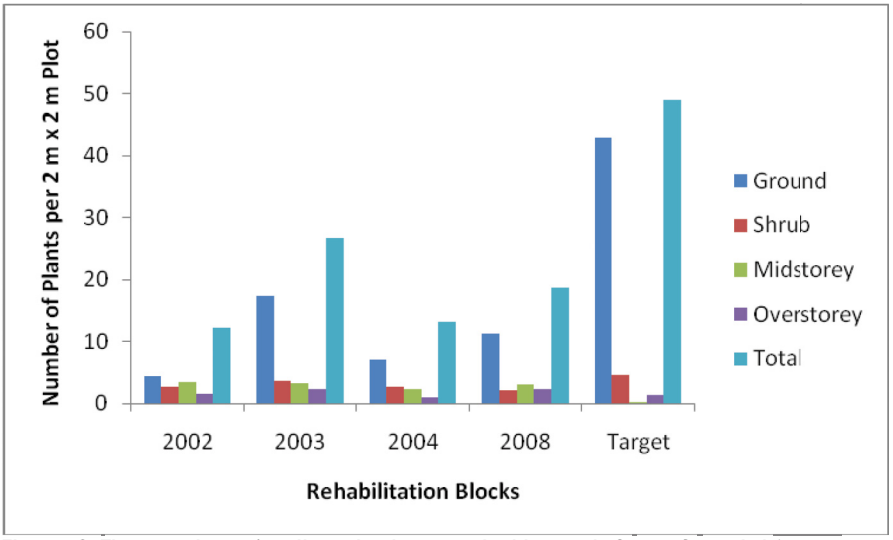


Figure 3: The number of native plants recorded in each 2 m x 2 m plot from rehabilitation blocks 2002, 2003, 2004 and 2008. The targets values represent levels defined by the native vegetation surrounding the subject site.

3.1.3. Stratum Proportions

The target stratum proportions for each stratum are 76% for ground species, 11% for shrub species, 1% for midstorey species and 12% for overstorey species. These results indicate that the greatest proportion of species diversity in the surrounding remnant native forest is represented by ground species. The shrub and overstorey components also make up a considerable proportion, while the midstorey stratum proportion is very low.

A general trend on all the surveyed rehabilitation blocks is an increased proportion of shrub, midstorey and canopy species; along with a much reduced proportion of ground species (Figure 4).

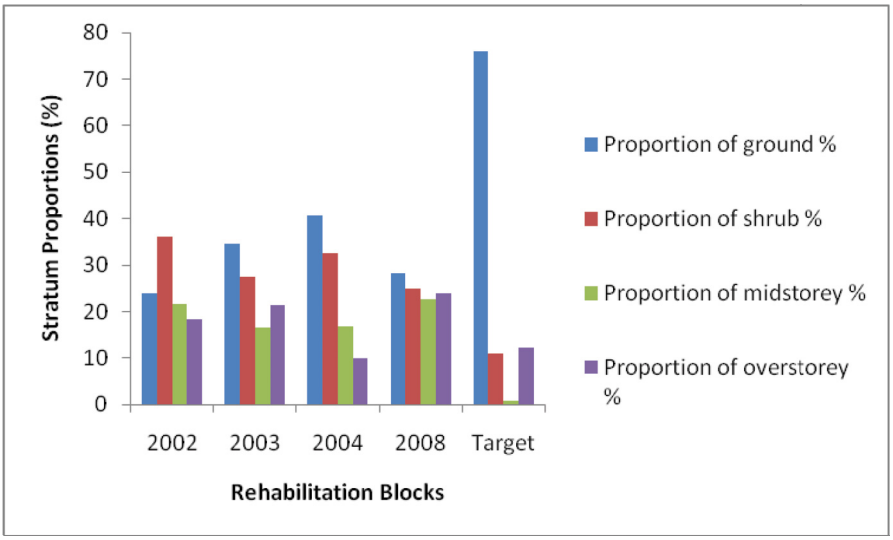


Figure 4: The proportion (%) of native species which make up each structural layer on rehabilitation blocks 2002, 2003, 2004 and 2008. The targets values represent levels defined by the native vegetation surrounding the subject site.

3.1.4. Height

The heights of each structural layer are progressing well on each of the rehabilitation blocks. The target values for the ground, shrub, midstorey and overstorey layers are 0.25 m, 0.5 m, 2.5 m and 13 m, respectively. As shown in Figure 5, rehabilitation blocks 2002, 2003 and 2004 are reasonably similar, either meeting or exceeding the target heights for the ground, shrub and midstorey layers. The heights of the ground, shrub and midstorey layers of rehabilitation block 2008 are lower than the other blocks, as can be expected given its younger age, however targets levels are still being achieved. The height of the overstorey layer is lower than the target value on all rehabilitation blocks due to their relatively young age. It is expected that this layer would meet the desired height approximately 20-30 years post initial rehabilitation works.

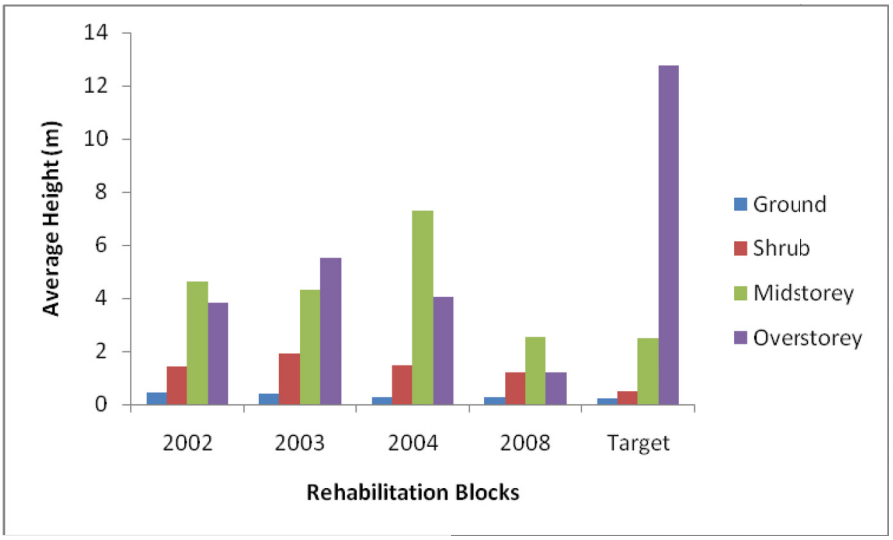


Figure 5: The average height (m) of native species which make up each structural layer on rehabilitation blocks 2002, 2003, 2004 and 2008. The targets values represent levels defined by the native vegetation surrounding the subject site.

3.1.5. Foliage Cover

The target level of the overall native foliage cover was defined as 71%. All the rehabilitation blocks are close to this value, as shown in Figure 6. Rehabilitation blocks 2002 and 2004 slightly exceed the target level, with overall native foliage cover of 78% and 72%, respectively. Rehabilitation blocks 2003 and 2008 are slightly below the target level, with overall native foliage cover of 60% and 58%, respectively.

It should be noted that while the rehabilitation appears to meet the desired native foliage cover, much of this is represented by the shrub, midstorey and overstorey layers. These layers compensate for the lower number and foliage cover of ground layer species, as previously discussed in section 3.1.2.

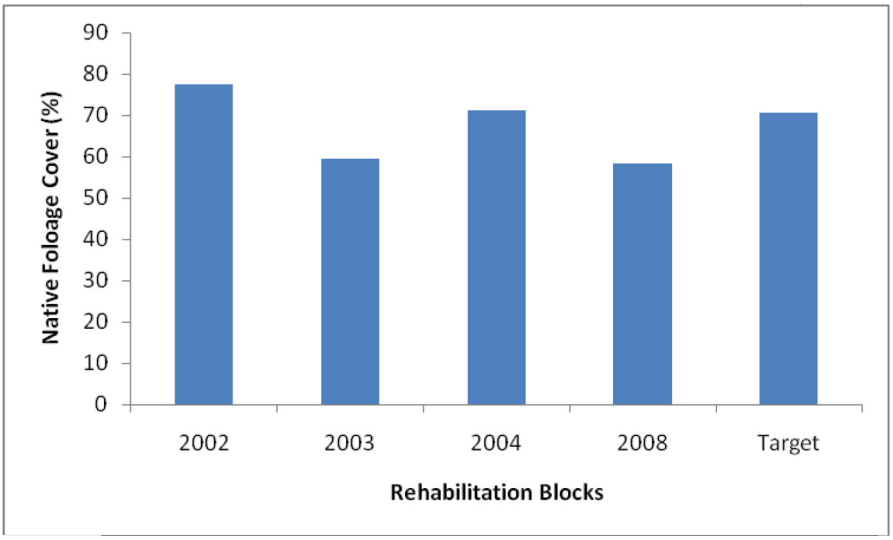


Figure 6: The average native foliage cover on rehabilitation blocks 2002, 2003, 2004 and 2008. The targets values represent levels defined by the native vegetation surrounding the subject site.

3.1.6. Weed Species

The target level of weed foliage cover was defined as less than 10%. On all the rehabilitation blocks weed foliage cover is low, as shown in Figure 7. Rehabilitation block 2008 has the highest weed cover, with approximately 10% cover. This is likely due to the fact that this block is the youngest, and as such has had the most recent disturbance. Pioneer weed species have established and may be outcompeted as growth and development of natives occur. The most significant weed infestations occur at the edges of the rehabilitation blocks, with the internal areas generally having a lower weed foliage cover.

Four weeds declared noxious under the *Noxious weeds Act 1993* were recorded on the rehabilitation, including St John's Wort (*Hypericum perforatum*), Blackberry (*Rubus fruticosus*), African Lovegrass (*Eragrostis curvula*) and Scotch Broom (*Cytisus scoparius*). Minor outbreaks of St John's Wort were recorded on rehabilitation block 2004; however significant infestations occur on rehabilitation block 2008. Scotch Broom and Blackberry represent minor infestations on rehabilitation block 2004 and 2008. African Lovegrass was found at the edges of all the rehabilitation blocks.

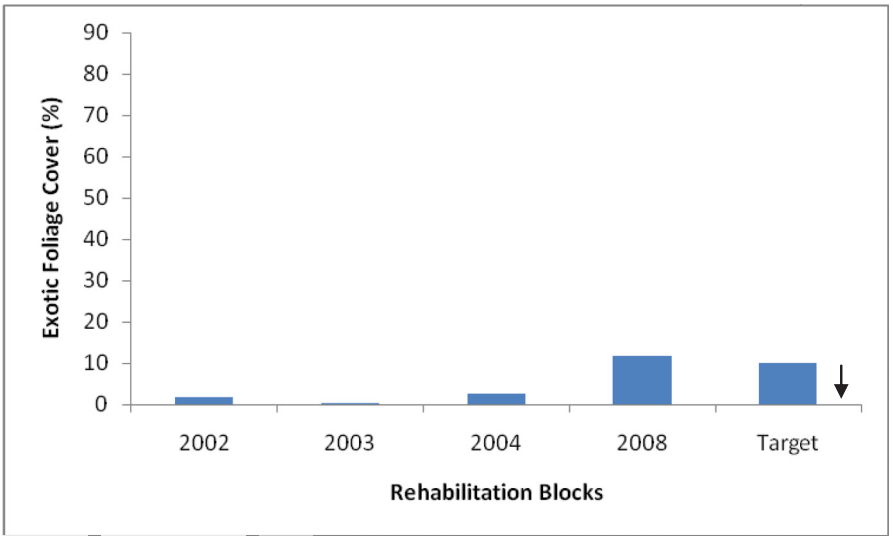


Figure 7: The average weed foliage cover on rehabilitation blocks 2002, 2003, 2004 and 2008.

3.1.7. Photographic Record

The typical status of each rehabilitation block is depicted in plates 1-4. Note the general dominance of *Eucalyptus* and *Acacia* species, over a rather sparse ground cover.

Plates 5 and 6 represent photographs of the quadrats surveyed in the native vegetation surrounding the subject site. These sites were used to determine the target parameters for the rehabilitation blocks.



Plate 1: Photograph of rehabilitation block 2002.



Plate 2: Photograph of rehabilitation block 2003.



Plate 3: Photograph of rehabilitation block 2004.



Plate 4: Photograph of rehabilitation block 2008.



Plate 5: Photograph of quadrat 1 in native vegetation surrounding the site.



Plate 6: Photograph of quadrat 2 in native vegetation surrounding the site.

3.1.8. Capertee Stringybark

The occurrence of the threatened Capertee Stringybark (*Eucalyptus cannonii*), listed as vulnerable under both the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999*, could not be verified on the rehabilitation. This species is common in the area and has previously been planted on the rehabilitation. However, the closely related Red Stringybark (*Eucalyptus macrorhyncha*) is also common to the area and has been planted on the rehabilitation. The only way to separate these two species is from reproductive structures; however plants on the rehabilitation are not at reproductive maturity and as such definitive identification could not be made. Young plants on rehabilitation blocks 2002, 2003 and 2004 could represent individuals of either of these species.

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4. Conclusion

Overall the rehabilitation blocks are progressing well. In terms of species diversity, the number of plant species is close to the target values. Plant density is short of targeted values; however this should increase with time as natural recruitment occurs. The stratum proportions are strongly dominated by the shrub, midstorey and overstorey layers, with a general trend of low numbers of ground layer species. Overall native foliage cover is generally within target values; however the ground layer cover should be increased to reflect levels in vegetation surrounding the site. Plant heights can be seen to be steadily increasing with age of rehabilitation. Weed cover and diversity is overall fairly low across the rehabilitation blocks.

5. References

Global Soil Systems (2007). *Invincible Colliery Open Cut Coal Mine Rehabilitation and Landscape Management Plan*. Report prepared for Coalpac Pty Lt.

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Appendix 1: Flora Species Recorded in Each Rehabilitation Block

* denotes a weed species

Family	Scientific Name	Common Name	2002	2003	2004	2008
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort	✓	✓		
Apiaceae	*Hydrocotyle tripartita*	Pennywort				✓
Apiaceae	*Platysace ericoides*			✓		
Asteraceae	*Cassinia aculeata*	Dolly Bush		✓	✓	✓
Asteraceae	*Cassinia quinquefaria*				✓	
Asteraceae	*Chrysocephalum apiculatum*	Yellow Buttons		✓		✓
Asteraceae	*Cirsium vulgare**	Spear Thistle			✓	✓
Asteraceae	*Conyza* sp.*					✓
Asteraceae	*Euchiton gymnocephalus*				✓	
Asteraceae	*Gamochaeta americana**	Cudweed				✓
Asteraceae	*Gnaphalium* sp.*				✓	
Asteraceae	*Hypochaeris radicata**	Catsear	✓	✓	✓	✓
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood		✓		✓
Asteraceae	*Senecio linearifolius*	Fireweed Groundsel			✓	
Asteraceae	*Senecio madagascariensis**	Fireweed				✓
Asteraceae	*Senecio quadridentatus*	Cotton Fireweed		✓	✓	
Asteraceae	*Senecio* sp.				✓	
Asteraceae	*Sonchus oleraceus**	Common Sowthistle			✓	
Boraginaceae	*Cynoglossum australe*				✓	
Boraginaceae	*Echium vulgare**	Vipers Bugloss				✓
Brassicaceae	*Capsella bursa-pastoris**	Shepherd's Purse				✓
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell			✓	
Campanulaceae	*Wahlenbergia stricta* subsp. *stricta*	Tall Bluebell		✓	✓	✓
Caryophyllaceae	*Stellaria pungens*	Prickly Starwort		✓	✓	✓
Casuarinaceae	*Allocasuarina distyla*	Scrub She-oak		✓	✓	✓
Chenopodiaceae	*Einadia hastata*	Berry Saltbush			✓	✓
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush		✓	✓	✓
Clusiaceae	*Hypericum gramineum*	Small St. John's Wort		✓		
Clusiaceae	*Hypericum perforatum**	St John's Wort			✓	✓
Convolvulaceae	*Convolvulus erubescens*	Blushing Bindweed			✓	

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Family	Scientific Name	Common Name	2002	2003	2004	2008
Cyperaceae	*Carex inversa*					✓
Cyperaceae	*Schoenus apogon*	Common Bog-rush				✓
Dilleniaceae	*Hibbertia obtusifolia*	Hoary Guinea Flower			✓	
Ericaceae - Styphelioideae	*Monotoca scoparia*			✓		
Fabaceae - Faboideae	*Bossiaea* sp.			✓	✓	
Fabaceae - Faboideae	*Cytisus scoparius**	Scotch Broom			✓	
Fabaceae - Faboideae	*Glycine* sp.			✓	✓	
Fabaceae - Faboideae	*Glycine tabacina*				✓	
Fabaceae - Faboideae	*Hardenbergia violacea*	Purple Coral Pea		✓	✓	✓
Fabaceae - Faboideae	*Indigofera australis*	Australian Indigo		✓	✓	
Fabaceae - Faboideae	*Podolobium ilicifolium*	Prickly Shaggy Pea		✓		
Fabaceae - Faboideae	*Trifolium repens**	White Clover				✓
Fabaceae - Mimosoideae	*Acacia buxifolia* subsp. *buxifolia*	Box-leaf Wattle	✓	✓	✓	✓
Fabaceae - Mimosoideae	*Acacia dealbata* subsp. *dealbata*	Silver Wattle	✓	✓	✓	✓
Fabaceae - Mimosoideae	*Acacia decurrens*	Black Wattle	✓	✓	✓	✓
Fabaceae - Mimosoideae	*Acacia falciformis*	Broad-leaved Hickory		✓	✓	✓
Fabaceae - Mimosoideae	*Acacia implexa*	Hickory Wattle		✓	✓	
Fabaceae - Mimosoideae	*Acacia myrtifolia*	Red-stemmed Wattle		✓	✓	
Fabaceae - Mimosoideae	*Acacia obtusifolia*		✓			
Fabaceae - Mimosoideae	*Acacia rubida*	Red-stemmed Wattle	✓	✓	✓	✓
Fabaceae - Mimosoideae	*Acacia* sp.				✓	✓
Fabaceae - Mimosoideae	*Acacia spectabilis*	Mudgee Wattle	✓	✓	✓	✓
Fabaceae - Mimosoideae	*Acacia terminalis*	Sunshine Wattle	✓	✓	✓	✓
Fabaceae - Mimosoideae	*Acacia ulicifolia*	Prickly Moses			✓	
Gentianaceae	*Centaurium erythraea**	Common Centaury			✓	✓
Geraniaceae	*Geranium solanderi*	Native Geranium		✓	✓	
Goodeniaceae	*Goodenia hederacea* subsp. *hederacea*	Forest Goodenia				✓
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort		✓	✓	✓
Haloragaceae	*Haloragis heterophylla*	Rough Raspwort				✓
Iridaceae	*Patersonia sericea*	Silky Purple-Flag		✓		
Juncaceae	*Juncus australis*					✓
Juncaceae	*Juncus vaginatus*		✓			
Lamiaceae	*Mentha satureioides*	Creeping Mint				✓
Lomandraceae	*Lomandra filiformis*	Wattle Mat-rush			✓	
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush		✓	✓	
Malaceae	*Cotoneaster* sp.*				✓	

Family	Scientific Name	Common Name	2002	2003	2004	2008
Myrsinaceae	*Anagallis arvensis**	Scarlet Pimpernel	✓	✓	✓	✓
Myrtaceae	*Eucalyptus albens*	White Box		✓		✓
Myrtaceae	*Eucalyptus bicostata*	Southern Blue Gum		✓	✓	
Myrtaceae	*Eucalyptus bridgesiana*	Apple Box	✓	✓	✓	
Myrtaceae	*Eucalyptus dalrympleana* subsp. *dalrympleana*	Mountain Gum		✓	✓	✓
Myrtaceae	*Eucalyptus dives*	Broad-leaved Peppermint		✓		
Myrtaceae	*Eucalyptus globoidea*	White Stringybark	✓	✓		✓
Myrtaceae	*Eucalyptus macrorhyncha/cannonii*	Red Stringybark	✓	✓	✓	
Myrtaceae	*Eucalyptus melliodora*	Yellow Box			✓	
Myrtaceae	*Eucalyptus obliqua*	Messmate		✓	✓	✓
Myrtaceae	*Eucalyptus pauciflora*	Snow Gum		✓	✓	✓
Myrtaceae	*Eucalyptus punctata*	Grey Gum	✓			✓
Myrtaceae	*Eucalyptus radiata* subsp. *radiata*	Narrow-leaved Peppermint		✓		✓
Myrtaceae	*Eucalyptus rossii*	Inland Scribbly Gum		✓	✓	✓
Myrtaceae	*Eucalyptus rubida*	Candlebark	✓	✓		
Myrtaceae	*Eucalyptus sieberi*	Silvertop Ash		✓	✓	
Myrtaceae	*Eucalyptus* sp.			✓		
Myrtaceae	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark			✓	
Myrtaceae	*Eucalyptus tereticornis/blakelyi*	Forest Red Gum		✓	✓	
Myrtaceae	*Eucalyptus viminalis*	Ribbon Gum		✓		
Nyctaginaceae	*Boerhavia dominii*	Tarvine		✓		
Oleaceae	*Notelaea microcarpa*	Native Olive		✓		
Oxalidaceae	*Oxalis perennans*			✓	✓	✓
Phyllanthaceae	*Poranthera microphylla*		✓	✓	✓	✓
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		✓		
Plantaginaceae	*Plantago lanceolata**	Lamb's Tongues				✓
Poaceae	*Austrodanthonia racemosa* var. *racemosa*			✓	✓	
Poaceae	*Austrodathonia* sp.			✓		
Poaceae	*Austrostipa scabra*				✓	✓
Poaceae	*Austrostipa* sp.			✓	✓	
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass	✓	✓	✓	✓
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass		✓		
Poaceae	*Entolasia stricta*	Wiry Panic		✓		
Poaceae	*Holcus mollis**	Creeping Fog				✓
Poaceae	*Joycea pallida*	Redanther Wallaby Grass	✓	✓		

Family	Scientific Name	Common Name	2002	2003	2004	2008
Poaceae	*Lachnagrostis aemula*	Blowngrass				✓
Poaceae	*Lolium* sp.					✓
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Grass	✓	✓		
Poaceae	*Panicum simile*	Two-colour Panic		✓		
Poaceae	*Phalaris aquatica**	Phalaris			✓	✓
Poaceae	*Poa sieberiana*		✓	✓	✓	✓
Poaceae	*Poaceae* sp.					✓
Polygonaceae	*Rumex* sp.*	Dock				✓
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung			✓	✓
Ranunculaceae	*Clematis aristata*	Old Man's Beard		✓		
Rosaceae	*Acaena novae-zelandiae*	Bidgee-widgee				✓
Rosaceae	*Rubus fruticosus**	Blackberry			✓	✓
Rubiaceae	*Galium binifolium*			✓	✓	
Rubiaceae	*Galium gaudichaudii*	Rough Bedstraw		✓	✓	
Rubiaceae	*Opercularia aspera*	Coarse Stinkweed		✓		
Santalaceae	*Exocarpos cupressiformis*	Native Cherry		✓		
Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell		✓	✓	✓
Solanaceae	*Solanum* sp.				✓	
Violaceae	*Viola betonicifolia*	Native Violet		✓		
Violaceae	*Viola hederacea*	Ivy-leaved Violet		✓		

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Appendix 2: Flora Species Recorded in Surrounding Vegetation

* denotes an weed species

\# denotes a threatened species

Family	Scientific Name	Common Name
Adiantaceae	*Cheilanthes sieberi* subsp. *sieberi*	Poison Rock Fern
Anthericaceae	*Arthropodium* sp.	
Anthericaceae	*Thysanotus tuberosus* subsp. *tuberosus*	Common Fringe-lily
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort
Apiaceae	*Platysace ericoides*	
Asteraceae	*Cassinia aculeata*	Dolly Bush
Asteraceae	*Chrysocephalum apiculatum*	Yellow Buttons
Asteraceae	*Coronidium scorpioides*	Button Everlasting
Asteraceae	*Euchiton involucratus*	Star Cudweed
Asteraceae	*Hypochaeris radicata**	Catsear
Asteraceae	*Lagenophora stipitata*	Blue Bottle-daisy
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood
Asteraceae	*Senecio quadridentatus*	Cotton Fireweed
Boraginaceae	*Cynoglossum australe*	
Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell
Campanulaceae	*Wahlenbergia stricta* subsp. *stricta*	Tall Bluebell
Clusiaceae	*Hypericum gramineum*	Small St. John's Wort
Dilleniaceae	*Hibbertia obtusifolia*	Hoary Guinea Flower
Ericaceae - Styphelioideae	*Brachyloma daphnoides*	Daphne Heath
Ericaceae - Styphelioideae	*Lissanthe strigosa* subsp. *subulata*	Peach Heath
Ericaceae - Styphelioideae	*Monotoca scoparia*	
Fabaceae - Faboideae	*Hardenbergia violacea*	Purple Coral Pea
Fabaceae - Faboideae	*Hovea heterophylla*	
Fabaceae - Mimosoideae	*Acacia buxifolia* subsp. *buxifolia*	Box-leaf Wattle
Fabaceae - Mimosoideae	*Acacia dealbata* subsp. *dealbata*	Silver Wattle
Fabaceae - Mimosoideae	*Acacia gunnii*	Ploughshare Wattle
Fabaceae - Mimosoideae	*Acacia implexa*	Hickory Wattle
Fabaceae - Mimosoideae	*Acacia obtusifolia*	
Goodeniaceae	*Goodenia bellidifolia*	Daisy-leaved Goodenia
Goodeniaceae	*Goodenia hederacea* subsp. *hederacea*	Forest Goodenia
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort
Iridaceae	*Patersonia sericea*	Silky Purple-Flag
Lauraceae	*Cassytha pubescens*	Devil's Twine
Lomandraceae	*Lomandra filiformis*	Wattle Mat-rush
Lomandraceae	*Lomandra glauca*	Pale Mat-rush

Family	Scientific Name	Common Name
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush
Loranthaceae	*Amyema pendulum* subsp. *pendulum*	
Myrtaceae	*Eucalyptus cannonii*#	Capertee Stringybark
Myrtaceae	*Eucalyptus macrorhyncha*	Red Stringybark
Myrtaceae	*Eucalyptus mannifera*	Brittle Gum
Myrtaceae	*Eucalyptus rossii*	Inland Scribbly Gum
Orchidaceae	*Calochilus* sp.	
Orchidaceae	*Dipodium roseum*	
Orchidaceae	*Diuris* sp.	
Oxalidaceae	*Oxalis perennans*	
Phormiaceae	*Dianella revoluta* var. *revoluta*	Blue Flax-Lily
Phyllanthaceae	*Poranthera microphylla*	
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry
Poaceae	*Austrodanthonia racemosa* var. *racemosa*	
Poaceae	*Austrostipa scabra*	
Poaceae	*Austrostipa* sp.	
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass
Poaceae	*Echinopogon caespitosus* var. *caespitosus*	Tufted Hedgehog Grass
Poaceae	*Entolasia stricta*	Wiry Panic
Poaceae	*Joycea pallida*	Redanther Wallaby Grass
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Grass
Poaceae	*Poa sieberiana*	
Rubiaceae	*Galium binifolium*	
Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell
Stylidiaceae	*Stylidium graminifolium*	Grass Trigger-plant

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