Hy-Tec Industries Pty Limited

ABN: 90 070 100 702

Austen Quarry
Stage 2 Extension Project

Terrestrial Ecology Assessment

Prepared by

Niche Environment and Heritage

August 2014

Specialist Consultant Studies Compendium
Volume 1, Part 4

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ABN: 90 070 100 702

Terrestrial Ecology Assessment

Prepared for:

R.W. Corkery & Co. Pty Limited
1st Floor, 12 Dangar Road
PO Box 239
BROOKLYN NSW 2083

Tel: (02) 9985 8511
Fax: (02) 6361 3622
Email: brooklyn@rwcorkery.com

On behalf of:

Hy-Tec Industries Pty Limited
Unit 4, Gateway Business Park
63-79 Parramatta Road
SILVERWATER NSW 2128

Tel: (02) 9647 2866
Fax: (02) 9647 2924
Email: darryl.thiedeke@hy-tec.com.au

Prepared by:

Niche Environment and Heritage
Central Coast/Hunter Office
c/- PO Box W36
PARRAMATTA NSW 2150

Tel: 0425 249 026
Fax: 02 4017 0071
Email: flemckert@niche-eh.com

Ref No: 1335

August 2014

niche Environment and Heritage

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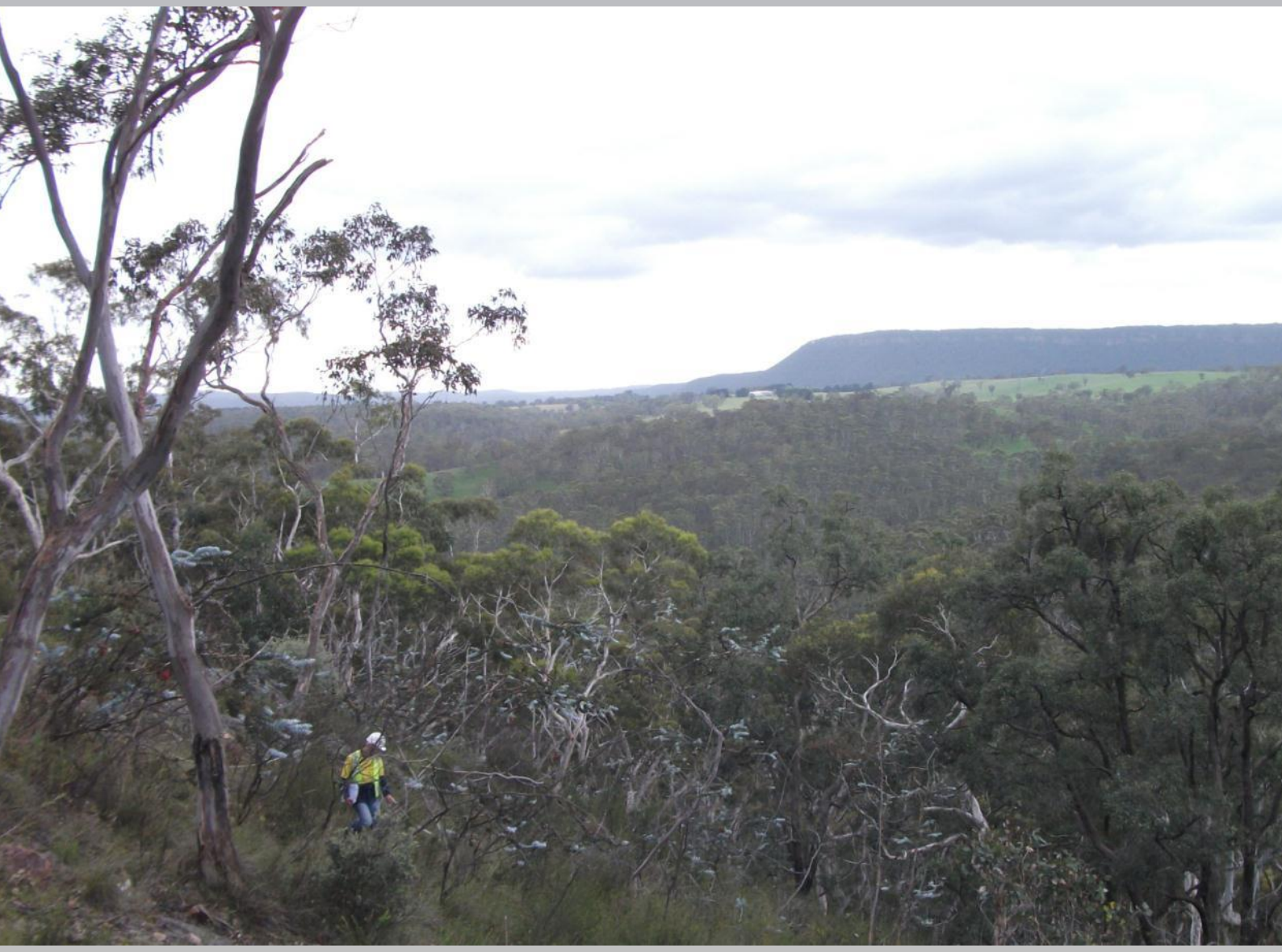

AUSTEN QUARRY – STAGE 2 EXTENSION

Biodiversity Impact Assessment – Terrestrial Ecology

August 2014

DOCUMENT CONTROL

Business Unit	Niche Environment and Heritage, Central Coast/Hunter Office		
Project No.	1335		
Document Description	Biodiversity Impact Assessment (Terrestrial Ecology) to form a compendium of an EIS for the proposed Stage 2 Extension of Austen Quarry		
	Name	**Signed**	**Date**
Supervising Manager(s)	Rhidian Harrington		26 August 2014

Person managing this document	**Person(s) writing this document**
Rhidian Harrington	Nathan Smith

Internal Review	**Name**
	Rhidian Harrington

Document Status	**Date**
Rev5	26 August 2014

Prepared for:	**Organisation**
Phil Calder	Aus10 Rhyolite Pty Ltd

Front Cover Photograph: *Eucalyptus pulverulenta* dominant on a hillside at Austen Quarry

EXECUTIVE SUMMARY

Niche Environment and Heritage Pty Ltd were engaged by Hy-Tec Industries Pty Ltd to assess the impacts of a proposal to expand the current operation of Austen Quarry (the Hartley Stage 2 Extension) on terrestrial biodiversity, including threatened species, populations and ecological communities (threatened biodiversity), as listed on the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This document, the Biodiversity Impact Assessment – Terrestrial Ecology (the BIA) addresses the project's Environmental Assessment Requirements (EARs) as supplied by the Director General of the NSW Department of Planning and Infrastructure (DP&I) that are specific to the assessment of the impacts on terrestrial ecology as a result of the Stage 2 Extension. The report also provides an assessment of the adequacy of a proposed Biodiversity Offset Strategy (BOS), which will be provided upon receipt of comments from OEH and DP&A. A separate report which assess impacts in relation to aquatic ecology has been prepared by Cardno (2013).

As a State Significant Development, the Stage 2 Extension is required to be assessed under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), thus requiring an Environmental Impact Statement (EIS). The BIA will form a compendium of the EIS to be prepared by RW Corkery & Co and also includes an assessment under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), noting that, a Referral to the Commonwealth has been submitted (Referral submitted 14 August 2013).

For the purposes of this report only, the BIA study area is defined as the proposed extension of the existing extraction area, enlargement of the existing overburden emplacement area, the construction of a sediment basin to the south of the overburden emplacement area, a ten metre buffer zone to account for edge effects and the proposed Stage 2 offset area.

The report describes the methods and results of the terrestrial ecological surveys conducted by Niche within the BIA study area in February 2012 and June 2013, and then assesses the potential direct and indirect impacts on threatened biodiversity. The conclusion of the impact assessment, once all avoidance and mitigation measures have been taken into account, is that a residual and unavoidable impact occurs to 29.0 hectares of native vegetation (direct removal of 26.5 hectares and edge effects to 2.5 hectares) which is habitat for a suite of threatened fauna. Furthermore, 721 individuals of the threatened plant *Eucalyptus pulverulenta*, which is listed as vulnerable on both the TSC and EPBC Acts, would be removed by the Stage 2 Extension.

The report concludes that, through the provision of 94.3 hectares of native vegetation and 1,850 individuals of *Eucalyptus pulverulenta* within an adjacent offset area, the Stage 2 Extension can achieve acceptable biodiversity outcomes that meet State and Commonwealth offsetting guidelines and policies. Subsequent to an adequacy review of the BIA by NSW Office of Environment and Heritage (OEH) and the federal Department of the Environment (DoE), a Biodiversity Offset Strategy (BOS) would be developed and implemented. The BOS would describe in detail the in perpetuity security, management and monitoring of the proposed offset area.

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KEY DEFINITIONS AND ABBREVIATIONS

Biodiversity Impact Assessment study area (the BIA study area): For the purposes of this report only, the BIA study area is defined as;

1. The extension of the existing Stage 1 rhyolite extraction area,
2. The enlargement of the overburden emplacement area,
3. The construction of a sediment basin to the south of the overburden emplacement area,
4. A ten metre buffer zone to account for edge effects, and
5. The proposed Stage 2 offset area.

EARs: Director-General's Environmental Assessment Requirements

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

DoE: Commonwealth Department of Environment (formerly DSEWPaC)

DP&I: Department of Planning and Infrastructure

EIS: Environmental Impact Statement

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

EPBC Act: *Environment Protection and Biodiversity Act 1999* (Commonwealth)

ha: Hectares

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

Local population: the population of a particular species that occurs in the study area.

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

Local occurrence: refers to the distribution of a threatened ecological community within the study area and areas of contiguous habitat.

MNES: Matters of National Environmental Significance (from the EPBC Act).

Resilience: the capacity of an ecosystem to regenerate

SEPP: State Environmental Planning Policy

TEC: Threatened Ecological Community

Threatened Biodiversity: threatened species, populations and ecological communities as listed on the TSC and/or EPBC Acts.

TSC Act: *Threatened Species Conservation Act 1995* (NSW)

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1 INTRODUCTION

1.1 Background

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Hy-Tec Industries Pty Ltd (Hy-Tec) to conduct a Biodiversity Impact Assessment for the proposed Stage 2 Extension of Austen Quarry. Austen Quarry is operated by Hy-Tec Industries Pty Ltd and is located approximately 3.5km south of Hartley in NSW (**Figure 1**).

Hy-Tec already operate extraction activities under a previous development consent on the property (DA 103/94 issued by Lithgow City Council). These activities are referred to as Stage 1 and include an extraction and overburden emplacement area. The Stage 2 Extension would expand both the extraction area (i.e., the existing quarry) and also the overburden emplacement area. The Stage 2 Extension is described in further detail in **Section 2**.

1.2 Purpose of this report

The purpose of this report is to address the Director General's Requirements (DGRs), including requirements provided by government agencies consulted by DP&I, that are specific to an assessment of the potential impacts on terrestrial ecology as a result of the Stage 2 Extension. **Section 10** lists the DGRs and provides a cross reference within the report to where each requirement has been addressed. A separate report, which assess impacts in relation to aquatic ecology, has been prepared by Cardno (2013).

Threatened biodiversity is defined as threatened species, populations or ecological communities as listed on the NSW *Threatened Species Conservation Act 1995* (TSC Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

As a State Significant Development, the Stage 2 Extension is required to be assessed under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), thus requiring an Environmental Impact Statement (EIS). The BIA will form a compendium of the EIS to be prepared by RW Corkery & Co.

The BIA also includes an assessment under the Commonwealth EPBC Act, noting that, a Referral to the Commonwealth had previously been submitted (Referral submitted on 14 August 2013). Whilst the *BioBanking Assessment Methodology and Credit Calculator Operational Manual* (DECCW 2009a) and the EPBC Offsets Calculator have been utilised to inform and quantify the offsetting requirements (**Section** 8 of this report), a formalised BioBanking Statement or Agreement is not sought by Hy-Tec in respect to the Stage 2 Extension. Offsetting would occur under the relevant NSW and Commonwealth offsetting policies and guidelines and a Biodiversity Offsets Strategy would be developed to describe the security, management and monitoring of the proposed offsets in detail.

1.3 Objectives of this assessment

In developing the BIA, Niche have met the following objectives of the EIS process:

1. Reviewed previous assessments, monitoring reports and documentation in relation to the BIA study area.
2. Collected, collated and analysed ecological data for the BIA study area.

3. Reported on the Methodology and Results of the ecological surveys.
4. Prepared impact assessments under NSW and Commonwealth legislation (Seven Part Tests and Significance Assessments respectively).
5. Prescribed appropriate amelioration measures to avoid and mitigate impacts.
6. Quantified the residual impact on biodiversity (after accounting for avoidance and mitigation measures) such that requirements for biodiversity offsetting may be determined.
7. Quantified and justified the proposed offsetting scenario.

The BIA has been prepared with regard and with reference to the following State regulatory framework and guidelines:

- ❒ *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians* (DECCW 2009c);
- ❒ *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft* (DEC 2004);
- ❒ *Guidelines for Threatened Species Assessment* (DoP 2005);
- ❒ *BioBanking Assessment Methodology and Credit Calculator Operational Manual* (DECCW 2009a);
- ❒ *The Threatened Species Assessment Guideline – The Assessment of Significance* (DECC 2007);
- ❒ State Environmental Planning Policy No. 44 – Koala Habitat Protection;
- ❒ *NSW offset principles for major projects (state significant development and infrastructure)* (OEH 2013); and
- ❒ *NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects* (OEH 2011).

Regard for the Commonwealth regulatory framework and guidelines has also been demonstrated with reference to:

- ❒ *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DEWHA 2009);
- ❒ Relevant approved recovery plans;
- ❒ *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (SEWPaC 2012); and
- ❒ *Offsets Assessments Guide* (EPBC Act Offsets Calculator, SEWPaC 2012).

2 DESCRIPTION OF THE STAGE 2 EXTENSION

2.1 The Stage 2 Site

2.1.1 Locality and property description

Existing extraction and processing operations (Stage 1) occur on Lot 1, DP1005511. An extension onto Lot 2, DP1005511 and Lot 31, DP1009967 is proposed. The Quarry Access Road is located predominantly on Lot 31, DP1009967 with a small section on Lot 4, DP876394 as it approaches Jenolan Caves Road.

Each of the four lots are owned by the Hartley Pastoral Corporation Pty Ltd (HPC), with whom the Applicant holds a lease for the approved activities within the Stage 2 Site.

Figure 1 illustrates the location of Austen Quarry, approximately 3.5 kilometres south-southwest of the village of Hartley and 10 kilometres south of Lithgow within the Lithgow Local Government Area in NSW.

The disturbance footprint of the proposed Stage 2 Extension, described in **Section 2.2.2,** covers 57.7 hectares and is located within the broader Stage 2 Site covering approximately 144 hectares (**Figure 2**). Of this 57.7 hectares, 26.5 hectares is native vegetation that would be removed. A portion of the Stage 2 Site forms a part the proposed biodiversity offset area. The biodiversity offset area also includes a significant amount of native vegetation to the immediate west of the Stage 2 Site and is 94.3 hectares in area.

Existing quarry operations are approved to continue until March 2020 with the proposed extension to include an increase in quarry life (from 2020) of 30 years, effectively extending operations until 2050.

2.1.2 The natural environment

The Stage 2 Site is adjacent to the Coxs River on the west fall of the Blue Mountains. Land to the south, east and west of the Stage 2 Site consists mainly of wooded ridges and predominantly cleared valleys. Land to the north is mainly gently undulating grazing land. The native vegetation and flora and fauna is described in detail in **Section 4** of this report.

The native vegetation within the BIA study area forms part of a larger patch of adjacent remnant vegetation that is greater than 500 hectares. This native vegetation remnant is in moderate to good condition and is connected to vegetation within the Blue Mountains Wilderness area to the east and partially fragmented vegetation in the Little Hartley area to the north (**Figure 3**).

The existing extraction and associated processing area is devoid of native vegetation, due to on-going activities.

The vegetated areas along the mid-upper slopes and ridges of the Stage 2 Site are in good condition with little evidence of significant past disturbance, except for some tracks and edge disturbances, timber harvesting and light grazing. Fire seems to have been largely excluded. A high level of resilience is apparent throughout most of these areas, which is demonstrated by the diversity of native herbs and ground cover, negligible weed cover and an unaltered soil profile.

The vegetation occurring on the mid-lower slopes of the Stage 2 Site has been historically cleared and thinned and has led to decreased diversity of under-storey and ground cover species. Whilst grazing

has continued on under management by HPC, stocking rates are likely to be much lighter than in the past leading to improvements in habitat quality within this area.

The Coxs River was found to be in good condition and plays an important role within the region as a vegetated corridor promoting connectivity. The vegetation along the Coxs River has been impacted by previous clearing, flooding and weed invasion.

Vegetation on the lower lying areas and gentle slopes within the Stage 2 Site had been impacted by clearing, resulting in a sparse canopy, mid and lower strata layers.

2.1.3 Hydrology

The Coxs River forms the northern and eastern borders of the BIA study area. The disturbance footprint of the Stage 2 Extension is set well back from the Coxs River, coming no nearer than 280 metres at its closest point.

2.1.4 Geology, soils and geomorphology

Austen Quarry is situated within the Bathurst sub-region of the South-eastern Highlands Bioregion (IBRA7, Commonwealth of Australia 2012).

The Stage 2 Site comprises various gradients ranging from flat land (i.e., the ridges) to steep slopes of up to 30 degrees. Drainages are moderately steep and ephemeral in nature.

2.1.5 Existing land uses

Part of the Austen Quarry site is currently subject to existing extraction and processing operations such as crushing and screening (Stage 1 operations). The vegetated areas of the Austen Quarry lease are a part of a larger pastoral property, however formal grazing is likely to be limited to fuel load reduction in these areas.

A conservation area of 2.2 hectares for the protection of *E. pulverulenta* (Conservation Area H), is maintained as required by Condition 7b of DA 103/94 and lies approximately 150 metres to the northeast of the Stage 2 Extension (**Figure 2**). Conservation Area H would remain unaffected by the Stage 2 Extension and continue to be monitored to record the extent of growth and natural regeneration of *E. pulverulenta*.

The Coxs River adjoins the BIA study area and this stretch of the river is used solely for recreational activities by third parties not associated with quarry operations. It is noted that a section of the Stage 2 Austen Quarry Processing Area occurs within 40 metres of the Coxs River and is therefore subject to a Controlled Activity Approval (CAA) under the NSW *Water Management Act 2000* (WM Act). The CAA status, as of January 2014, has not changed despite the application for such an approval being submitted to the NSW Office of Water (NOW) by R.W. Corkery Pty Ltd (RWC) on behalf of Hy-Tec in July 2013.

2.2 Description of current and proposed operations

2.2.1 Current operations

Current operations (Stage 1 extraction, processing and overburden emplacement) are undertaken by Hy-Tec Industries Pty Limited (the Applicant) under Development Consent No. 103/94 (DA 103/94), originally issued by Lithgow City Council. DA 103/94 is current to March 2020.

2.2.2 Proposed operations

No changes to the current processing operations or approved annual production limit (1.1 megatonnes per year) are proposed.

Figure 2 provides an illustration of the main features of the Stage 2 Extension, namely:

- A 17.7 hectares extension of the previously approved Stage 1 extraction area;
- A sediment basin; and
- An extension of the overburden emplacement to the south and west.

Figure 2 also identifies the secondary processing area (rhyolite crushing, screening and stockpiling operations), which would not be modified as a result of the Stage 2 Extension. Other components of the project not represented in **Figure 2** that would not require modification include the primary crushing station within the extraction area and primary conveyor to the secondary processing area, the Yorkeys Creek Stockpile (an elevated terrace to the west of the secondary processing area), other water management infrastructure (discharge to the Coxs River as required and in compliance with EPL 12323), a weighbridge and a sealed Quarry Access Road to Jenolan Caves Road.

The proposed Stage 2 extraction area adjoins the approved Stage 1 extraction area and extends approximately 100 metres to the east and 500 metres to the south. Extraction is proposed to a depth of 685 metres AHD, approximately 60 metres deeper than the current extraction area floor (745 metres AHD) and 55 metres deeper than the footings of the primary crushing station (740 metres AHD). The extraction rate would vary annually in response to product sales and the volume of rhyolite and overburden material encountered each year, however, it would not exceed 1.5 megatonnes per year.

Extraction activities within the Stage 2 extraction area would be a continuation of those currently implemented. These would include land preparation by clearing vegetation (bulldozer and/or chainsaw), soil stripping by bulldozer and stockpiling of cleared vegetation and soil resources. Following the removal of soil, any rippable rock would be ripped using the tynes of a bulldozer or where this is not possible drilled and blasted before being loaded to haul trucks and placed on the overburden emplacement. The exposed rhyolite would be drilled and blasted with the fractured rock loaded into haul trucks and tipped into the hopper of the primary crushing station.

From the primary crushing station within the Stage 1 extraction area, the rhyolite would be conveyed to the Processing Area for further crushing and screening to separate the rhyolite into various size aggregates and to blend some products to produce customised road base products.

The Austen Quarry has approval (DA 103/94) to produce and despatch up to 1 100 000 tonnes per year via the public road network, although it currently operates below its approved maximum limit, despatching up to approximately 750 000 tonnes per annum. Products are despatched between 5 a.m. and 10 p.m. Monday to Friday and 5 a.m. to 3 p.m. on Saturdays. If approved, the production rate from the Stage 2 Extension is projected to increase, although not above the currently approved limit of 1 100 000 tonnes per year.

The Applicant would progressively rehabilitate the Stage 2 extraction and overburden emplacement areas to create a final landform, soil substrate and vegetative cover suitable for passive nature conservation and/or a level of agricultural productivity similar to existing levels. The specific objectives for the long term rehabilitation program are to:

- ❒ Blend the created landforms and vegetation established on the post-mining landform with the surrounding topography;
- ❒ Provide a low maintenance, geotechnically stable and safe landform with minimal erosion, particularly within the Stage 2 extraction area and overburden emplacement; and
- ❒ Re-instate the pre-disturbance soil and land capability in the area used for processing and the Yorkeys Creek Stockpile.

A more detailed description of the existing and proposed activities of the Stage 2 Extension can be reviewed within the EIS, which this document has been prepared to support.

2.3 The Biodiversity Impact Assessment study area

In relation to impacts on biodiversity, the Stage 2 Extension involves four main components (**Figure 4**):

1. Clearing of native vegetation and habitat as a result of the extension of the existing Stage 1 rhyolite extraction area (the "Stage 2 extraction area");
2. Clearing of native vegetation and habitat as a result of the enlargement of the overburden emplacement area (the "Stage 2 overburden emplacement");
3. Clearing of native vegetation and habitat as a result of the construction of a sediment basin to the south of the overburden emplacement area (the "Stage 2 sediment basin"); and
4. Indirect impacts associated with a ten metre buffer zone to account for edge effects (refer to **Section 5.1.1** for a full justification of this buffer zone).

For the purposes of this report only, the above four components, together with the proposed Stage 2 offset area (**Figure 4**), form the **Biodiversity Impact Assessment study area** (the BIA study area). Any operations outside of the BIA study area are not considered in this report, other than to provide context for the assessment. Impacts on biodiversity are assessed in **Section** 5 of this report, amelioration measures described in **Section 6** and the offsetting assessment in **Sections** 7 **and** 8**,** for NSW and the Commonwealth respectively.

2.4 Framework for planning approval

2.4.1 NSW *Environmental Planning and Assessment Act 1979* (EP&A Act)

As the Stage 2 Extension is an extractive industry that would produce more than 500 000 tonnes of products per year, it is recognised as a State Significant Development under State Environmental Planning Policy (State and Regional Development) 2011. As State Significant Development, approval is required from the Minister for Planning and Infrastructure or as delegated by the Minister to the Planning Assessment Commission, the Director-General of DP&I or to another public authority (in accordance with Division 4.1 of the EP&A Act). As such, the Stage 2 Extension is required to be assessed under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), and therefore requires an Environmental Impact Statement (EIS) to be prepared. **Section 10** describes how this assessment complies with the assessment requirements of the Director General of DP&I.

The significance of potential impacts on threatened biodiversity or their habitats, as listed on the TSC Act, is required to be assessed as a part of the EIS. The BIA (this document) will assess the significance of these potential impacts on threatened biodiversity and constitute a compendium to the EIS.

Subject to the receipt of a development consent covering the entire quarry development, the Applicant would relinquish DA 103/94.

State Environmental Planning Policies (SEPPs)

The following six SEPPs could potentially apply to the Stage 2 Extension:

- SEPP (State and Regional Development) 2011;
- SEPP (Rural Lands) 2008;
- SEPP (Mining, Petroleum Production and Extractive Industries) 2007;
- SEPP 33 – Hazardous and Offensive Development;
- SEPP 44 – Koala Habitat Protection; and
- SEPP (Sydney Drinking Water Catchment) 2011.

Local Environmental Plan (LEP)

Austen Quarry is located in an area currently zoned Rural 1(a) under Lithgow Local Environmental Plan 1994 (LEP). Development for the purpose of extractive industry is permissible activities within this zone, subject to development consent.

It is noted that a draft LEP for Lithgow City Council came off public exhibition in August 2013. The draft LEP changes the naming convention for zones and zone development standards to provide consistency with the core mandated zone objectives and drafting directions provided by the DP&I Practice Note Preparing LEPs using the Standard Instrument: standard zones 2011 (PN 11-002). Although the naming of zones and some objectives and development standards are expected to change, the draft LEP does not indicate that these changes will affect the permissibility of extractive industry development at the Site.

2.4.2 Other NSW approvals

Based upon the current design and understanding of environmental issues, the Stage 2 Extension would require the following additional approvals to proceed:

- A variation to Environment Protection Licence No. 12323 under the NSW *Protection of the Environment Operations Act 1997*. The issuing authority is the NSW Environment Protection Authority (EPA); and
- A Controlled Activity Approval under the NSW Water Management Act 2000 is required for existing approved operations. The following describes water related approvals required;
  a) A Water Supply Work Approval issued by NOW in accordance with Section 92 of the Water Management Act 2000 for extraction that intercepts the groundwater table. By virtue of Section 89K of the EP&A Act, such an authorisation or approval cannot be refused if it is necessary for carrying out State Significant Development that is authorised by, and substantially consistent with, a development consent under Division 4.1.
  b) A Water Access Licence issued by NOW in accordance Part 2 of the Water Management Act 2000 for extraction and use of groundwater intercepted by the quarry or surface water extracted from the Coxs River. The Applicant currently holds WAL 24367 for groundwater and WA 25616 for the Coxs River.
  c) An Approval for a Controlled Activity has been sought under the Water Management Act 2000. Approval is required as the secondary processing area and Quarry Access Road occur within 40m of the Coxs River and Yorkeys Creek respectively.

2.4.3 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The Stage 2 Extension has been determined as a controlled action under Section 75 of the EPBC Act. In accordance with the one-off accredited assessment process for this project, the impacts of the controlled action have been assessed under the EP&A Act with reference to additional assessment requirements supplied by DoE (compliance with these requirements is demonstrated in **Section 10**.

3 METHODOLOGY

3.1 Literature and database review

In combination, the results from previous surveys, threatened species database searches and preliminary habitat investigations, serve two key purposes:

1. To inform the list of threatened species required to be targeted for survey within the BIA study area and therefore the survey methods and effort required (subject species);
2. To provide a decision-making framework for determining threatened species likely to be impacted by the Stage 2 Extension (affected species).

Threatened species are those listed as Extinct, Critically Endangered, Endangered And Vulnerable on the relevant schedules of the TSC Act and/or the EPBC Act. Threatened Migratory species as listed on the EPBC Act are also considered.

3.1.1 Review of previous studies

Available literature for the BIA study area includes flora and fauna reports from on-going monitoring programs and previous impact assessments originating as far back as 1994. These reports are listed in **Section 4.1** and their results briefly described.

3.1.2 Threatened species databases

Database searches, consisting of 10 kilometre searches around the BIA study area were conducted in December 2013 to produce a list of potentially occurring threatened and migratory species. The following databases were used:

- The Atlas of NSW Wildlife (**Appendix 1**);
- The NSW Threatened Species Profiles Database; and
- The Commonwealth Department of the Environment (DoE) Protected Matters Search Tool (**Appendix 2**).

3.2 Threatened species likelihood of occurrence

The collation of threatened species data from previous reports, the Atlas and Protected Matters Search Tool has been used to assess the likelihood of occurrence for threatened species, the results of which are provided in **Section 4.1**.

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

Species considered further in formal Assessments of Significance (Seven Part Tests in NSW and EPBC Act Significant Impact Criteria) were those assessed as having a moderate, high or known likelihood of occurrence, and for which known or potential habitat would be impacted. The results of the assessment of likelihood of occurrence for the Stage 2 Extension are provided in **Section 4.2**. Assessment of impacts on these species is provided in **Section** 5.

Table 1: Likelihood of occurrence criteria

Likelihood rating	Threatened Flora/EEC Criteria	Threatened and Migratory Fauna Criteria
Known	The species/EEC was observed within the study area.	The species was observed within the study area.
High	It is likely that a species/EEC inhabits or utilises habitat within the study area for one or more of the following reasons: ❒ preferred habitat present and is in good condition ❒ there is a high number of records of the species within the locality.	It is likely that a species inhabits or utilises habitat within the study area for one or more of the following reasons: ❒ preferred habitat present and is in good condition ❒ species is dependent on habitat within the study area on a permanent or seasonal basis ❒ there is a high number of records of the species within the locality.
Moderate	It is possible that a species/EEC inhabits or utilises habitat within the study area for one or more of the following reasons: ❒ potential habitat for a species/EEC occurs on the site but is in a disturbed condition ❒ records for the species occur within the locality ❒ species is cryptic and was not seasonally targeted.	It is possible that a species inhabits or utilises habitat within the study area for one or more of the following reasons: ❒ potential habitat for a species occurs on the site and the species may occasionally utilise that habitat ❒ species unlikely to be wholly dependent on habitat present within the study area ❒ species was not seasonally targeted or surveyed using optimal techniques for detection.
Low	It is unlikely that the species/EEC inhabits the study area for one or more of the following reasons: ❒ species has a low number of previous records in the locality ❒ non-cryptic species that was not recorded during targeted field surveys. ❒ habitat for the species is not considered to be present within the study area.	It is unlikely that the species inhabits the study area for one or more of the following reasons: ❒ if present at the site the species would likely be a transient visitor ❒ the study area contains only very common habitat for this species which the species does not rely on for its on-going local existence.
None	The species/EEC is not considered to be present within the study area for one or more of the following reasons: ❒ the habitat within the study area is unsuitable for the species/EEC ❒ the species has not been recorded previously in the study area or locality ❒ The study area is beyond the known limit of the species distribution.	The species is not considered to be present within the study area for one or more of the following reasons: ❒ the habitat within the study area is unsuitable for the species/EEC ❒ the species has not been recorded previously in the study area or locality ❒ The study area is beyond the known limit of the species distribution.

3.3 Flora and vegetation survey methodology

3.3.1 Aerial photography interpretation

Vegetation was mapped in a GIS system, using interpretation of digital ortho-rectified aerial photography and GPS-located field vegetation observations, which was compared to existing vegetation mapping at appropriate scales (typically 1:4,000 – 1:8,000). Following the *BioBanking Assessment Methodology* (DECC 2008a), the minimum vegetation polygon size was 0.25 hectares (c. 50 metres x 50 m: longer and narrower polygons were digitised for riparian areas). Photo-interpretation of vegetation communities relies on crown/canopy colour, crown-shadow shape, canopy pattern and topographic association.

A small amount of aerial photograph interpretation (API), in relation to threatened flora, was conducted in order to discern the limits of core habitat for *Eucalyptus pulverulenta*. The core distribution of the species largely coincided with that of vegetation community c1, Silver-leaved Mountain Gum mallee woodland, which could clearly be delineated by API. Individual observations of the species, i.e., those outside of the core areas, were recorded with a GPS whilst in the field.

3.3.2 Plant taxonomy

Plant taxonomy used was consistent with the nomenclature of the *Flora of NSW* (Harden 1992; 1993; 2000; 2002 and the on-line version PlantNet, http://plantnet.rbgsyd.nsw.gov.au/), except where more recent revisions have been published in recognised scientific journals and accepted by the National Herbarium of New South Wales.

3.3.3 Native vegetation

The vegetation and BioBanking field surveys were completed by Nathan Smith and Luke Baker over seven days in two separate survey periods between 27 February and 2 March 2012 and 20 and 21 June 2013. The second survey period was required to cover survey gaps once the Stage 2 Extension area had been finalised.

Floristic and BioBanking plots

In order to classify the vegetation of the site, cover scores using a rating system of 1 through to 6 were applied to each species recorded in a 20 x 20 metre floristic plot nested within 50 x 20 metre BioBanking plot. The floristic and cover abundance data was collected in order to run a full floristic cluster analysis.

At the same time as the collection of the floristic data, BioBanking site attribute data (ten attributes) was collected as per the methodology outlined in Appendix 2 of DECCW (2009a). The method is based on a 20 x 50 metre plot with a 50 metre transect along the centre-line and a 20 x 20 metre floristic plot for native plant species richness. The Native Species Richness score (i.e., the number of native species) from the 20 x 20 metre plot is used as the first of the ten condition attributes in the BioBanking plots. The Biobanking data provides the basis for the quantification of potential offsetting requirements for the Stage 2 Extension.

The minimum number of plots required is prescribed on page 26 of DECCW (2009a). A break down of the plots conducted against the minimum requirement per vegetation type is provided in **Table 3** in **Section 4.3.1**.

Rapid Data Points

The use of the Rapid Data Point (RDP) survey methodology for ground-truthing vegetation mapping is recognised as best-practice in the consulting industry (Siverston 2009).

The collection of RDPs is a method that enables rapid yet accurate vegetation mapping for spatial analysis. Variability in vegetation distribution cannot be fully predicted using remote sensing and GIS and, therefore, ground-truthing vegetation types through field surveys is essential. RDPs are summaries of floristic information recorded at specific points in the field and are used to complement full floristic plot information. RDPs were noted on BioBanking data sheets, field base-mapping (A3 sheets) or a separate note-pad, and later transferred to GIS. Information recorded included:

- Dominant species, estimated cover and height for each layer of vegetation present usually including canopy, mid-storey, shrubs and ground-cover;
- Vegetation condition (Niche uses a measure of 'ecosystem resilience' as a function of disturbance), BioBanking condition (Moderate-Good, Low and Cleared) and other notes regarding habitat and other important features; and
- Physical attributes of the site (vegetation structure, soil type, elevation, slope, aspect, physiographical position) are also recorded and photographs taken for later reference.

All safely accessible tracks and roads across the BIA study area were driven and mapping units recorded on printed A3 maps. Those areas inaccessible by vehicle were walked on foot to ensure that all vegetated parts of the BIA study area were assessed. Polygons were drawn around areas of vegetation and a vegetation type assigned. Subsequently, the remaining data for RDPs was collected at each of the plot locations and the digital mapping updated accordingly.

Floristic analysis

A full floristic cluster analysis of the cover-abundance data (20 x 20 metre plots) was carried out using the multivariate software PATN to inform decisions relating to the vegetation communities present on the site. The resulting dendrogram (**Appendix 7**) from the PATN analysis, combined with supporting data from the RDPs, provides a high level of rigor to the assessment.

The polygons digitised from the API were then codified with a floristic community specific to the plot or RDPs. These communities were subsequently aggregated and aligned with Revised Biometric Vegetation Types (RBVTs), Keith Formation, Keith Class and EEC type (**Appendix 8**). Updating and validation of the vegetation map layer was done progressively throughout the field survey. Polygon areas are reported in hectares (ha) in all relevant tables.

Limitations of the native vegetation survey

Coverage of the site was deemed adequate for the purposes of this vegetation survey (**Figure 5**), although inclement weather and the steepness of the BIA study area made access and mobility around the site difficult. Two surveys were conducted in the last week of summer 2012 and early winter 2013, not ideal for the detection of spring flowering herbs and forbs and therefore, the species richness is likely to be understated. This last point is tempered by the fact that there had been substantial rainfall in the BIA study area over the preceding periods and vegetation biomass was consequently high.

Floristic and BioBanking plots are a measure of the structure, composition and condition of the site at a point in time and therefore previous survey data are not utilised. Furthermore, the current floristic analysis is the first within the BIA study area to use multivariate analysis of cover-abundance scores to aid analysis of vegetation communities. Previous surveys used such data for monitoring purposes only and previously the BIA study area has only been mapped on the basis of validating existing modelled mapping from Benson and Keith (1990) and Tozer (2010). This information has been used as a guide to the vegetation within the BIA study area, however the current survey is considered to comprise the most rigorous analysis of vegetation conducted to date.

3.3.4 Threatened flora surveys

Random meander

A threatened plant random meander following the OEH *Guidelines* (DEC 2004) was conducted targeting threatened plant species with the potential to occur within the BIA study area. A random meander allows optimal coverage of the BIA study area and target species. All threatened plants are marked by GPS and, where time permits, a population estimate conducted.

The minimum amount of time for the random meander is 0.5 hours per plot per stratification unit (DEC 2004). The flora and native vegetation field survey was conducted over five days in February 2012 and June 2013 and included random meander surveys. The threatened flora random meander conducted within the BIA study area was considered more than adequate to meet the minimum survey requirement.

Population counts and estimates

Where a threatened plant population was too large to provide a total count, an estimate was determined by sampling in set plot sizes in order to ascertain a density of individuals, i.e., number of individuals per hectare. This density was then used to estimate the population throughout its known spatial extent (Cropper 1993). In this assessment, such a method was applied to the estimate of *Eucalyptus pulverulenta* within its core habitat areas. The results of this population estimate are contained in **Section 0**.

Limitations of the threatened flora survey

An assessment was carried out during February 2012 and June 2013, and therefore, outside of the peak flowering time for most of the species considered. However, abundant threatened plant survey has been carried out during past impact assessments and monitoring works within the BIA study area and *Eucalyptus pulverulenta* has consistently been the only threatened flora species recorded. *E. pulverulenta* itself is a conspicuous species, detectable in any season.

The assessment of threatened flora likelihood of occurrence in **Section 4.1** indicates that cryptic threatened flora are unlikely to be present within the BIA study area. Given that the subject threatened flora are conspicuous species and unlikely to remain undetected, the season of survey was not considered a major limitation of the assessment.

3.4 Fauna survey methodology

3.4.1 Habitat assessment

The API and vegetation survey work described in **Section 3.3.1** was utilised prior to the field survey to identify potential habitat types for fauna and determine stratification units for survey design.

Habitat assessments were conducted via BioBanking plots throughout the BIA study area and observations of important fauna habitat were made. Habitat characteristics and parameters that were assessed included:

- Aspect and slope of the site;
- Dominant vegetation, floristic composition and structure (informed by the native vegetation survey);
- Composition of ground layer (bare earth, litter, fungi, moss, lichen etc.);
- Presence and relative abundance of key habitat features (e.g. tree hollows, large logs, exfoliating rock, flowering resources, aquatic features);
- Condition and disturbance factors; and
- Vegetation age structure.

3.4.2 Targeted fauna surveys

Targeted threatened fauna were determined through an assessment of likelihood of occurrence (**Section 4.2**).

Targeted fauna survey effort

Field surveys were undertaken on three occasions covering eight days and eight nights in February and March 2012 (**Appendix 4**). Monitoring equipment was left out for various durations between field survey visits. The survey design targeted threatened fauna identified as having at least a moderate likelihood of occurrence on the site (**Appendix 3**). The survey was also was designed to meet the minimum survey requirements of OEH using a range of the most suitable techniques (DEC 2004).

Targeted fauna survey methods

Targeted fauna survey methods for fauna groups are described below and were based on DEC (2004). The effort undertaken for each of the targeted fauna groups are considered to have equalled or exceeded the minimum survey effort required, although the actual levels required for camera traps are not stipulated in these guidelines.

Arboreal Elliot trapping – Squirrel Glider and other arboreal mammals

Ten Elliot B traps were placed along each of three trapping transects for four nights. Elliot traps were mounted to trees on a wooden shelf approximately two metres above the ground. Traps were baited (and re-baited as required) with a mixture of honey, oats, peanut butter. A honey mixture was regularly sprayed on the tree around the trap. Traps were checked each morning and any captured animals were identified and released at the site of capture.

Infra-red and white-light camera trap – Spotted-tailed Quoll and other ground-dwelling omnivores/scavengers

Seven motion sensing camera traps were placed at ground level at each trapping site for between 8 and 24 nights. A PVC tube baited with either sardines, dog food or a mixture of honey, oats, peanut butter and truffle oil was placed in front of the camera traps. The ground in front of the camera traps was sprayed with a mixture of honey, truffle oil and water. Upon recovery, the pictures were individually analysed and animals were identified to the lowest possible taxonomic level.

Hair tubes – Ground dwelling and Arboreal mammals

PVC hair tubes were attached to trees with electrical tape and secured under logs or other debris on the ground at each of 46 sites (three transects). Double sided tape was only adhered to the upper and lateral inner surface of the tubes so as to limit the incidence of 'by catch'. Tubes were baited with a mixture of honey, oats and peanut butter. Hair samples were sent to Barbara Triggs for analysis.

Ultrasonic – micro-bats

Three Wildlife Acoustics SM2 Bat detector units were deployed at six sites over the survey period along identified flyways and around watercourses.

Trip lining – micro-bats

A trip line (fishing wire) was stretched several times to form a zig-zag pattern at one dam in the northern end of the BIA study area. This method was discontinued as rain occurred throughout the survey period limiting the need for bats to drink at the dams targeted.

Diurnal bird surveys

Seven 30 minute, two hectare bird surveys were conducted across the BIA study area. Birds were identified with the use of 10 X 42 binoculars or from their calls. Where possible surveys were conducted close to dawn or dusk when bird activity is greatest.

Spotlighting

Spotlighting surveys targeting owls and arboreal mammals were performed either on foot or via a vehicle around roads and tracks of the BIA study area and throughout the subject site.

Call playback – Powerful Owl, Barking Owl, Masked Owl, Sooty Owl

Listening for owls was conducted immediately prior to sunset and sunrise. Call-playback sites were established across the BIA study area to enable maximum coverage. After an initial listening period of five minutes calls of the target species were broadcast through a 10 watt megaphone for five minutes followed by a five minute listening period and a period of spotlighting.

Rock rolling and herpetological searches

Herpetological surveys included diurnal targeted searches under rocks, timber, logs and tree bark in identified potential habitat throughout the BIA study area. In addition, reptiles were searched for during spotlighting surveys around aquatic features and through visual observations when traversing the site.

Frog chorus survey and aquatic habitat surveys

Frogs were listened for at farm dams and permanent and ephemeral drainage lines throughout the BIA study area. Active searching for frogs using spotlights was also conducted around watercourses. Roads near the quarry were also inspected for frogs on rainy or humid nights by driving slowly and searching for frogs.

Survey conditions

Weather was mixed during the survey period. Site visits were timed to take advantage of warmer conditions without heavy rain or wind. Field survey was suspended due to heavy rain and flooding on 29 February 2012. Records from the Bureau of Meteorology for Lithgow, during the survey period, are presented in **Appendix 5**.

Limitations of the fauna survey

Access to the northwestern and western slopes of the BIA study area was limited due to the rugged terrain present.

4 RESULTS

4.1 Literature and database review

4.1.1 Review of previous studies

Available literature for the BIA study area includes flora and fauna reports from on-going monitoring programs and previous impact assessments originating as far back as 1994. The following previous work, in chronological order, has been utilised as background information for this report:

SKM	1994	*Hartley Rhyolite Quarry Environmental Impact Statement*
Biosis	Jun-05	*Hartley Quarry Fauna Monitoring Report Winter 2005*
Biosis	Apr-06	*Austen Quarry Flora and Fauna Monitoring Report 2006*
Biosis	Jan-07	*Austen Quarry Winter 2006 Flora and Fauna Monitoring Report*
Biosis	Jul-07	*Austen Quarry Flora and Fauna Monitoring Report Summer 2006*
OzArk	2007	*Environmental Impact Statement: Proposed Austen Quarry Expansion, Appendix 3 - Ecological/Aboriginal Heritage Assessment*
Biosis	Jun-08	*Austen Quarry Flora and Fauna Monitoring Report 2007-2008*
OnSite	Nov-08	*Ecological Monitoring Report - Austen Quarry, Hartley; Ecological Survey*
OnSite	Nov-10	*Ecological Monitoring Report - Austen Quarry, Hartley; Ecological Survey*
Niche	July 2011	*Austen Quarry Extension – Biodiversity Constraints Assessment*
VGT	2011	*Environmental Management Report, Austen Quarry via Hartley, Reporting Period: 1 July 2010 to 30 June 2011*

These studies have focussed on vegetation composition, bird assemblages and herpetological surveys (reptiles and amphibians). Threatened flora random meanders were conducted during the field survey by SKM (1994) and OzArk (2007). These were conducted to assess and monitor potential impacts of quarry operations on surrounding lands and also within the current study area. No obvious evidence of quarry-related impacts were found for frogs, birds or vegetation communities (Biosis 2008). Four currently threatened birds were recorded during the course of monitoring programs: Gang-gang Cockatoo (*Callocephalon fimbriatum*), Hooded Robin (*Petroica boodang*), Scarlet Robin (*Petroica multicolour*), and Flame Robin (*Petroica phoenicea*). Additionally, the Varied Sittella (*Daphoenositta chrysoptera*) has previously been recorded on the site (Biosis 2006). The threatened plant *Eucalyptus pulverulenta* (Silver-leaved Mountain Gum), has also been found widely across the BIA study area on slopes and ridges. This species, listed as vulnerable on both the TSC and EPBC Acts, has been successfully propagated as tubestock and used in rehabilitation of the Stage 2 Quarry.

4.1.2 Database review

The results of Atlas of NSW Wildlife and Protected Matters Search Tool searches have been included in **Appendix 1** and **Appendix 2** respectively. These searches were based on a 10 kilometre radius from the BIA study area and conducted on 1 January 2014 (EPBC Act) and 12 December 2013 (Atlas of NSW Wildlife).

4.2 Assessment of threatened species likelihood of occurrence

Appendix 3 is a table of threatened species, as listed on the TSC and/or EPBC Acts that:

- ❒ have been recorded within 10 kilometres of the BIA study area on the Atlas of NSW Wildlife (**Appendix 1**);
- ❒ are predicted to occur within 10 kilometres of the BIA study area by the EPBC Act Protected Matters Search Tool (**Appendix 2**);
- ❒ have been recorded in previous studies (summarised in **Section 4.1.1**); or
- ❒ have been recorded on-site by Niche (**Appendix 9**).

The likelihood of occurrence rating in **Appendix 3** has been assigned based on information from previous surveys and the results of the Niche 2012 and 2013 field surveys (**Sections 4.3** and **4.4** describe in detail the results of the field surveys). The species rated as having a moderate, high or known likelihood of occurrence are listed in **Table 2** and require further consideration as potentially affected species **(Section 5). Table 2** also shows the requirement for assessments of significance under either the NSW EP&A Act (Seven Part Test) and the Commonwealth EPBC Act (Significant Impact Criteria). The relevant Seven Part Tests and Significant Impact Criteria have been provided in **Appendix 10** and **Appendix 11** respectively.

Table 2. Threatened species with a moderate, high or known likelihood of occurrence within the BIA study area

Species	TSC Act	EPBC Act	Likelihood of Occurrence	NSW Seven Part Test required (Yes/No)	Commonwealth Significance Assessment required (Yes/No)
Woodland Birds					
Flame Robin *Petroica phoenicea*	V	-	**Known**	**Yes**	No
Hooded Robin *Melanodryas cucullata*	V	-	**Known**	**Yes**	No
Scarlet Robin *Petroica boodang*	V	-	**Known**	**Yes**	No
Varied Sittella *Daphoenositta chrysoptera*	V	-	**Known**	**Yes**	No
Psittacines (Parrots)					
Gang-gang Cockatoo *Callocephalon fimbriatum*	V	-	**Known**	**Yes**	No
Little Lorikeet *Glossopsitta pusilla*	V	-	**High**	**Yes**	No
Forest Owls					
Powerful Owl *Ninox strenua*	V	-	**Known**	**Yes**	No

Species	TSC Act	EPBC Act	Likelihood of Occurrence	NSW Seven Part Test required (Yes/No)	Commonwealth Significance Assessment required (Yes/No)
Migratory Birds (EPBC Act)					
Fork-tailed Swift *Apus pacificus*	-	M	**Moderate**	No	**Yes**
Rainbow Bee-eater *Merops ornatus*	-	M	**High**	No	**Yes**
Satin Flycatcher *Myiagra cyanoleuca*	-	M	**Known**	No	**Yes**
White-throated Needletail *Hirundapus caudacutus*	-	M	**Moderate**	No	**Yes**
Microbats					
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	V	-	**Known**	**Yes**	No
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	V	-	**Known**	**Yes**	No
Eastern Freetail-bat *Mormopterus norfolkensis*	V	-	**Known**	**Yes**	No
Greater Broad-nosed Bat *Scoteanax rueppellii*	V	-	**Known**	**Yes**	No
Large-eared Pied Bat *Chalinolobus dwyeri*	V	V	**Known**	**Yes**	**Yes**
Southern Myotis *Myotis macropus*	V	-	**High**	**Yes**	No
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	V	-	**High**	**Yes**	No
Mammals (other than microbats)					
Grey-headed Flying-fox *Pteropus poliocephalus*	V	V	**Moderate**	**Yes**	**Yes**
Koala *Phascolarctos cinereus*	V	V	**Moderate**	**Yes**	**Yes**
Squirrel Glider *Petaurus norfolcensis*	V	-	**Moderate**	**Yes**	No
Spotted-tailed Quoll *Dasyurus maculatus*	V	E	**High**	**Yes**	**Yes**
Plants					
Eucalyptus aggregata Black Gum	V	-	**Moderate**	**Yes**	No
Eucalyptus pulverulenta Silver-leaved Mountain Gum	V	V	**Known**	**Yes**	**Yes**

** Atlas of NSW Wildlife*

4.3 Flora and vegetation survey results

The compiled plant list from all 28 floristic plots is provided in **Appendix 6** of this report. A total of 214 species were recorded, including 41 weeds (19 per cent).

One threatened flora species, *Eucalyptus pulverulenta*, which is listed as vulnerable on both the TSC and EPBC Acts, was recorded as a common to dominant species during the field survey. The species' distribution is illustrated in **Figure 9** and the population estimates are described in **Section 0**.

4.3.1 Vegetation community classification and alignment

Figure 7 illustrates the extent and distribution of the vegetation communities present within the Stage 2 Site and **Figure 8** is zoomed in on the BIA study area (impact and proposed offset areas). This map was derived from initial API, the RDP information collected throughout the BIA study area and the PATN analysis for the cover-abundance scores collected within the 28 floristic plots throughout the BIA study area. The resultant dendrogram, illustrating the hierarchical alignment of each of the plots, is provided in **Appendix 7**.

The vegetation communities within the BIA study area include six parent types and two derived communities: Brittle Gum - Broad-leaved Peppermint open forest, Silver-leaved Mountain Gum mallee woodland, Forest Red Gum grassy open forest, Forest Red Gum native grassland, Forest Red Gum exotic grassland, River Oak riparian open forest, and Rough-barked Apple gully forest. **Table 3** lists each of these vegetation types as defined by Niche, and also provides the area of each within the impact area, conservation area and the entire study area, as well as the number of plots required and the number that were conducted.

The BIA study area is 135 hectares in total, and is composed of 123.3 hectares of native vegetation and 11.7 hectares of disturbed lands, rehabilitated areas or dams (**Appendix 8**).

Table 3 shows that, of the 123.3 hectares of native vegetation within the BIA study area, a total of 29.0 hectares of native vegetation would be impacted by the Stage 2 Extension either directly through complete removal (26.5 hectares) or indirectly through edge effects (2.5 hectares). The area of indirect impacts was defined as a ten metre buffer for edge effects in this instance (see Section 5.1.1 for justification). The remaining 94.3 hectares of native vegetation forms the proposed offset area.

Table 3. Vegetation impacted and conserved and plot survey effort

Vegetation Community Unit (Niche)	Niche Type	Stage 2 Extension area of direct impact (ha)	Stage 2 Extension area of indirect impact (ha)	Proposed offset area (ha)	Total study area (ha)	Plots Required	Plots Completed
c1	Brittle Gum - Broad-leaved Peppermint open forest	17.3	1.3	46.3	64.9	5	8
c2	Silver-leaved Mountain Gum mallee woodland	-	-	1.9	1.9	1	1
c3	Forest Red Gum grassy open forest	4.4	0.8	22.8	28.0	4	6
c3a	Forest Red Gum native grassland	-	-	0.8	0.8	1	1
c3b	Forest Red Gum exotic grassland	-	-	9.7	9.7	3	3
c4	Rough-barked Apple gully forest	-	-	2.4	2.4	2	2
c5	Stringybark - Apple Box open forest	4.8	0.4	-	5.2	3	3
c6	River Oak riparian open forest	-	-	10.4	10.4	3	4
Total Native Vegetation		**26.5**	**2.5**	**94.3**	**123.3**	**22**	**28**

Assessment of the impacts on threatened biodiversity is provided in **Section** 5 and a description of the proposed amelioration measures for both direct and indirect impacts, including offsetting, are included in **Section** 6. **Sections** 7 **and** 8 describe how the proposed offset area meets NSW and Commonwealth offsetting requirements respectively.

The alignment of the vegetation types with Endangered Ecological Communities (EECs), revised Biometric Vegetation Types (RBVTs), Keith Formations and Keith Classes has been provided in **Appendix 8**. RBVTs relate to the vegetation types defined within the Biometric Vegetation Types Database as required for use in the BioBanking Credit Calculator. BioBanking Credit Calculations for both the potential extraction area and the proposed offset area are provided in **Section** 7.

None of the vegetation communities within the BIA study area are listed as threatened ecological communities (TECs) on the TSC or EPBC Acts. Furthermore, no preliminary determinations for TECs on the TSC Act or nominations on the EPBC Act applied to the BIA study area at the time of this report.

4.3.2 Vegetation community descriptions

Table 3 outlines the vegetation that falls within the potential extraction footprint, as interpreted by Niche, and the vegetation that is proposed for conservation within the BIA study area. Each vegetation community is described below (Communities 3a and 3b have been discussed as variants of Community 3).

Community 1 (c1): Brittle Gum – Broad-leaved Peppermint open forest

Conservation status: Not listed as an EEC.

RBVT: HN570 – Red Stringybark - Brittle Gum - Brittle Gum dry open forest of the tablelands, South Eastern Highlands

Keith Formation: Dry Sclerophyll Forests (Shrubby subformation)

Keith Class: Southern Tableland Dry Sclerophyll Forests

Regional status: 55% cleared within Hawkesbury-Nepean CMA region. Not regionally significant.

Description: Brittle Gum – Broad-leaved Peppermint Open Forest is the most prominent vegetation type within the BIA study area and occurs mostly on the higher slopes and ridgelines. This vegetation type was generally in good condition within the BIA study area, with all structural layers intact and minimal disturbance. This vegetation type accounts for most of the impact on native vegetation, but also accounts for approximately half of the proposed offset area.

Direct impact (ha): 17.3 ha *Indirect impact (ha)*: 1.3 ha *Proposed offset (ha)*: 46.3

Structure: Open forest community:

- ❒ Canopy (Tree height 10-15 m, 15% projected foliage cover (% PFC);
- ❒ Midstorey (Tree height 7-10m, 5% PFC);
- ❒ Lower (Shrub height 1-3m, 20% PFC); and
- ❒ Ground cover (0-1m height, 60% PFC).

Dominant trees: *Eucalyptus dives* and *Eucalyptus mannifera.*

Dominant shrubs: *Acacia buxifolia, Banksia spinulosa, Brachyloma daphnoides, Calytrix tetragona, Daviesia acicularis, Hibbertia obtusifolia, Leptospermum parvifolium, Ozothamnus diosmifolius, Persoonia linearis,* and *Persoonia pinifolia.*

Dominant groundcover: *Aristida echinata, Aristida ramosa, Aristida vagans, Aristida warburgii, Austrodanthonia racemosa, Austrodanthonia tenuior, Austrostipa rudis, Austrostipa scabra, Calotis lappulacea, Cheilanthes sieberi, Dianella caerulea, Dichelachne rara, Echinopogon caespitosus, Entolasia stricta, Lepidosperma laterale, Lomandra filiformis, Lomandra longifolia, Microlaena stipoides, Poa sieberiana, Schoenus paludosus, Stypandra glauca* and *Wahlenbergia gracilis.*

Introduced taxa: *Conyza bonariensis, Ehrharta erecta, Hypochaeris radicata* and *Solanum nigrum.*

Community 2 (c2): Silver-leaved Mountain Gum mallee woodland

Conservation status: The community contains *Eucalyptus pulverulenta* which is listed as a threatened species, but does not align to an EEC.

RBVT: HN570 – Red Stringybark - Brittle Gum - Brittle Gum dry open forest of the tablelands, South Eastern Highlands

Keith Formation: Dry Sclerophyll Forests (Shrubby subformation)

Keith Class: Southern Tableland Dry Sclerophyll Forests

Regional status: 55% cleared within Hawkesbury-Nepean CMA region. Not regionally significant.

Description: Silver-leaved Mountain Gum mallee woodland occupies a patch on a north-facing slope wholly within the proposed offset area. The community was in good condition within the BIA study area, with all layers intact and with minimal disturbance.

Direct impact (ha): 0 ha *Indirect impact (ha)*: 0 ha *Proposed offset (ha)*: 1.9 ha

Structure: Mallee woodland:

- ❒ Canopy (Tree height 3-7 m, 10% PFC);
- ❒ Lower (Shrub height 1-3m, 40% PFC); and
- ❒ Ground cover (0-1m height, 50% PFC).

Dominant trees: *Eucalyptus pulverulenta*

Dominant shrubs: *Acacia buxifolia, Banksia spinulosa, Brachyloma daphnoides, Hakea dactyloides, Prostanthera serpyllifolia* subsp. *microphylla and Leptospermum parvifolium*.

Dominant groundcover: *Aristida ramosa, Austrostipa scabra, Echinopogon caespitosus, Entolasia stricta, Imperata cylindrica, Cheilanthes sieberi, Dianella revoluta, Gonocarpus tetragynus, Goodenia hederacea, Lomandra longifolia, Phyllanthus hirtellus, Schoenus paludosus* and *Wahlenbergia gracilis*.

Introduced taxa: *Conyza* spp. and *Hypochaeris radicata*.

Community 3 (c3): Forest Red Gum grassy open forest

Conservation status: Not listed as an EEC.

RBVT: HN527 – Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands

Keith Formation: Dry Sclerophyll Forests (Shrub/grass subformation)

Keith Class: Central Gorge Dry Sclerophyll Forests

Regional status: 50% cleared within Hawkesbury-Nepean CMA region. Not regionally significant.

Description: Forest Red Gum grassy open forest occurs on the lower lying areas and gentle slopes within the BIA study area.

Three variations of the community were recorded in the BIA study area:

- ❒ Community 3: Forest Red Gum grassy open forest;
- ❒ Community 3a: Forest Red Gum native grassland; and
- ❒ Community 3b: Forest Red Gum exotic grassland.

A total of 5.3 hectares of this vegetation type would be impacted by the Stage 2 Extension, all of which occurs in the parent type (3). Approximately 33.5 hectares of this vegetation type would form a component of the proposed offset area.

Direct impact (ha): 4.4 ha *Indirect impact (ha)*: 0.8 ha *Proposed offset (ha)*: 33.3 ha

Structure: The structure of the community differed dependant on each variant.

The structure of the open forest is as follows:

- ❒ Canopy (Tree height 15-25 m, 5% PFC);
- ❒ Midstorey (Tree height 10-15m, 5% PFC);
- ❒ Lower (Shrub height 1-3m, 15% PFC); and
- ❒ Ground cover (0-1m height, 80-90% PFC).

The native grassland and exotic grassland variants (c3a and c3b respectively) contained a sparse canopy layer, mid and lower strata due to clearing. The main difference in the two variants is the native grassland contains more than 50 % of native ground cover present.

Dominant trees: *Eucalyptus tereticornis* and *Eucalyptus tereticornis x blakelyi* and other eucalypt species in varying proportions.

Dominant shrubs: *Acacia buxifolia, Calytrix tetragona, Daviesia acicularis* and *Lissanthe strigosa*.

Dominant groundcover: *Aristida ramosa, Austrodanthonia racemosa, Austrostipa scabra, Bothriochloa macra, Bromus catharticus, Centella asiatica, Cheilanthes sieberi, Cymbopogon refractus, Dichelachne micrantha, Dichondra repens, Echinopogon caespitosus, Lomandra longifolia, Microlaena stipoides, Poa sieberiana, Themeda australis, Vittadinia cuneata* and *Wahlenbergia gracilis*.

Introduced taxa: *Cirsium vulgare, Conyza bonariensis, Conyza sumatrensis, Echium vulgare, Ehrharta erecta, Hypochaeris radicata, Paspalum dilatatum, Sida rhombifolia, Solanum nigrum* and *Verbena bonariensis*.

Community 4 (c4): Rough-barked Apple gully forest

Conservation status: Not listed as an EEC.

RBVT: HN527 – Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands

Keith Formation: Dry Sclerophyll Forests (Shrub/grass subformation)

Keith Class: Central Gorge Dry Sclerophyll Forests

Regional status: 50% cleared within Hawkesbury-Nepean CMA region. Not regionally significant.

Description: Rough-barked Apple gully forest occurs in a steep gully towards the northern and central portion of the proposed offset area. None of this vegetation type would be impacted by the Stage 2 Extension.

Direct impact (ha): 0ha *Indirect impact (ha)*: 0 ha *Proposed offset (ha)*: 2.4 ha

Structure: open forest:

- ❒ Canopy (Tree height 18-25 m, 40% PFC);
- ❒ Midstorey (Tree height 12-18 m, 30% PFC);
- ❒ Lower (Shrub height 1-5m, 40% PFC); and
  Ground cover (0-1m height, 50% PFC).

Dominant trees: *Angophora floribunda, Eucalyptus dives, Eucalyptus mannifera* and *Eucalyptus stellulata*.

Dominant shrubs: *Kunzea ambigua, Leptospermum continentale* and *Leptospermum parvifolium*.

Dominant groundcover: *Aristida ramosa, Austrodanthonia racemosa, Austrodanthonia tenuior, Austrostipa scabra, Cheilanthes sieberi, Cyperus gracilis, Dianella revoluta, Dichelachne rara, Dichondra repens, Echinopogon caespitosus, Entolasia stricta, Imperata cylindrica, Lomandra longifolia, Microlaena stipoides, Poa sieberiana, Themeda australis* and *Wahlenbergia gracilis*.

Introduced taxa: *Conyza bonariensis, Hypochaeris radicata, Senecio madagascariensis* and *Verbena bonariensis*.

Community 5 (c5): Stringybark – Apple Box open forest

Conservation status: Not listed as an EEC.

RBVT: HN501 – Apple Box - Broad-leaved Peppermint dry open forest of the Abercrombie-Tarlo area, South Eastern Highlands

Keith Formation: Grassy Woodlands

Keith Class: Southern Tableland Grassy Woodlands

Regional status: 30% cleared within Hawkesbury-Nepean CMA region. Not regionally significant.

Description: Stringybark – Apple Box open forest occurs just on the east-facing slope of the main ridgeline that runs north-south from the main quarry road to the southern portion of the property. The patch is to the west of the existing overburden area and would be impacted by the proposed overburden area.

Direct impact (ha): 4.8 ha *Indirect impact (ha)*: 0.4 ha *Proposed offset (ha)*: 0 ha

Structure: open forest:

- ❒ Canopy (Tree height 18-25 m, 45% PFC);
- ❒ Midstorey (Tree height 10-15 m, 15% PFC);
- ❒ Lower (more or less absent); and
- ❒ Groundcover (0-0.5 m height, 90% PFC).

Dominant trees: *Eucalyptus eugenoides* with a mix of *Eucalyptus bridgesiana* and *Eucalyptus tereticornis*. *Acacia falciformis* sub-dominant to 15 m.

Dominant shrubs: More or less absent.

Dominant groundcover: *Aristida ramosa, Austrodanthonia racemosa, Austrodanthonia tenuior, Austrostipa scabra, Cheilanthes sieberi, Cyperus gracilis, Dianella revoluta, Dichelachne rara, Dichondra repens, Echinopogon caespitosus, Entolasia stricta, Lomandra longifolia, Microlaena stipoides, Poa sieberiana, Themeda australis* and *Wahlenbergia gracilis*.

Introduced taxa: *Conyza bonariensis, Hypochaeris radicata, Senecio madagascariensis* and *Verbena bonariensis*.

Community 6 (c6): River Oak riparian open forest

RBVT: HN574 – River Oak open forest of major streams, Sydney Basin and South East Corner

Keith Formation: Forested Wetlands

Keith Class: Eastern Riverine Forests

Conservation status: Not listed as an EEC.

Regional status: 40% cleared within Hawkesbury-Nepean CMA region. Not regionally significant.

Description: River Oak riparian open forest occurs in a strip along the Coxs River, none of which would be impacted by the Stage 2 Extension and all of which would form a component of the proposed offset area. The community does not occur in the impact area. This type was in moderate to good condition but has been impacted by previous clearing, flooding and weed invasion.

Direct impact (ha): 0 ha *Indirect impact (ha)*: 0 ha *Proposed offset (ha)*: 10.4 ha

Structure: open woodland:

- ❒ Canopy (Tree height 25-30 m, 20% PFC);
- ❒ Midstorey (Tree height 20-25 m, 10% PFC);
- ❒ Lower (Shrub height 1-5m, 20% PFC); and
- ❒ Ground cover (0-1m height, 50% PFC).

Dominant trees: *Casuarina cunninghamiana* subsp. *cunninghamiana, Eucalyptus viminalis*

Dominant shrubs: *Leptospermum parvifolium, Lomatia myricoides*

Dominant groundcover: *Austrodanthonia racemosa, Austrodanthonia* spp., *Austrostipa scabra, Bromus catharticus, Centella asiatica, Centella asiatica, Chenopodium album, Conium maculatum, Echinopogon caespitosus, Echinopogon ovatus, Einadia hastata, Entolasia marginata, Eragrostis curvula* and *Pteridium esculentum*.

Introduced taxa: *Cirsium vulgare, Conyza sumatrensis, Ehrharta erecta, Eleusine indica, Hypericum perforatum, Hypochaeris radicata, Paspalum dilatatum, Rubus fruticosus* sp. agg., *Solanum nigrum, Urtica incisa* and *Verbena bonariensis*.

4.3.3 Groundwater Dependent Ecosystems (GDEs)

The web-site for the NSW Office of Water (NOW) states:

> "Groundwater dependent ecosystems (GDEs) are a diverse and important component of biological diversity. The term GDE takes into account ecosystems that use groundwater as part of their survival strategies. GDEs can potentially include wetlands, vegetation, mound springs, river base flows, cave ecosystems, playa lakes and saline discharges, springs, mangroves, river pools, billabongs and hanging swamps and near-shore marine ecosystems."

and...

> "Species and communities that require permanently wet conditions, particularly in arid, semi-arid or seasonally dry conditions are more likely to be groundwater dependent than those tolerant of a regular cycle of wetting and drying."

Initial modelling and mapping of GDEs at Austen Quarry is considered only a very coarse layer of modelled raster GIS data, obtained from the Australia Bureau of Meteorology Atlas of Groundwater Dependent Ecosystems (BOM 2014) without site validation. Greater accuracy of the occurrence and distribution of GDEs is provided by the site validated vegetation mapping, described by Niche above, inferred from the mapped vegetation units. Of the vegetation units mapped by Niche, only the River Oak riparian forest along Coxs River is reliant on water availability for survival. In this respect, it is considered that, in such a steep landscape, seasonal flows and storm surges during high rainfall events are far more deterministic of the condition of this vegetation, rather than groundwater as defined in the statements above (for example river base flows). The River Oak riparian forest is dependent on the intermittently flowing Coxs River, is tolerant of a regular cycle of wetting and drying and does not constitute forested wetland or swamp in semi-permanent standing or sub-surface water.

4.3.4 Threatened flora survey results

Eucalyptus pulverulenta (Silver-leaved Mountain Gum) was common within the BIA study area. No other threatened flora were recorded within the BIA study area, although *Eucalyptus aggregata* (Black Gum) is considered to have a moderate likelihood of occurrence (**Section 4.2**).

***Eucalyptus pulverulenta* - estimate within core population areas**

Two areas of densely populated core habitat were identified within the proposed offset area in February 2012 (**Figure 9**). The majority of these individuals broadly coincided with the area mapped as Silver-leaved Mountain Gum mallee woodland with a minor extension to the north of this area and also a separate area north of that again. Due to the density of the population and the potential for double-counting, the most reliable method of estimating the population was considered to be plot-based counts, which could then be extrapolated to estimate their density. For the population estimate, three 20 x 20 metre plots were established and two counts conducted in each (one each by Nathan Smith and Luke Baker). The results of these counts are provided in **Table 4**.

Table 4. Population estimate for *E. pulverulenta* core habitat areas, February 2012

Site Number	N. Smith (Plants per 400 m^2)	L. Baker (Plants per 400 m^2)
031	27	40
038	29	24
039	27	25
TOTAL Plants per 1200 m^2	**83**	**89**

An average of 86 plants were recorded over the 1,200 square metres surveyed, which equates to 716 plants per hectare. The total area of core habitat for *E. pulverulenta* within the Stage 2 BIA study area is 2.8 hectares (**Figure 9**). On this basis, it is estimated that 2,004 individuals are present within the core habitat areas (716 x 2.8). Conservation Area H is under prior management and accounts for 0.4 hectares of this core population. Therefore, 2.4 hectares would fall within the proposed offset area, which equates to 1,718 individuals.

Two additional core habitat areas were located just to the north of the existing pit in the June 2013 surveys which are represented as vegetation type c2 – Silver-leaved Mountain Gum mallee woodland in **Figure 7**. These two areas have not been included in the estimate above, but amount to an additional 0.39 hectares of habitat. Therefore, this component of the core population is estimated at an additional 279 individuals (0.39 x 716 plants per hectare). Neither of these areas are the subject of this assessment as they lie within the previously approved Stage 1 extraction area and would remain undisturbed throughout the life of operations in the Stage 2 Extension.

A total of 2,283 individuals in core habitat are estimated to exist within the Austen Quarry lease, 1,718 of which fall within the proposed offset area for the Stage 2 Extension. None of these individuals would be impacted by the Stage 2 Extension.

Eucalyptus pulverulenta – natural isolated occurrences within the BIA study area

Clumped and isolated occurrences of *Eucalyptus pulverulenta* within the BIA study area were counted and spatially located with a Garmin GPS in their entirety (**Figure 9**). During the June 2013 surveys, nine additional individuals were recorded in natural habitat within the BIA study area, none of which fall within either the Stage 2 Extension area of impact or proposed offset area. The total number of isolated individuals in non-core remnant areas within the BIA study area is 231. Of these, 90 would be impacted by the Stage 2 Extension and 132 fall within the proposed offset area.

Eucalyptus pulverulenta - occurrence within rehabilitation areas

In June 2013, in addition to further vegetation and habitat condition surveys (and at the request of Hy-Tec), *Eucalyptus pulverulenta* counts were carried out in the previously un-assessed rehabilitation areas (i.e., counts of installed tubestock). These areas are mapped in **Figure 11**. The results of these counts are provided in **Table 5** and show that, as at June 2013, 1,386 individuals of *Eucalyptus pulverulenta* tubestock had been successfully planted in the rehabilitation areas throughout the Austen Quarry site.

Table 5. *Eucalyptus pulverulenta* installed in rehabilitation areas.

Niche Veg Code	Niche Veg Type	Rehab area (Figure 11)	Area (ha)	E. pulverulenta count
rh	Rehab Area	A	0.23	48
rh	Rehab Area	B	0.16	12
rh	Rehab Area	C	0.83	13
rh	Rehab Area	D	0.32	62
rh	Rehab Area	E	0.11	60
rh	Rehab Area	F	0.60	221
rh	Rehab Area	G	1.22	20
rh	Rehab Area	H	1.64	370
rh	Rehab Area	I	0.32	320
rh	Rehab Area	J	0.28	186
rh	Rehab Area	K	0.81	74
rh	Rehab Area	L	0.10	0
		Total	**6.62**	**1,386**

***Eucalyptus pulverulenta* – Estimated total population**

The total number of *Eucalyptus pulverulenta* within the Austen Quarry lease is estimated at 3,815 individuals (2,283 core + 146 non-core + 1,386 planted). Of this, 721 individuals (90 non-core + 631 planted) would be removed as a result of the Stage 2 Extension. The total number of individuals in the proposed offset area is estimated at 1,850 (1,718 core + 132 non-core).

Rehabilitation areas within the Austen Quarry lease that are not impacted by the Stage 2 Extension would conserve 755 planted individuals (1,386 less 631). As these plantings are a component of a previous approval they cannot formally contribute to the offsetting strategy for *Eucalyptus pulverulenta* in relation to the Stage 2 Extension.

4.3.5 Noxious weeds

The weeds listed in **Table 6** were recorded in the BIA study area and are listed as noxious on the NSW *Noxious Weeds Act 1992* (NW Act) for the Lithgow LGA. The presence of these species has implications for the on-going management of native vegetation within the BIA study area. In a more general sense, grass weeds (Poaceae) and daisies (Asteraceae) were dominant as could be expected within the grassy open forests and degraded pastures. *Nasella trichotoma* (serrated tussock) and *Lycium ferrocissimum* (African boxthorn) have both been previously subject to management at the site (OnSite 2011). *L. ferrocissimum* was not recorded during the current field survey though it is acknowledged as likely to be present.

Table 6. Noxious weeds recorded within the BIA study area

Noxious Weed	Class	Legal requirements
Eragrostis curvula African lovegrass	4	The growth of the plant must be managed in a manner that reduces its numbers, spread and incidence and continuously inhibits its reproduction
Rubus fruticosus agg. spp. Blackberry		
Nassella trichotoma Serrated tussock		
Conium maculatum Hemlock		
Onopordum spp. Scotch, Stemless, Illyrian and Taurian thistles		
Hypericum perforatum St. John's wort		
Rosa rubiginosa Sweet briar		

4.4 Fauna survey results

4.4.1 Habitat assessment and description

Habitat assessments conducted during fauna field survey and BioBanking plots confirmed the habitat types available and revealed additional information regarding habitat characteristics and the quality of habitats available within and around the BIA study area. Detailed information regarding habitat characteristics gathered during BioBanking plots including vegetation cover, hollow densities and length of fallen logs.

Four dominant habitat types were found to occur within the BIA study area, comprising Ridge Forest, Gully Forest, Riparian Forest and Cleared Areas.

In broad terms, available habitat types reflect the vegetation types of the BIA study area, which are determined by an interaction of factors including geomorphology, geology and climate. The broad vegetation formations of the BIA study area and their distribution throughout the BIA study area are:

- ❒ Dry Sclerophyll Forest - shrubby sub-formation (the mid to upper slopes and ridges);
- ❒ Dry Sclerophyll Forest – shrub/grass sub-formation (low slopes);
- ❒ Forested Wetlands (adjacent to the Coxs River); and
- ❒ Aquatic habitat.

A short description of each of the above areas is provided below.

Dry Sclerophyll Forest – shrubby sub-formation (Ridge Forest)

This formation occurs along the mid-upper slopes and ridges of the BIA study area and vegetation is predominantly in good condition with little evidence of significant past disturbance (including fire), except for some tracks and edge-effects due to adjacent quarrying.

The predominant vegetation reflects a low nutrient environment with skeletal soils. There is a relatively low diversity of canopy and mid-storey species and the ground cover is patchy with some areas having a high proportion of outcropping, embedded and loose surface rock. Whilst rock was prominent in some areas, exfoliating rock slabs were generally absent. Hollow densities throughout this formation were moderate; however large hollows (greater than 30 cm) were generally absent.

There was moderate cover of fallen timber but large hollow logs were infrequent, reflecting limited tree size and limited large hollow development.

Habitats within the BIA study area offer a variety of habitat types for resident fauna. A high to moderate level of resilience of the different habitat types is apparent in most areas as evidenced by the diversity of native herbs and ground cover and a low cover of weeds.

Dry Sclerophyll Forest – shrub/grass sub-formation (Gully Forest)

This vegetation occurs along the mid-lower slopes of the BIA study area where there is a better developed soil profile and a higher moisture regime. Areas of this sub-formation had a mixed composition within the understorey and ground cover strata, with some patches having high cover of a limited suite of understorey shrubs, while other areas supported grass only. It is probable that past disturbance has decreased the diversity of the understorey and ground cover vegetation, impacting on habitat values for ground-dwelling fauna.

There were occasional small and medium sized hollows throughout this habitat type and limited logs. Small patches of rocky areas occurred along steeper sections and consisted mainly of rock embedded into the soil, limiting the availability of higher quality reptile habitat.

Forested Wetlands (Riparian Forest)

Vegetation within this sub-formation consisted of large *Casuarina cunninghamiana* and *Eucalyptus viminalis* trees forming dense foliage in places. *Casuarina* may offer important food resources for particular fauna species such as Glossy Black-cockatoos. Large logs within these riparian areas also offer important habitat to particular species and create in-stream woody debris. Occasional medium and small hollows were present.

Aquatic habitat

The most prominent and valuable aquatic habitat feature of the BIA study area is the Coxs River. A number of ephemeral tributaries flow into the Coxs River, however, these offer limited aquatic habitat. There are a number of dams within the BIA study area that offer habitat for amphibians and reptiles and watering points for various other fauna, including bats. The Coxs River is in good condition and also plays an important role within the region as a vegetated corridor providing connectivity.

4.4.2 Terrestrial fauna recorded

A total of 89 vertebrate species were recorded during field survey comprising 50 birds, 23 mammals, ten reptiles and six frogs (**Appendix 9**). Three introduced species were recorded; dog, fox and rat. The species assemblage observed includes common and widespread species as well as moderately rare species on a regional or state basis. The good vegetation condition and proximity of the area to large vegetated reserves contributes to the conservation value of the BIA study area and propensity to provide good habitat for fauna species.

Five threatened fauna species listed on the TSC and/or EPBC Acts were recorded during the field survey; Gang-gang Cockatoo, Powerful Owl, Scarlet Robin, Eastern Bentwing-bat and Large-eared Pied Bat. Additional threatened fauna recorded during previous studies within the BIA study area include; Hooded Robin, Flame Robin and Varied Sittella. In total, eight threatened fauna have been recorded within the BIA study area.

The low diversity and abundance of arboreal and small ground dwelling mammals recorded can be attributed to the low density or seasonal variability of foraging resources within the BIA study area. For ground dwelling mammals, it may also be due to a lack of ground and mid-storey vegetation cover and from a lack of ground habitat features (rock outcrops and logs).

5 IMPACT ASSESSMENT

5.1 Impacts of the Stage 2 Extension

5.1.1 Direct and indirect impacts

An assessment of the potential impacts of the Stage 2 Extension on biodiversity is provided in **Table 7**. Impacts are categorised as direct or indirect as described in DECC (2007), which states:

> *"**Direct impacts** are those that directly affect the habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat. When applying each factor, consideration must be given to all of the likely direct impacts of the proposed activity or development.*
>
> ***Indirect impacts** occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas. As with direct impacts, consideration must be given, when applying each factor, to all of the likely indirect impacts of the proposed activity or development."*

A likelihood rating of known, likely or unlikely has been assigned to each of the potential impacts listed in **Table 7**. **Section** 6 and **Table 9** list and describe the appropriate amelioration measure for each impact.

Table 7 illustrates that the Stage 2 Extension would result in three key and unavoidable impacts:

1. The removal of 26.5 hectares of native vegetation;
2. The creation of new bushland edges (indirect impact on native vegetation of an additional 2.5 hectares); and
3. The removal of part of a known population of a threatened plant species, *Eucalyptus pulverulenta* (721 individuals in total of which 631 have been planted as part of previous management actions and 90 are in remnant bushland).

These three impacts cannot be avoided or mitigated against and therefore must be offset (**Section 6.4** and **Section** 7). The indirect impacts listed as likely to occur as a result of the Stage 2 Extension in **Table 7** include edge effects, deleterious hydrological changes, sedimentation and erosion, weed invasion and increased human activity within or directly adjacent to sensitive habitat areas. Other than edge effects, each of these indirect impacts would be mitigated through the implementation of on-site management actions (**Section 6.3**).

Edge effects

Edge effects are an indirect impact and relate to how ecological interactions are altered along the edge between two adjacent and competing land uses, in this case the proposed development area of the Stage 2 extension and the proposed conservation area. Such edge effects invariably result in an altered microclimate (light, heat and moisture) which can lead to a reduction in the resilience of native bushland, potential for weed invasion, potential for increased grazing of stock and altered predator-prey relationships. In respect to the mitigation of potential edge effects on site, stock will

be removed, the conservation area fenced, predator-prey relationships not exacerbated any more than currently exist on the site and the site will not be in a publicly accessible location, thereby providing immunity from uncontrolled human, pet and vehicle access.

In the case of the Stage 2 extension, it is anticipated that the only un-mitigated edge effect will be a minor level of weed invasion as a result of the altered microclimate. It is anticipated that such weed invasion would be limited to a few minor annual herbaceous weeds with, at worst the potential for some invasion of perennial exotic grasses within two or three metres of the disturbance edge. Therefore, a 10 metre buffer was selected to more than allow for the potential for herbaceous weed invasion and also to quantify an area for indirect impacts in terms of the ecosystem credit requirement for offsetting. This 10 metre buffer for edge effects is considered more than adequate, given mitigation through an on-site weed management program will prioritise weed invasion along this edge and the exclusion zone created by the fencing of the conservation area would likely incorporate the buffer (i.e., in reality form a component of the conservation area).

Table 7. Assessment of direct and indirect impacts as a result of the Stage 2 Extension

Impact	Likelihood of impact as a result of the Stage 2 Extension
Direct impacts	
Removal or Modification of Native Vegetation	Removal of 26.5 ha hectares of native vegetation
Loss of individuals of a threatened species	Removal of 721 individuals of *Eucalyptus pulverulenta*
Removal or Modification of threatened species habitat other than native vegetation	Unlikely - all other threatened species habitats are either not present on site or have been avoided
Death through trampling	Unlikely
Death through poisoning	Unlikely
Loss of individuals through starvation	Unlikely
Loss of individuals through exposure	Unlikely
Predation by domestic and/or feral animals	Unlikely
Loss of breeding opportunities	Unlikely
Loss of shade/shelter	Unlikely
Indirect impacts	
Edge effects	**Likely**, 2.5 ha
Deleterious hydrological changes	**Likely**
Increased soil salinity	Unlikely
Sedimentation and erosion	**Likely**
Inhibition of nitrogen fixation	Unlikely
Weed invasion	**Likely**
Fertiliser drift	Unlikely
Increased human activity within or directly adjacent to sensitive habitat areas	**Likely**

Loss of Habitat Connectivity

The study area lies within a large remnant of native vegetation lying across a range of hills that run from west of Jenolan Caves Road in the west and the village of Little Hartley in the east. These wooded hills are surrounded by cleared or partly cleared farming lands to the north and south, although there is mostly a vegetated link through this farmland to the village of Hartley in the north. Limited connectivity exists at the western end of these hills linking to extensive areas of vegetation within Lidsdale and Hampton State Forests (Figure 3). Limited connectivity also occurs to the east of these hills, with semi-rural residential development at Little Hartley inhibiting connectivity to Fairy Bower Reserve and, to the east of the Great Western Highway, the extensive vegetated areas of the

Blue Mountains National Park (Figure 3). Some connectivity exists to the north and south of the site within riparian vegetation along Coxs River, which varies in width from about 20-100 metres.

There is currently a vegetated corridor approximately 100 metres wide between the northern boundary of the current quarry and the processing area adjacent to the Coxs River, but the area also contains infrastructure and roads so would provide limited connectivity. This 100 metre gap to the north of the quarry would not be changed by the proposal, although it may increase in width with rehabilitation. There is a vegetated corridor approximately 320 metres in width between the southern boundary of the current quarry and cleared farmland south of the site. This 320 metre corridor would be reduced to approximately 110 metres by the proposal, with further increase in width achieved following rehabilitation of the extraction area and overburden emplacement.

The proposal would reduce connectivity within the vegetated hills between the east and west of the quarry, but not sever it. It is considered that small non-mobile animals and arboreal animals could still move east-west across the site, but that this movement may be reduced. More mobile fauna, such as large mammals, could continue to move east-west through partly vegetated farmland to the north and south of the site.

5.1.2 Key threatening processes

Table 8 lists the Key Threatening Processes (KTPs) as listed in the relevant schedules of the TSC and EPBC Acts. The table demonstrates that the Stage 2 Extension constitutes, or is likely to exacerbate, the following four KTPs due to unavoidable or unmitigated impacts of the Stage 2 Extension:

1. Clearing of native vegetation;
2. Climate change (human-caused);
3. Loss of hollow-bearing trees; and
4. Removal of dead wood and dead trees.

Consideration of these KTPs is provided under the relevant criteria in the Assessments of Significance provided in **Appendix 10** (NSW) and **Appendix 11** (Commonwealth).

Table 8. Key Threatening Processes in operation at the site (terrestrial processes)

Key Threatening Process	TSC Act	EPBC Act equivalent	Proposal constitutes or is likely to exacerbate KTP
Alteration of habitat following subsidence due to longwall mining	✓	x	NO
Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands.	✓	x	NO
Bushrock removal	✓	x	NO (mitigated)
Clearing of native vegetation	✓	✓	YES
Climate change (human-caused)	✓	✓	YES
Competition and grazing by the feral European rabbit	✓	✓	NO
Competition and habitat degradation by feral goats	✓	✓	NO
Competition from feral honeybees	✓	x	NO
Forest Eucalypt Dieback from psyllids and Bell Minor interaction	✓		NO
Environmental degradation caused by feral deer	✓	x	NO
High frequency fires	✓	x	NO
Importation of red imported fire ants into NSW	✓	✓	NO
Infection by *Psittacine circoviral* (beak & feather)	✓	✓	NO
Infection of frogs by amphibian chytrid fungus	✓	✓	NO
Infection of native plants by *Phytophthora cinnamomi*	✓	✓	NO
Introduction of the large earth bumblebee	✓	x	NO
Invasion and establishment of exotic vines and scramblers	✓	x	NO
Invasion and establishment of Scotch Broom	✓	✓	NO
Invasion and establishment of the Cane Toad	✓	✓	NO
Invasion of native plant communities by African Olive	✓		NO
Invasion of native plant communities by Bitou Bush	✓	x	NO
Invasion, establishment and spread of Lantana	✓	x	NO
Invasion of native plant communities by exotic perennial grasses	✓	✓ (only N. Aust)	NO (mitigated)
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants	x	✓	NO
Loss of hollow-bearing trees	✓	x	YES
Loss and/or degradation of sites used for hill-topping by butterflies	✓	x	NO
Novel biota and their impact on biodiversity	x	✓	NO
Predation and hybridisation of feral dogs	✓	✓	NO
Predation by the European Red Fox	✓	✓	NO
Predation by the feral cat	✓	✓	NO
Predation by *Gambusia holbrooki*, Plague Minnow	✓	x	NO
Predation, habitat degradation, competition and disease transmission by Feral Pigs	✓	✓	NO
Removal of dead wood and dead trees	✓	x	YES

5.2 Native Vegetation

The BIA study area is 135 hectares in total, and is composed of 123.3 hectares of native vegetation and 11.7 hectares of disturbed lands, rehabilitated areas or dams (**Appendix 8**).

Table 3 shows that, of the 123.3 hectares of native vegetation within the BIA study area, a total of 29.0 hectares of native vegetation would be impacted by the Stage 2 Extension either directly through

complete removal (26.5 hectares) or indirectly through edge effects (2.5 hectares). The area of indirect impacts was defined as a ten metre buffer for edge effects in this instance. The remaining 94.3 hectares of native vegetation forms the proposed offset area.

No Threatened Ecological Communities (TECs) listed on the TSC and/or EPBC Acts were recorded within the BIA study area. No TECs would be affected by the Stage 2 Extension.

5.3 Groundwater Dependent Ecosystems

The impacts of the proposal on groundwater supply and condition have been assessed by hydrogeological consultancy, Ground Doctor Pty Ltd (Ground Doctor, 2014). As reported by Ground Doctor (2014) the quarry extension will result in a one-off loss of the water currently held within the rock to be removed and reduce the standing water level in the immediate vicinity of the quarry by approximately 45m. However, on dewatering of the aquifer to the base of the extraction area, which is isolated laterally from surrounding groundwater by the incised gullies of the Coxs River, Yorkeys Creek and their tributaries, a new equilibrium condition would become established where the rate of infiltration is balanced by the rate of groundwater discharge to the extraction area and lower slopes of the surrounding valleys. While the volume of groundwater in storage would decrease, this reduction in storage should not cause any significant change to the current site water balance. That is, the system will return to equilibrium with the recharge – discharge rate to Coxs River and Yorkeys Creek remaining equivalent to the current rates.

In the absence of a substantial impact to the supply or condition of groundwater to the River Oak riparian forest along Coxs Creek, then there is unlikely to be any indirect impact whatsoever on GDEs, if indeed the River Oak riparian forest can be considered a GDE (see discussion in Section 4.3.3 of this report).

5.4 Threatened flora

A significant population of *Eucalyptus pulverulenta* (Silver-leaved Mountain Gum), which is listed as Vulnerable on both the TSC and EPBC Acts, was recorded within the BIA study area. This assessment has demonstrated that 721 of these individuals fall within the Stage 2 footprint, while an estimated 1,850 individuals would be managed and secured in an in-perpetuity offset (**Section 0**). *Eucalyptus aggregata* (black gum), which is listed as Vulnerable on the TSC Act only, has not been recorded on the site during the field survey, however the habitat description for the species matches the habitat on the site and there are six records within 10 kilometres of the BIA study area.

A Seven Part Test has been conducted for both *Eucalyptus pulverulenta* and also *Eucalyptus aggregata*, while the EPBC Act Significant Impact Criteria for vulnerable species has been conducted for *Eucalyptus pulverulenta* only. The assessments conclude that the Stage 2 Extension is unlikely to have a significant impact on *Eucalyptus aggregata*, however *Eucalyptus pulverulenta* would be significantly impacted.

The offsetting assessments in **Section** 7 (NSW) and **Section** 8 (Commonwealth) demonstrate that the Stage 2 Extension can achieve an 'improve or maintain' outcome in relation to impacts on *Eucalyptus pulverulenta*.

5.5 Threatened fauna

Impacts to threatened fauna as a result of the Stage 2 Extension occur through the removal of native vegetation. Each of the 22 threatened or migratory fauna in **Table 2** that would be potentially

impacted are relatively mobile and therefore have the capacity to move into adjacent areas of habitat, however where such habitat is occupied by conspecifics this may lead to exclusion of individuals or restricted ranges for activities such as foraging. These impacts may effect population dynamics and size, and lead to a decrease in the local population of the species. Such impacts are more likely to occur for relatively sessile species with smaller ranges that inhabit the BIA study area (e.g. Scarlet Robin).

Nesting and breeding activities for threatened birds potentially nesting within the BIA study area (e.g. Scarlet Robin) could be disturbed by clearing activities leading to abandonment of nest sites or loss of fledgling chicks, which could impact a small number of individuals within the existing population.

Roosting, torpor and breeding activities of threatened tree-roosting bats may be impacted by the clearing of hollow-bearing trees within the subject site. Impacts from clearing of potential roost trees in this case would occur over a relatively small area compared with available habitat in the locality, and the density of hollow bearing trees is low (particularly those with large hollows that may sustain more important roost habitat). Field surveys did not locate or detect any bat roost sites within the BIA study area.

Five threatened fauna species listed on the TSC and/or EPBC Acts were detected during this study, including Gang-gang Cockatoo, Powerful Owl, Scarlet Robin, Eastern Bentwing-bat and Large-eared Pied Bat. Additional threatened fauna previously recorded within the BIA study area include Hooded Robin, Flame Robin and Varied Sittella. As a result of the field surveys a moderate to high likelihood of occurrence and potential habitat was considered to exist within the BIA study area for Grey-headed Flying-fox, Koala and an additional three threatened microbats (Eastern False Pipistrelle, Eastern Freetail-bat and Greater Broad-nosed Bat).

NSW Assessments of Significance (Seven Part Tests) have been conducted for each of these species (**Appendix 10**), which are all listed as Vulnerable on the TSC Act. A single Seven Part Test has been conducted for the threatened microbats which have similar habitat requirements (hollow roosting).

An address of the EPBC Act Significant Impact Criteria for vulnerable species has been conducted for Grey-headed Flying-fox, Large-eared Pied Bat and Koala. An address of the criteria for EPBC threatened migratory species has been conducted for Cattle Egret, Rainbow Bee-eater, Satin Flycatcher, White-throated Needletail.

The Assessments of Significance concluded that the Stage 2 Extension was unlikely to have a significant impact on any threatened fauna.

5.6 SEPP 44 – Koala Habitat Protection (NSW)

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

a) by requiring the preparation of plans of management before development consent can be granted in relation to areas of core Koala habitat

b) by encouraging the identification of areas of core Koala habitat, and

c) by encouraging the inclusion of areas of core Koala habitat in environment protection zones.

SEPP 44 applies to land within Local Government Areas (LGAs) listed in SEPP 44, Schedule 1 (including Greater Lithgow LGA) for which a development application has been made (SEPP 44, Section 6) and Council is the determining authority. SEPP 44 does not apply to land dedicated or reserved under the

National Parks and Wildlife Act (NPW Act) 1974 or to land dedicated under the *Forestry Act* 1916 as State Forest or flora reserve (SEPP 44, Section 5). Nor does it apply to land where Council is not the determining authority.

Under SEPP 44, the distinction is made between 'Potential' and 'Core' Koala Habitat. Potential Koala habitat means areas of native vegetation where the trees of the types listed in Schedule 2 of the Policy constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. "Core Koala habitat" means an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

Eucalyptus tereticornis (Forest Red Gum) is the only koala feed tree species, as listed in Schedule 2 of the Policy, present within the area of impact and is considered to be no more than 80 per cent dominant within the Forest Red Gum grassy open forest vegetation type (other species such as *Angophora floribunda*, *Eucalyptus eugenoides* and *Eucalyptus melliodora* are also present in the vegetation type). Therefore, the Forest Red Gum grassy open forest vegetation type constitutes potential Koala habitat as defined in the SEPP (4.4 hectares or 17 per cent removed), despite most of the Stage 2 Extension area being composed of tree species that do not constitute potential koala habitat as defined by the SEPP (22.1 hectares or 83 per cent of the vegetation to be removed. Whilst potential habitat as defined by SEPP 44 exists for Koala within the Stage 2 Extension, no individuals have ever been recorded despite extensive surveys. Therefore, an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population. Therefore, core Koala habitat does not exist within the Stage 2 Extension.

6 AMELIORATION MEASURES

6.1 Avoid, minimise and offset

Assessment of impacts on biodiversity sits within a hierarchy of avoid, minimise and offset. Development proposals must demonstrate that all necessary measures have been taken to avoid and minimise any unnecessary impacts on biodiversity. After all feasible measures have been taken to avoid or minimise impacts to biodiversity, offsets are used to compensate for any remaining residual and unavoidable impacts. Within both the NSW and federal offsetting frameworks, the most desirable outcome is that of improve or maintain.

Table 9 lists the direct and indirect impacts of the Stage 2 Extension on biodiversity.

Table 9. Amelioration of the direct and indirect impacts of the Stage 2 Extension

Impact	Likelihood of impact as a result of the Stage 2 Extension	Amelioration Measure (Avoid/Minimise/Mitigate/Offset)
Direct impacts		
Removal or Modification of Native Vegetation	Removal of 26.5 hectares of native vegetation	Measures to avoid direct impacts have been described in **Section 6.2**. Offsetting of residual impacts required – refer to **Sections 6.4, 7 and** 8. The forthcoming Biodiversity Offset Strategy will describe these measures in detail.
Loss of individuals of a threatened species	Removal of 721 individuals of *Eucalyptus pulverulenta*	
Indirect impacts		
Edge effects	Likely	Mitigated through the implementation of strict exclusion zones and weed management during and after construction. Offsetting – A minor residual effect can be expected due to the permanently altered increase in light levels, exposure to dust and altered vegetation structure. This residual impact must be offset and amounts to 2.5 ha of native vegetation as a ten metre buffer around the area of direct impact.
Deleterious hydrological changes	Likely	The Stage 2 Extension does not impact on any flowing streams, waterways or important aquifers. Mitigation through implementation of sediment and erosion control measures and on-site detention systems.
Sedimentation and erosion	Likely	Mitigation through implementation of sediment and erosion control measures and on-site detention systems.
Weed invasion	Likely	Weed invasion in rehabilitated on-site areas is likely. Would be mitigated through implementation of an on-site VMP.
Increased human activity within or directly adjacent to sensitive habitat areas	Likely	Mitigation through the strict implementation of exclusion zones during construction and operation. Would form a component of both the VMP and the management of the proposed offset area.

The Stage 2 Extension would result in the unavoidable removal of 26.5 hectares of native vegetation and 721 individuals of *Eucalyptus pulverulenta* (these are direct impacts). These impacts would require offsetting.

Less tangible, though no less important are the indirect impacts that have the potential to occur as a result of the Stage 2 Extension and include edge effects, altered hydrology, sedimentation and erosion, weed invasion and increased human activity. As is described in **Table 9**, each of these indirect impacts would be mitigated through the implementation of on-site management actions, though it is likely that some minor unavoidable indirect impact would accrue due to the creation of a

new bushland edge. As such, this indirect impact is required to be offset and, for the purposes of this report, the ten metre buffer has been utilised such that an offset calculation can be made in respect to these edge effects. The ten metre buffer results in an additional 2.5 hectares of native vegetation that is required to be offset (a total of 29.0 hectares).

6.2 Measures to avoid impacts

The Stage 2 Extension is to be the subject of a development application in accordance with the NSW regulatory framework and as such a comprehensive mitigation framework is yet to be finalised. The State assessment process, in combination with assessment under the EPBC Act as a controlled action, would provide the necessary regulatory framework required to establish an appropriate impact mitigation strategy for the Stage 2 Extension.

Where significant residual impacts are identified, the Stage 2 Extension would also provide for biodiversity offsets in accordance with relevant NSW and Commonwealth guidelines. If required, these would be developed in consultation with the relevant NSW and Commonwealth agencies.

Given the early stages of planning of the Action, no management plans have been created or implemented specific to the Action. It is expected that appropriate management measures would be developed to avoid, reduce, manage and/or offset any relevant impacts of the action upon receipt of the adequacy review and Conditions of Approval from DP&I and DoE (formerly SEWPaC).

The following discussion considers the alternative method of development which could avoid or reduce impacts.

6.2.1 Method of Extraction

Given the nature and location of the rhyolite resource at or near the surface, open cut methods were determined to be the only feasible means of extracting the identified resource.

6.2.2 Limit of Extraction

The extraction area could be reduced in size and still provide for an increase in the life of the quarry. However, given the resource is now well understood, and the Applicant's experience in the current setting, there is little to be gained by progressively extending the quarry in smaller increments over the next 30 to 40 years. By presenting the larger extension, certainty can be provided to the local community, Council, DP&I and construction industry as to the ultimate extent and life of operation at the Austen Quarry.

Two core habitat areas for the threatened plant, *Eucalyptus pulverulenta* (Silver-leaved Mountain Gum), were located just to the north of the existing pit in the June 2013 surveys which are represented as vegetation type c2 – Silver-leaved Mountain Gum mallee woodland in **Figure 7**. Both of these areas lie within the previously approved Stage 1 extraction area and would remain undisturbed throughout the life of operations in the Stage 2 Extension.

6.2.3 Overburden Disposal

Backfilling of completed sections of the final extraction area would be considered during the latter years of the Stage 2 Extension. Notwithstanding this possibility, it is considered appropriate to provide for the extension of the existing overburden emplacement for the full 4.4 Mt of overburden.

6.2.4 Transport Options

The use of rail to transport quarry products has been given consideration, however, it is considered to be of little benefit to pursuing this option for the following reasons:

- Quarry products would have to be delivered by road to a rail siding, possibly at Lithgow, Lidsdale or Mount Victoria, negating the benefit of using the rail; and
- The Applicant does not have access to a rail facility capable of loading the aggregate products. The cost of constructing such a facility would be prohibitive.
- The locations of the Applicant's concrete batching plants are not near rail sidings and its customers are not static. Consequently, even if products could be placed on rail, there would be added cost and road transport necessary to deliver the products to their final destination.

6.3 Measures to mitigate impacts

As can be seen in **Table 9** a series of mitigation measures designed to reduce or manage indirect impacts would be implemented within the Stage 2 Extension. Such measures include the implementation of strict exclusion zones, weed management and sediment and erosion control measures, and on-site detention systems. Implementation of these measures would be detailed in relevant on-site Management Plans, where required (e.g., in relation to erosion and sediment control and vegetation management).

6.4 Offsetting of residual impacts

Having implemented the mitigation measures as described in **Section 6.3** above, a residual impact still exists to the extent that 29.0 hectares of native vegetation and 721 individuals of *E. pulverulenta* would be either directly or indirectly impacted by the Stage 2 Extension. As such, these residual impacts are required to be offset in line with both NSW and Commonwealth offsetting policies and guidelines.

Sections 7 **and** 8 of this report quantify the offset requirements under the NSW and Commonwealth policies respectively. In NSW, offsetting of State Significant Development and Infrastructure is conducted within the framework of the *NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects* (OEH 2011) and also seven offsetting principles. Offset calculations in NSW are conducted using the BioBanking Assessment Methodology. Within the EPBC Act framework, offset calculations are driven by the EPBC Act Offsets Assessment Guide (a spreadsheet calculator) and principles are described in the *EPBC Act Environmental Offsets Policy* (SEWPaC 2012).

Upon receipt of the adequacy review and Conditions of Approval from DPI and DoE, a Biodiversity Offsets Strategy (BOS) would be developed such that the offsetting requirements for both the State and Commonwealth are satisfied. **Sections** 7 **and** 8 clearly demonstrate that, through the in-perpetuity management and security of the proposed offset area as described in this report, both State and federal offsetting requirements are met.

7 NSW OFFSETTING ASSESSMENT

For the purposes of this assessment, Niche have conducted nominal BioBanking credit calculations for both the Stage 2 Extension area (Development Site) and the proposed offset area (BioBank Site), as presented in this report (**Figure 4**). A description of both scenarios, which were conducted using Version 2 of the BioBanking Credit Calculator (the Calculator), is provided in this section. The relevant credit reports have been provided in **Appendix 12** (development site credits required) and **Appendix 13** (offset area credits created).

Figure 12 illustrates the Landscape Assessment factors required by the Calculator. Both the Development Site (the Stage 2 Extension) and the BioBank Site (the proposed offset area):

- ❒ Fall entirely within the same 1000 hectare assessment circle;
- ❒ Are within the Hawkesbury/Nepean Catchment Management Authority (CMA) boundary;
- ❒ Are within the Bathurst CMA sub-region; and
- ❒ Are dominated by the Sydney Basin Western Escarpment Mitchell Landscape.

7.1 Development Site

The Stage 2 Extension would result in the removal of 26.5 hectares of native vegetation and indirectly impact on a further 2.5 hectares through edge effects (a 10 metre buffer). Furthermore, 721 individuals of *Eucalyptus pulverulenta* fall within the Hartley Stage 2 Extension, 90 from non-core remnant bushland habitat and 631 from previously planted (rehabilitated) areas.

7.1.1 Landscape value

Table 10 shows the values used for the change in native vegetation cover as a result of development (**Figure 12**). This was estimated based on the approximate amount of native vegetation cover within the 1,000 hectare and 100 hectare circles both before and after the removal of 26.5 hectares of native vegetation. The 2.5 hectares of indirect impacts do not affect the landscape assessment.

Table 10. Native Vegetation Cover Classes – Development Site

	Native Vegetation Cover Class (%)	
	Circle 1	
	Before Clearing	**After Clearing**
1000 ha	51 – 60 %	41 – 50 %
100 ha	71 – 80 %	41 – 50 %

7.1.2 Connectivity value

A connectivity assessment was conducted for the Stage 2 Extension using the method outlined in DECCW (2009a). The following aspects were considered:

- ❒ The width of the current and future connecting link; and
- ❒ The condition of the current and future connecting link (over-storey and mid-storey/ground cover).

Figure 12 illustrates that the main connecting link through the Development Site (the Stage 2 Extension) is in the south of the BIA study area and that the connectivity width would remain within the range of 100 to 500 metres before and after the Stage 2 Extension (**Table 11**).

Table 11. Connectivity Value – Development Site

	Before Development	After Development
Width	>100-500m	>100-500m
Condition		
Over-storey Condition	PFC at BM*	PFC at BM
Mid-storey/ground cover condition	PFC at BM	PFC at BM

- *PFC at BM = Projected Foliage Cover at Benchmark*

7.1.3 Vegetation zones and management zones

The vegetation types defined by Niche within the Austen Quarry site have been aligned with Revised Biometric Vegetation Types (RBVTs), TECs, Keith Formations and Keith Classes in **Appendix 8**.

Three vegetation zones exist within the Hartley Stage 2 Extension development site. These three vegetation zones have been split into six management zones in all, two each for the direct and indirect impact areas. This impact is summarised in **Table 12** and illustrated in **Figure 8**.

Table 12. Vegetation zones of the Hartley Stage 2 Extension development site

Niche vegetation type	RBVT	Veg Zone number	Veg Zone	Veg Zone Area (ha)	Management Zone number*	Management Zone Area – Direct Impact (ha)	Management Zone Area – Indirect Impact (ha)
c1: Brittle Gum - Broad-leaved Peppermint open forest	HN570: Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest	1	HN570_mod/good	18.6	mz1	17.3	
					mz2		1.3
c5: Stringybark - Apple Box open forest	HN501: Apple Box - Broad-leaved Peppermint dry open forest	2	HN501_mod/good	5.2	mz3	4.8	
					mz4		0.4
c3: Forest Red Gum grassy open forest	HN527: Forest Red Gum - Yellow Box woodland of dry gorge slopes	3	HN527_mod/good	5.2	mz5	4.4	
					mz6		0.8
				29.0		26.5	2.5

** Rows have been highlighted to differentiate Management Zones within the same vegetation type*

7.1.4 Threatened species requiring survey

As the BBAM is not being utilised for a formal BioBanking Assessment, the threatened species requiring survey output is not relevant. Niche have conducted thorough and rigorous ecological surveys for threatened species that have a moderate to high likelihood of occurrence within the BIA study area. This survey was determined through an analysis of records on the Atlas of NSW Wildlife and EPBC Act Protected Matters Search Tool. A full description of the methodology and results of the survey are provided in **Sections** 3 **and** 4 of this report respectively.

7.1.5 Threatened fauna predicted

The Calculator identified four threatened fauna, defined as ecosystem credit species in the Threatened Species Profiles Database (TSPD, OEH 2014), within the Stage 2 Extension area and therefore predicted to occur:

1. Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*;
2. Scarlet Robin *Petroica boodang*;
3. Grey-headed Flying-fox *Pteropus poliocephalus*; and
4. Greater Broad-nosed Bat *Scoteanax rueppellii*.

Of these, Eastern Bentwing-bat and Scarlet Robin were detected during the field surveys conducted by Niche.

7.1.6 Site values

A break down of the plots conducted against the minimum requirement per vegetation type is provided in **Table 3** in **Section 4.3.1**. Plots were completed by Nathan Smith and Luke Baker, Accredited BioBanking Assessors. Original plot data can be provided on request.

The default decrease in site score allowed by the Calculator for the areas of direct impact was accepted for management zones 1, 3 and 5. This reduced the site values to zero as all native vegetation within these management zones would be completely removed by the Stage 2 Extension.

Management zones 2, 4 and 6 would only be indirectly impacted through edge effects and remain largely intact. The only BioBanking site attribute reduced to zero for these zones was exotic cover, the assumption being that the zone of indirect impact would suffer some minor impacts from creation of new edges and potential subsequent weed invasion. Whilst this assumption has been made, in all probability the potential for weeds to spread from newly created edges would be minimised due to on-site weed management as described in **Section 6.3**. Therefore, our assessment of this additional 2.5 hectare buffer zone is considered an over-estimate of the offset requirement for indirect impacts.

7.1.7 Threatened species survey results

No threatened fauna as listed on the TSC Act, that require the retirement of species credits, were detected by Niche during the field surveys. Five threatened fauna were detected by Niche throughout the proposed offset area, all of which are predicted by ecosystem credits, including; Gang-gang Cockatoo, Powerful Owl, Scarlet Robin, Eastern Bentwing-bat and Large-eared Pied Bat.

All other threatened fauna, as listed on the TSC Act and assessed in this report as having a moderate, high or known likelihood of occurrence (**Table 2** and **Appendix 3**) are predicted as ecosystem credit species and therefore species credits are not required for any threatened fauna.

As has already been stated, 721 individuals of *Eucalyptus pulverulenta* fall within the area that would be removed by the Stage 2 Extension. Species credits are required in order to offset this impact.

7.1.8 Development Site credit calculations

Appendix 12 provides the full Development Site Credit Extract derived from the BioBanking Credit Calculator.

A total of 902 ecosystem credits are required to offset impacts to 28.3 hectares of native vegetation within the Hartley Stage 2 Extension. A breakdown of this calculation is provided in **Table 13**.

Table 13. Ecosystem credit requirement

Niche veg type	Vegetation Zone	Management Zone Number*	Credit Requirement per Management Zone	Credit Requirement per Vegetation Zone
c1: Brittle Gum - Broad-leaved Peppermint open forest	HN570: Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest	**mz1**; 17.3 ha direct impact	604	620
		mz2; 1.3 ha indirect impact	16	
c5: Stringybark - Apple Box open forest	HN501: Apple Box - Broad-leaved Peppermint dry open forest	**mz3**; 4.8 ha direct impact	146	148
		mz4; 0.4 ha indirect impact	2	
c3: Forest Red Gum grassy open forest	HN527: Forest Red Gum - Yellow Box woodland of dry gorge slopes	**mz5**; 4.4 ha direct impact	129	134
		mz6; 0.8 ha indirect impact	5	
			902	

** Rows have been highlighted to differentiate Management Zones within the same vegetation type*

A total of 11,092 species credits are required to offset the removal of 721 *Eucalyptus pulverulenta* individuals within the Hartley Stage 2 Extension.

7.2 The proposed offset area (BioBank Site)

7.2.1 Landscape value

Table 14 shows the values used for the change in native vegetation cover as a result of the management of the proposed offset area. This assumes some improvement in cover in the open paddocks particularly in the northern part of the site.

Table 14. Native vegetation cover classes – offset area

	Native Vegetation Cover Class (%)	
	Circle 1	
	Before Management	**After Management**
1000 ha	41 – 50 %	51 – 60 %
100 ha	41 – 50 %	61 – 70 %

7.2.2 Connectivity value

Figure 12 illustrates that the main connecting link through the prosed offset area is in the south of the BIA study area and that the connectivity width would remain within the range of 100 to 500 metres before and after management (**Table 15**).

Table 15. Connectivity value – offset area

	Before BioBank	After BioBank
Width	100-500m	100-500m
Condition		
Over-storey Condition	PFC at BM	PFC at BM
Mid-storey/ground cover condition	PFC at BM	PFC at BM

7.2.3 Vegetation zones and management zones

An alignment of the vegetation zones at Austen Quarry with Revised Biometric Vegetation Types (RBVTs), EECs, Keith Formations and Keith Classes has been provided in **Appendix 8**. As there is only a single 1,000 hectare assessment circle for the site, each Threatened Species Sub-Zone equates directly to a vegetation zone and a management zone. The vegetation zones and management zones within the proposed offset area are provided in **Table 16**.

Table 16. Vegetation zones and management zones within the Offset site

Niche vegetation type	Vegetation Zone number	RBVT Code and Name	Vegetation Zone	Management zone number and area*
c1: Brittle Gum - Broad-leaved Peppermint open forest	**1**	HN570: Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest	HN570_mod/good_High	**mz1**; 46.3 ha
c2: Silver-leaved Mountain Gum mallee woodland	**2**		HN570_mod/good_Other	**mz2**; 1.9 ha
c3: Forest Red Gum grassy open forest	**3**	HN527: Forest Red Gum - Yellow Box woodland of dry gorge slopes	HN527_mod/good_High	**mz3**; 22.8 ha
c3a: Forest Red Gum native grassland	**4**		HN527_mod/good_Medium	**mz4**; 0.8 ha
c3b: Forest Red Gum exotic grassland	**5**		HN527_low	**mz5**; 9.7 ha
c4: Rough-barked Apple gully forest	**7**		HN527_mod/good_Other	**mz7**; 2.4 ha
c6: River Oak riparian open forest	**6**	HN574: River Oak open forest	HN574_mod/good_High	**mz6**; 10.4 ha
			Total	*94.3 ha*

** Rows have been highlighted to differentiate Management Zones within the same vegetation types*

7.2.4 Threatened species requiring survey

The Calculator identified six threatened species that would require to be detected within the proposed offset area in order to generate species credits, they are:

1. Booroolong Frog *Litoria booroolongensis*;
2. Capertee Stringybark *Eucalyptus cannonii*;
3. Flockton Wattle *Acacia flocktoniae*;
4. Kanangra Wattle *Acacia clunies-rossiae*;
5. Little Eagle *Hieraaetus morphnoides*; and
6. Rosenberg's Goanna *Varanus rosenbergi*.

This is an indicative list only as all threatened species can generate species credits if detected within an offset area, other than those threatened fauna that are defined as ecosystem credit species in the TSPD (OEH 2014). None of the species listed above were detected during the field surveys and therefore species credits cannot be generated for these species.

7.2.5 Threatened fauna predicted

The Calculator identified 11 threatened fauna defined as ecosystem credit species in the TSPD (OEH 2014) within the proposed offset area:

1. Diamond Firetail *Stagonopleura guttata*;
2. Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*;
3. Glossy Black-cockatoo *Calyptorhynchus lathami*;
4. Greater Broad-nosed Bat *Scoteanax rueppellii*;

5. Grey-headed Flying-fox *Pteropus poliocephalus*;
6. Large-footed Myotis *Myotis macropus* (formally *Myotis adversus*);
7. Little Lorikeet *Glossopsitta pusilla*;
8. Masked Owl *Tyto novaehollandiae*;
9. Powerful Owl *Ninox strenua*;
10. Scarlet Robin *Petroica boodang*; and
11. Yellow-bellied Glider *Petaurus australis*.

Five threatened fauna were detected by Niche throughout the proposed offset area, all of which are defined as ecosystem credit species in the TSPD (OEH 2014), including; Gang-gang Cockatoo, Powerful Owl, Scarlet Robin, Eastern Bentwing-bat and Large-eared Pied Bat.

7.2.6 Site values

The minimum number of plots required is prescribed on page 26 of DECCW (2009a). A break down of the plots conducted against the minimum requirement per vegetation type is provided in **Table 3** in **Section 4.3.1**.

A single management zone was selected per threatened species sub-zone. The default increase in site score allowed by the Calculator was accepted for the offset area, except for Forest Red Gum exotic grassland, where the gain in site value was increased through the proposed revegetation of the degraded pasture.

7.2.7 Threatened species survey results

Five threatened fauna were detected by Niche throughout the proposed offset area, all of which are predicted by ecosystem credits, including; Gang-gang Cockatoo, Powerful Owl, Scarlet Robin, Eastern Bentwing-bat and Large-eared Pied Bat.

All other threatened fauna, as listed on the TSC Act and assessed in this report as having a moderate, high or known likelihood of occurrence (**Table 2** and **Appendix 3**) are predicted as ecosystem credit species and therefore species credits cannot be created for any threatened fauna within the proposed offset area. Species credits can be created in the future should a threatened fauna species that creates species credits be detected on site.

An estimated 1,850 individuals of *Eucalyptus pulverulenta* fall within the proposed offset area and can generate species credits.

7.2.8 Proposed offset area (BioBank Site) credit calculations

Appendix 13 provides the full BioBanking Credit extract for the proposed offset area.

A total of 1,003 ecosystem credits are generated on the proposed offset area (**Table 17**).

A total of 11,100 *Eucalyptus pulverulenta* species credits are created by the conservation of 1,850 individuals within the proposed offset area.

Table 17. Ecosystem Credit Calculations – proposed offset area

Niche vegetation type	Vegetation Zone number	RBVT Code and Name	Vegetation Zone	Management zone number	Credits Created per management zone	Credits Created per RBVT
c1: Brittle Gum - Broad-leaved Peppermint open forest	**1**	HN570: Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest	HN570_mod/good_High	**mz1**; 46.3 ha	446	461
c2: Silver-leaved Mountain Gum mallee woodland	**2**		HN570_mod/good_Other	**mz2**; 1.9 ha	15	
c3: Forest Red Gum grassy open forest	**3**	HN527: Forest Red Gum - Yellow Box woodland of dry gorge slopes	HN527_mod/good_High	**mz3**; 22.8 ha	299	439
c3a: Forest Red Gum native grassland	**4**		HN527_mod/good_Medium	**mz4**; 0.8 ha	9	
c3b: Forest Red Gum exotic grassland	**5**		HN527_low	**mz5**; 9.7 ha	110	
c4: Rough-barked Apple gully forest	**7**		HN527_mod/good_Other	**mz7**; 2.4 ha	21	
c6: River Oak riparian open forest	**6**	HN574: River Oak open forest	HN574_mod/good_High	**mz6**; 10.4 ha	103	103
					1,003	

7.3 Offsetting State Significant Development

In 2011, OEH published the *NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects*. The assessment and discussion that follows adheres to the three-tiered offsetting scenario available to proponents such that a project may result in Improve or Maintain (Tier 1), No Net Loss (Tier 2) or Mitigated Net Loss (Tier 3) outcomes for threatened biodiversity.

7.3.1 Ecosystem credits

Appendix 14 is a table of the complete ecosystem offsetting requirements and the subsequent status of the credit supply after each round of offsetting.

Tier 1: Like-for-like or improve/maintain

At the SSD Tier 1 level (i.e. like-for-like/improve or maintain), all 134 ecosystem credits that are required to offset impacts to the RBVT, HN527 Forest Red Gum - Yellow Box woodland, can be retired against the 439 ecosystem credits for the same RBVT that would be generated in the proposed offset area. The Stage 2 Extension would therefore achieve a full improve or maintain outcome in relation to HN527, provided the proposed offset area is secured and managed into perpetuity.

At the Improve or Maintain SSD Tier 1 level, 461 ecosystem credits of the 620 required for HN570 Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest would be retired. This creates a deficit of 159 ecosystem credits for HN570. On a like-for-like basis (again Tier 1), a deficit of 148 ecosystem credits exists for HN501 Apple Box - Broad-leaved Peppermint dry open forest as no credits are generated within the proposed offset area for this BVT.

In total, 595 ecosystem credits (134 for HN527 and 461 for HN570), or approximately 66 per cent of the ecosystem credit requirement, would be offset at the Tier 1 level on a like-for-like basis within the adjacent proposed offest site, thus achieving an 'improve or maintain' outcome for these vegetation types.

A surplus of 103 Ecosystem Credits exists for HN574 River Oak open forest, none of which is impacted by the Stage 2 Extension. HN527 would provide a surplus of 305 ecosystem credits for RBVTs within the same Keith Formation for which there may be a deficit (see Tier 3 below).

In relation to the deficits of ecosystem credits for both HN570 and HN501, Niche conducted a search on the BioBanking Credit Register for the market availability of these credits (search conducted 1 September 2014), such that an improve or maintain outcome might be achieved through the purchase and retirement of the required ecosystem credits at BVT level. This search demonstrated that neither of these BVTs are available as ecosystem credits on the BioBanking Credit Register, either within the Bathurst CMA sub-region or the adjacent CMA sub-regions. According to the Credit Profile (see **Appendix 12**: Full Credit Report for the development area), a number of BVTs align to HN501 within the Hawkesbury-Nepean CMA region. Upon investigation, two of these equivalent BVTs, HN572 (Ribbon Gum – Snow Gum grassy forest) and HN524 (Forest Red Gum – Grey Box shrubby woodland) provide up to 310 ecosystem credits and are available in the Oberon and Wollemi CMA subregions.

Threatened species profiles of BVTs

The BBAM and therefore offsetting of BVTs (native vegetation types) in NSW is predicated on the basis that the BVTs in question are habitat surrogates for some threatened fauna. The suite of threatened fauna predicted in any one BVT is its Threatened Species Profile. Therefore, improve or maintain outcomes are achieved when the Threatened Species Profile of the BVTs present within an offset area match those predicted to be impacted in the development area.

The Threatened Species Profile for the three BVTs impacted by the proposal (HN501, HN527 and HN570) is exactly the same, i.e., they are each predicted to provide habitat for the following threatened fauna; Eastern Bentwing Bat, Greater Broad-nosed Bat, Grey-headed Flying Fox and also Scarlet Robin. In combination, HN501, HN527 and HN570 provide 900 ecosystem credits in total within the proposed conservation area and 902 ecosystem credits are required. In this sense, the retirement of all 900 ecosystem credits provides a 99.8 per cent improve or maintain outcome for the proposal (a shortfall of 2 credits), provided the proposed conservation area is secured and managed into perpetuity.

It is considered that this is further justified by:

1. The fact that HN501 Apple Box - Broad-leaved Peppermint dry open forest is somewhat curiously (and probably erroneously) aligned to the Grassy Woodland Keith formation within the BVTs database and yet is a 'dry open forest'. HN501 should probably be aligned to the Dry Sclerophyll Forest formation, the same as HN527 and HN570.
2. The fact that HN527 is a more highly cleared veg type (50 per cent) compared to HN501 (30 per cent), resulting a like-for-like 'or better outcome (i.e., improve or maintain).
3. The 103 surplus ecosystem credits for the River Oak riparian forest (HN574) along Coxs Creek which also, according to the Threatened Species Profile for this BVT provides threatened fauna habitat for Masked Owl and Powerful Owl. This would also constitute a high conservation area and would be nominated as such under the new Framework for Biodiversity Assessment.
4. The offset would be a local offset, thereby guaranteeing that the suite of species and local populations affected, threatened or otherwise, are compensated for locally.
5. The offset site would guarantee the security and management of a key and significant population of the threatened plant, *Eucalyptus pulverulenta*. Other components of this assessment have demonstrated an improve and maintain outcome in relation to this species.

Therefore, whether the above justifications fall within the Tier 1 component of the policy or Tier 3, it is considered that the acquisition of additional offset lands or ecosystem credits is entirely unnecessary in this instance, as the proposal is likely to meet an improve or maintain outcome in relation to the threatened fauna predicted within the three BVTs impacted on site.

Tier 2: No net loss

None of these RBVTs are considered Endangered Ecological Communities and therefore Tier 2 does not apply.

Tier 3: Mitigated net loss

Under Tier 3 (mitigated net loss), an investigation must firstly be made as to whether deficit in credit status at the RBVT level can be reconciled with credits from the same Keith Formation within the same IBRA bioregion (Criterion (a) of Appendix B of OEH 2011). At a Keith Formation level, HN570 aligns with HN527 and therefore can be fully offset through retirement of 159 of the 305 ecosystem credit surplus for HN527. Thus the Stage 2 Extension meets a mitigated net loss outcome for HN570.

The deficit of 148 ecosystem credits for HN501 cannot be offset at the Keith Formation level and therefore the assessment must progress to Criteria (c).

Criterion (c) of Appendix B of OEH (2011) allows for the removal from consideration of clearing of a RBVT of less than four hectares for types that are not greater than 70 per cent cleared or a State or Commonwealth TEC. More than four hectares of HN501 would be cleared and therefore Criterion (c) does not apply.

Progression to Criterion (d) or (e) of Appendix B of OEH (2011) allows for the conversion of ecosystem credits into hectares such that an equivalent amount of land can be utilised as an offset. In this case, the 148 ecosystem credit deficit for HN501 is an equivalent of 16 hectares (based on the OEH Credit Converter). HN527 and HN574 created credits at the rate of 11.8 credits per hectare (542 credits created over 46.1 hectares). Therefore an additional 189 ecosystem credits (16 x 11.8) from either of these BVTs must be retired in order to offset impacts to HN501. As 249 surplus ecosystem credits are available from HN527 and HN574 combined, HN501 can be offset through the retirement of 189 ecosystem credits from these BVTs (the equivalent of 16 hectares).

Furthermore, HN527 (50 per cent cleared) and HN574 (40 per cent cleared) are both more highly cleared than HN501 (30 per cent cleared) and therefore, this outcome is conserving vegetation of higher conservation value.

The proposed offset area is therefore considered to provide an 'improve or maintain' outcome in relation to 66 per cent of the native vegetation that is impacted by the Stage 2 Extension. The remaining 34 per cent of the impact would be offset in a way that meets the requirements of Tier 3 of OEH (2011) and therefore achieves a mitigated net loss outcome.

Finally, the RBVTs that would be conserved within the proposed offset area provide habitat for each of the four threatened fauna that are predicted to occur within the Hartley Stage 2 Extension area. These were Eastern Bentwing-bat (recorded in the proposed offset area), Scarlet Robin (recorded in the proposed offset area), Grey-headed Flying-fox and Greater Broad-nosed Bat. Additional species that are predicted to occur within the RBVTs within the proposed offset area include Diamond Firetail, Glossy Black-cockatoo, Large-footed Myotis, Little Lorikeet, Masked Owl, Powerful Owl (recorded on site) and Yellow-bellied Glider. Gang-gang Cockatoo and Large-eared Pied Bat were also recorded within the proposed offset area and are predicted in ecosystem credits.

7.3.2 Species credits

Under the BioBanking development scenario conducted, the loss of 721 *Eucalyptus pulverulenta* individuals (631 in rehabilitation areas and 90 in remnant though non-core habitat) results in a requirement of 11,092 species credits. Site surveys and analysis of likelihood of occurrence demonstrates that no other species that require species credits are required to be offset. Under the offsetting scenario presented, the conservation of 1,850 *Eucalyptus pulverulenta* individuals creates 11,100 species credits. These 1,850 individuals are from the core and non-core remnant populations within the proposed offset area and does not including 755 retained in rehabilitation areas, or 280 individuals that fall within the currently managed Conservation Area H from a previous approval.

Therefore, there is a resultant surplus of eight (8) *Eucalyptus pulverulenta* species credits (11,100 less 11,092). As such, through the provision of a managed and secure in-perpetuity offset, the Stage 2 Extension would achieve an 'improve or maintain' outcome for *Eucalyptus pulverulenta*.

7.4 Address of NSW Offsetting Principles for State Significant Development

The NSW Government has developed seven principles (OEH 2013) to be used in assessing impacts to biodiversity and determining acceptable offsets for state significant development and state significant infrastructure projects. This section of the report addresses each of these in relation to the impacts and provision of a managed and secured in-perpetuity offset adjacent to the Stage 2 Extension.

The seven principles are listed and described on the OEH web-site at this link (OEH 2013):

http://www.environment.nsw.gov.au/biocertification/offsets.htm

1. Before offsets are considered, impacts must first be avoided and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts.

Sections 6.2 and **6.3** of this report describe the varying measures Hy-Tec have taken or would take in order to avoid and minimise impacts associated with the Stage 2 Extension. Hy-Tec explored other options in terms of the method and limit of extraction, overburden disposal and various transport options to avoid ecological values. Measures such as the implementation of strict exclusion zones, weed management and sediment and erosion control measures and on-site detention systems would mitigate most indirect impacts associated with the Stage 2 Extension.

In regards to impacts on *Eucalyptus pulverulenta* a reduction in the number of individuals removed has been achieved through avoidance of parts of the previously rehabilitated areas in the Stage 1 extraction area. This has reduced the total impact on the species from approximately 1,500 individuals, as nominated in the Referral (Niche 2013), to a current loss of 721 individuals, a reduction of 779 individuals or 52 per cent of the original number.

After consideration of all avoidance and mitigation measures, an unavoidable and residual impact on 29.0 hectares of native vegetation (including 2.5 hectares of indirect impacts) and 721 individuals of *Eucalyptus pulverulenta* would occur. Offsetting is, therefore, required under both State and Commonwealth policies.

2. Offset requirements should be based on a reliable and transparent assessment of losses and gains.

In relation to this principle, the *BioBanking Assessment Methodology* (DECC 2008a), is considered best practice. The BBAM was utilised in this assessment to compare the biodiversity values (expressed in

terms of biodiversity credits) of both the Stage 2 Extension development and the proposed offset area. Mr Nathan Smith and Dr Rhidian Harrington of Niche Environment and Heritage (both Accredited BioBanking Assessors), performed and reviewed (respectively) credit calculations using the BioBanking Credit Calculator (BBCC), including the application of the BBAM and the use of the NSW interim policy for offsetting SSD (OEH 2011). All survey effort met the draft survey guidelines as required by OEH (DEC 2004) and all data required to operate the BBCC has been supplied. The assessment is therefore transparent and reliable.

3. Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.

Section 7.3 of this report describes how, under the NSW interim policy for offsetting SSD (OEH 2011), the Stage 2 Extension meets a "Tier 1 Improve or Maintain" outcome for 66 per cent of the native vegetation impacted and for the entire loss of 721 individuals of *Eucalyptus pulverulenta*. The remaining 34 per cent of native vegetation impacted by the Stage 2 Extension would be offset under a "Tier 3 Mitigated Net Loss" scenario. The Stage 2 Extension therefore substantially targets, where possible, the offsetting of like-for-like ecosystem and threatened species values and conforms to current NSW policy to offset the remaining non like-for-like native vegetation.

4. Offsets must be additional to other legal requirements on the site proposed.

The proposed offset area would be secured under a Voluntary Conservation Agreement (VCA), addition to OEH estate, BioBanking Site or similar, and is independent of any existing legal requirements to manage the site for conservation. It should be noted that Conservation Area H (**Figure 4**) is already under conservation for a previous approval and has therefore been excluded from consideration as a part of the proposed offset area for the Stage 2 Extension.

5. Offsets must be enduring, enforceable and auditable.

The proposed offset area would be subject to good governance arrangements to ensure it is managed and secured as an in-perpetuity offset. Appropriate plans of management would be developed, including monitoring, and legal security would be guaranteed through a suitable planning mechanism such as a VCA, BioBanking Agreement or addition to the NSW national parks estate. The proposed offset area would be secured in perpetuity with such a mechanism.

The proposed offset area has been determined prior to approval but has not been finalised, subject to agreement with OEH and DoE. This is consistent with this component of the policy.

6. Supplementary measures can be used in lieu of offsets.

In this instance, it is considered that the land-based proposed offset area is adequate, feasible and practical, and therefore supplementary measures are not required. However, Hy-Tec have previously demonstrated a willingness and capability to carry out the successful recovery of *Eucalyptus pulverulenta* on-site through previous rehabilitation works. Recovery of a threatened species qualifies as a supplementary measure, but has not been considered as part of the offset package in this assessment.

7. Offsets can be discounted where significant social and economic benefits accrue to NSW as a consequence of the proposal.

The proposed direct land-based offset area has been shown to be adequate under the NSW interim policy for offsetting SSD (OEH 2011). There is no necessity to discount the offset, despite the social and economic benefits from the project.

8 COMMONWEALTH OFFSETTING ASSESSMENT

8.1 Protected Matters Requiring Offsets

Section 5 of this report provides an impact assessment in relation to both threatened and migratory biodiversity listed as Matters of National Environmental Significance (MNES or Protected Matters) on the EPBC Act. An address of the relevant Significance Impact Criteria for these species under the EPBC Act guidelines has been provided in **Appendix 11.**

A Referral to the Minister was prepared and submitted in August 2013 and a subsequent determination made by SEWPaC (now DoE) that the Stage 2 Extension was a controlled action under section 75 of the EPBC Act due to a significant impact on *Eucalyptus pulverulenta*, which is listed as Vulnerable on the EPBC Act. The Determination allows for the one off accredited assessment of impacts to MNES under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). In line with the Commonwealth Determination, this report describes in detail the assessment of impacts on *Eucalyptus pulverulenta*. The conclusion of this impact assessment (**Section** 5 and **Appendix 11**) is that an offsets package would need to be presented to DoE in order to demonstrate that the Stage 2 Extension can achieve an improve or maintain outcome for *Eucalyptus pulverulenta* due to the residual and unavoidable impacts on this species.

Requirement 7 of DoEs assessment requirements is as follows:

> *"Where impacts cannot be avoided or mitigated, an offset package to compensate for any predicted or potential residual significant impacts on matters of national environmental significance will be required. Offsets should demonstrate consistency with the EPBC Act Environmental Offsets Policy (October 2012 or subsequent). Information must include:*
>
> *a) the description of any offset package should include how the offset compensates for the residual impacts, when the offset will be delivered and how the offset will be managed;*
> *b) an assessment of the impact of the offset on other matters of environmental, economic, or social significance; and*
> *c) analysis of cost, both financial and other, related to offsets."*

Section 8.2 below describes the outcome of the use of the EPBC Act Offsets Assessment Guide by Niche to determine the adequacy of the proposed offset area in relation to an improve or maintain outcome for *Eucalyptus pulverulenta*. **Section 8.3** then demonstrates consistency with the EPBC Act Environmental Offsets Policy (SEWPaC 2012). Together, **Sections 8.2** and **8.3** address the preamble and point (a) above.

In relation to point (b) above, the proposed offset area provides additional biodiversity value for a range of threatened species that are listed both on the TSC and EPBC Acts. Some of these are predicted to occur in the ecosystems present on the site (refer to **Section 7.2.5**), whilst others were recorded on the site, either by Niche or in previous surveys (refer to **Section 4.4.2**). No direct social or economic matters of significance are likely to be affected by the proposed offset area, though indirectly it could be said that the extension of the life of the quarry is likely to have a net positive impact on the NSW economy.

In relation to point (c) above an analysis of costs would be provided within a formal and separate Biodiversity Offset Strategy (BOS) upon receipt of the adequacy review.

8.2 EPBC Act Offsets Calculator

Niche conducted an assessment of the adequacy of the proposed offset area in relation to its provision of habitat for *Eucalyptus pulverulenta*. The proposed offset area provides both core areas of natural remnant habitat dominated by the species and non-core areas of natural remnant habitat where the species is common, but not dominant. Together, these core and non-core areas contain a population of 1,850 individuals of the species (refer to **Section 0** for the results of the *Eucalyptus pulverulenta* population estimate). In terms of impact, the Stage 2 Extension would directly remove 721 individuals of the species, 90 of which occur in remnant non-core areas of the Stage 2 expansion and 631 that occur in the previously rehabilitated areas associated with Stage 1.

The "Number of individuals" attribute in the EPBC Offset Assessment Guide was utilised given that known numbers of individuals would be lost and provided as an offset. The following values (with justification) were used in the Offsets Calculator component of the Guide:

- Total quantum of impact = "721"; the number of individuals impacted by the Stage 2 Extension.
- Proposed offset = "Direct reservation of the population of the species in adjacent lands"; the type of offset proposed.
- Time horizon (years) = "0"; the benefit to the species as a result of conservation and management within the proposed offset area would occur as soon as the offsetting mechanism is agreed to.
- Start value = "0"; no plants within the population are currently reserved.
- Future value without offset = "0"; no plants within the population are secure in-perpetuity without the proposed offset area.
- Future value with offset = "1850"; the number of plants within the population that would be reserved and managed in-perpetuity with the proposed offset area.

The EPBC Offset Assessment Guide summary of the adequacy for *Eucalyptus pulverulenta* is provided in **Table 18** (this is provided within the Calculator spreadsheet). The Guide clearly states that the provision of the direct offset is adequate in this case. It can therefore be stated that the Stage 2 Extension would achieve an 'improve or maintain' outcome in relation to *Eucalyptus pulverulenta* through the in-perpetuity management and security of the proposed offset area. The full copy of the Guide used for this assessment can be provided on request.

Table 18. Summary of EPBC offset adequacy for *Eucalyptus pulverulenta*

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?
Birth rate	0			
Mortality rate	0			
Number of individuals	721	1850	256.59 %	Yes
Number of features	0			
Condition of habitat	0			
Area of habitat	0			
Area of community	0			

8.3 Address of Commonwealth Offsetting Requirements

The Commonwealth Offsetting Policy (SEWPaC 2012) lists eight requirements that must be met in order to achieve a suitable offset for impacts on threatened biodiversity as listed on EPBC Act. An

address of the requirements is provided below in relation to the provision of the proposed offset for *Eucalyptus pulverulenta*. These requirements reflect closely the NSW Offsetting Principles which have been addressed in **Section 7.4**.

1. Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter

Section 8.2 of this report demonstrates, through the use of the EPBC Act Offsets Assessment Guide (the Offsets Calculator), that the offsets proposed deliver an overall conservation outcome that improves or maintains the viability of the protected matter, the threatened plant *Eucalyptus pulverulenta*. Specifically, the Offsets Calculator has concluded that the in-perpetuity conservation and management of a 1,850 individuals of the species is an adequate direct offset for the loss of 721 individuals (only 90 of which exist in remnant non-core habitat, whilst the other 631 individuals impacted exist in rehabilitation areas on the site and were planted by the proponent additional to their conditioned rehabilitation requirements).

2. Suitable offsets must be built around direct offsets but may include other compensatory measures

It is considered that the proposed land-based offsets provide an 'improve or maintain' outcome for *Eucalyptus pulverulenta*, and that they are feasible and practical, and therefore, other indirect measures are not required.

3. Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter

The offsetting of 1,850 individuals of *Eucalyptus pulverulenta*, which is listed as Vulnerable on the EPBC Act, is on a like-for-like basis for the loss of 721 individuals of the same species. Therefore, the offsets are in proportion to the level of statutory protection that applies to the protected matter, the threatened plant *Eucalyptus pulverulenta*.

4. Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter

Section 8.2 of this report demonstrates, through the use of the EPBC Act Offsets Assessment Guide (the Offsets Calculator), that the offsets proposed deliver an overall conservation outcome that 'improves or maintains' the viability of the protected matter, the threatened plant *Eucalyptus pulverulenta*. The scale of the offset, as compared to the impact, has been calculated by the EPBC Offsets Calculator at 256.59 per cent (i.e. the proposed offset is 2.5 times larger than is required).

5. Suitable offsets must effectively account for and manage the risks of the offset not succeeding

The proposed offset area would be subject to good governance arrangements to ensure it is managed and secured as an in-perpetuity offset. Appropriate plans of management would be developed and legal security guaranteed through a suitable planning mechanism such as a VCA, BioBanking Agreement or addition to the NSW national parks estate. The proposed offset area would be secured with such a mechanism.

The proposed offset area has been determined prior to approval but has not been finalised, subject to agreement with OEH and DoE. This is consistent with NSW policy.

6. Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs

The proposed offset area would be secured under a VCA, addition to OEH estate, BioBanking Site or similar and is independent of any additional legal requirements to manage the site noting that

Conservation Area H (**Figure 4**) is already under conservation for a previous approval and has therefore been excluded from consideration as a part of the proposed offset for this assessment.

7. Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable

The EPBC Act Offsets Assessment Guide was utilised in this assessment to assess the proposed offset to the impacts on *Eucalyptus pulverulenta*. The use of the Guide is described in detail in **Section 8.2** of this report. All survey effort met the draft survey guidelines as required by OEH (DEC 2004) and all data collected during the assessment has been supplied. The assessment is therefore transparent, scientifically robust and reasonable.

The proposed offset area would be secured and managed in-perpetuity through a VCA, addition to NPWS estate, BioBanking site or with a similar mechanism once agreement has been reached as to the adequacy of the offsetting strategy with OEH and DoE.

8. Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced

The proposed offset area would be subject to good governance arrangements to ensure it is managed and secured as an in-perpetuity offset. Appropriate plans of management would be developed, including monitoring, and legal security would be guaranteed through a suitable planning mechanism such as a VCA, BioBanking Agreement or addition to the NPWS estate. The proposed offset area would be secured with such a mechanism.

The proposed offset area has been determined prior to approval but has not been finalised, subject to agreement with OEH and DoE. This is consistent with NSW policy.

9 CONCLUSION

Niche were engaged by Hy-Tec to assess the impacts of a proposal to expand the current operation of Austen Quarry, the Hartley Stage 2 Extension, on threatened biodiversity as listed on the TSC Act and EPBC Act. This report describes the methods and results of the terrestrial ecological surveys conducted by Niche within the BIA study area in February 2012 and June 2013.

An assessment of the impacts of the Stage 2 Extension found that a residual and unavoidable impact occurs to 29.0 hectares of native vegetation which is habitat to a suite of threatened fauna. Furthermore, 721 individuals of the threatened plant *Eucalyptus pulverulenta*, which is listed as vulnerable on both the TSC and EPBC Acts, would be removed by the Stage 2 Extension.

The report clearly demonstrates that, through the provision of an adjacent offset area, 94.3 hectares of native vegetation and 1,850 individuals of *Eucalyptus pulverulenta* would be secured, managed and monitored into perpetuity. The report also demonstrates that the proposed offset area meets the necessary guidelines and policies for offsetting within State and Commonwealth regulatory frameworks.

10 COMPLIANCE WITH ASSESSMENT REQUIREMENTS

Table 19 provides the list of requirements for the environmental assessment of the Stage 2 Extension for the State of NSW and the Commonwealth respectively. The tables demonstrate this report's compliance with those requirements by nominating the relevant Sections where a requirement has been addressed.

Table 19. Environmental Assessment Requirements

NSW requirements		
Organisation	**Paraphrased Requirement**	**Relevant Section(s)**
DIRECTOR-GENERAL'S REQUIREMENTS		
The EIS must include: • accurate estimates of proposed vegetation clearing and impacts on regionally significant remnant vegetation, or vegetation corridors;		4.3 and 5.2
• a detailed assessment of potential impacts of the development on any terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities and groundwater dependent ecosystems; and		5, only in relation to terrestrial ecology.
• a detailed description of the measures taken to avoid, reduce or mitigate impacts on biodiversity including an appropriate biodiversity offset strategy.		6, 7 and 8
ISSUES RAISED BY OTHER GOVERNMENT AGENCIES (Cont'd)		
BIODIVERSITY		
OEH (03/09/13)	Biodiversity impacts can be assessed using either the BioBanking Assessment Methodology (scenario 1) or a detailed biodiversity assessment (scenario 2). The BioBanking Assessment Methodology can be used either to obtain a BioBanking statement, or to assess impacts of a proposal and to determine required offsets without obtaining a statement. In the latter instances, if the required credits are not available for offsetting, appropriate alternative options may be developed in consultation with OEH officers and in accordance with the 'NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects.	7
	Scenario 2 Where a proposal is assessed outside the BioBanking Assessment Methodology the EIS should include. • a detailed biodiversity assessment, including assessment of impacts on threatened biodiversity, native vegetation and habitat. This assessment should address the matters included in the following sections.	3, 4, 5, 6, 7 and 8
	• a field survey of the site should be conducted and documented in accordance with relevant guidelines, including: - the Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna -Amphibians (DECCW, 2009); - Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft (DEC, 2004); and - Threatened species survey and assessment guideline information on www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm.	3 and 4
	- Commonwealth survey requirements (birds, bats, reptiles, frogs, fish and mammals): ttp://www.environment.gov.au/epbc/publications/guidelines.html. These are relevant when species or communities listed under the *Environment Protection and Biodiversity Conservation Act* are present.	3 and 4

Commonwealth Requirements	Relevant Section(s)
KEY ASSESSMENT REQUIREMENTS	
1. Assessment under the *Environmental Planning and Assessment Act 1979* (EP&A Act).	Whole of report
2. Include enough information for the Minister for the Environment to make an informed decision on whether or not to approve the action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)	Whole of report – Section 8 and Appendix 11 in particular.
3. The requirements outlined below concerning matters in the EPBC Act and schedule 4 of the *Environment Protection and Biodiversity Conservation Regulations 2000* should be integrated into the assessment requirements of the EP&A Act.	Whole of report
GENERAL INFORMATION	
The background of the action including: a) the title of the action; b) the full name and postal address of the designated proponent; c) a clear outline of the objective of the action; d) the location of the action; e) the background to the development of the action; f) how the action relates to any other actions (of which the proponent should reasonably be aware) that have been, or are being, taken or that have been approved in the region affected by the action; g) the current status of the action; and h) the consequences of not proceeding with the action.	1 and 2
DESCRIPTION OF THE ACTION	
A description of the action, including:	
a) all the components of the action;	2
b) the precise location of the preferred option for any works to be undertaken, structures to be built or elements of the action that may have relevant impacts;	1 and 2
c) how the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts;	2 and 6
d) the timing and duration of the works to be undertaken;	2
e) to the extent reasonably practicable, a description of any feasible alternatives to the controlled action that have been identified through the assessment, and their likely impact, including: (i) if relevant, the alternative of taking no action; (ii) a comparative description of the impacts of each alternative on the matters protected by the controlling provisions for the action; and (iii) sufficient detail to make clear why any alternative is preferred to another; and	6
f) a description of long-term and short-term advantages and disadvantages of the options.	6 and 8

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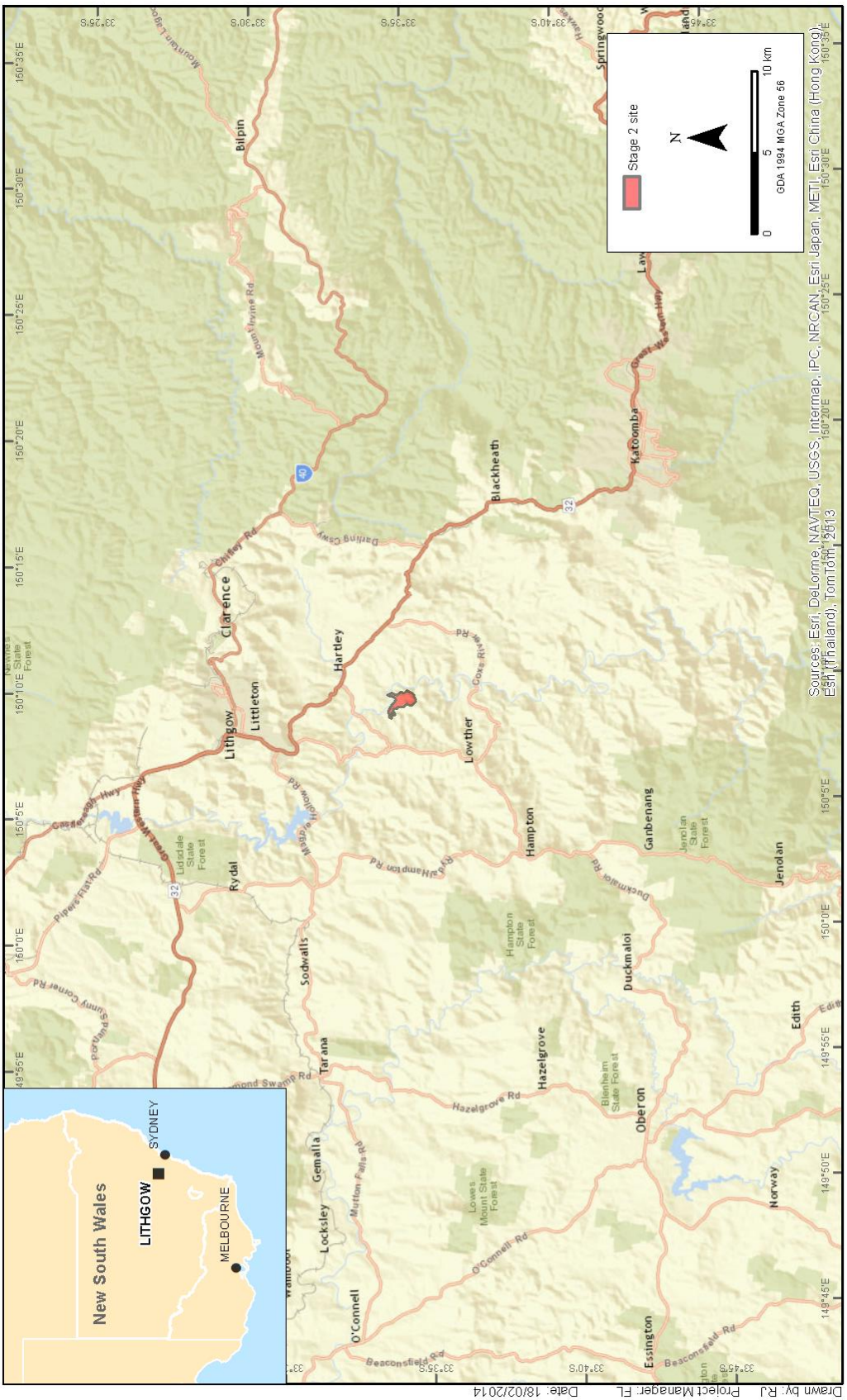
FIGURES



Location of Austen Quarry in a regional context

Austen Quarry Stage 2 Extension Biodiversity Impact Assessment

FIGURE 1

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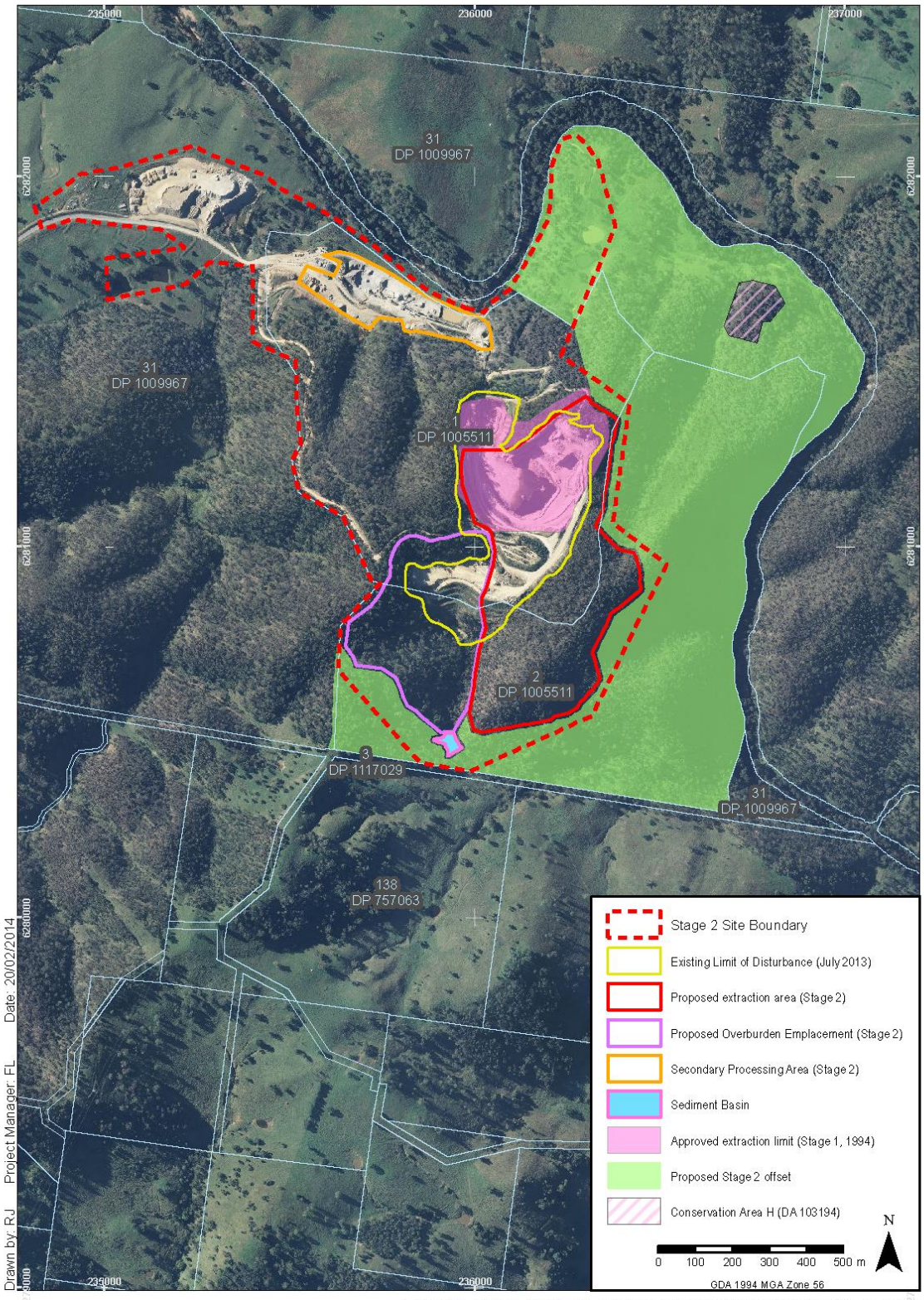

Layout of the Stage 2 Extension and proposed offset area

Austen Quarry Stage 2 Extension Biodiversity Impact Assessment

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FIGURE 2

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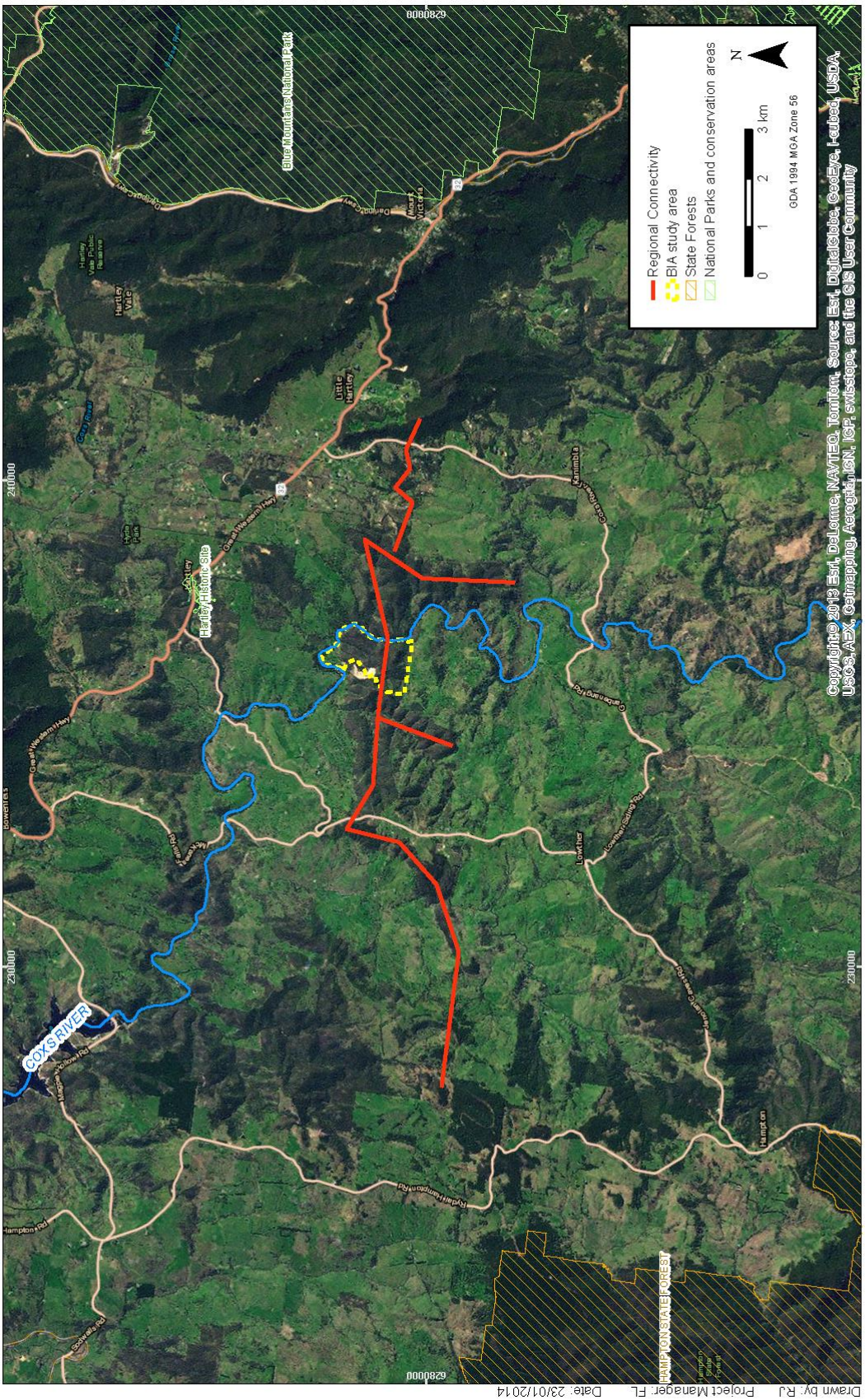

Regional corridors and connectivity

Austen Quarry Stage 2 Extension Biodiversity Impact Assessment

FIGURE 3

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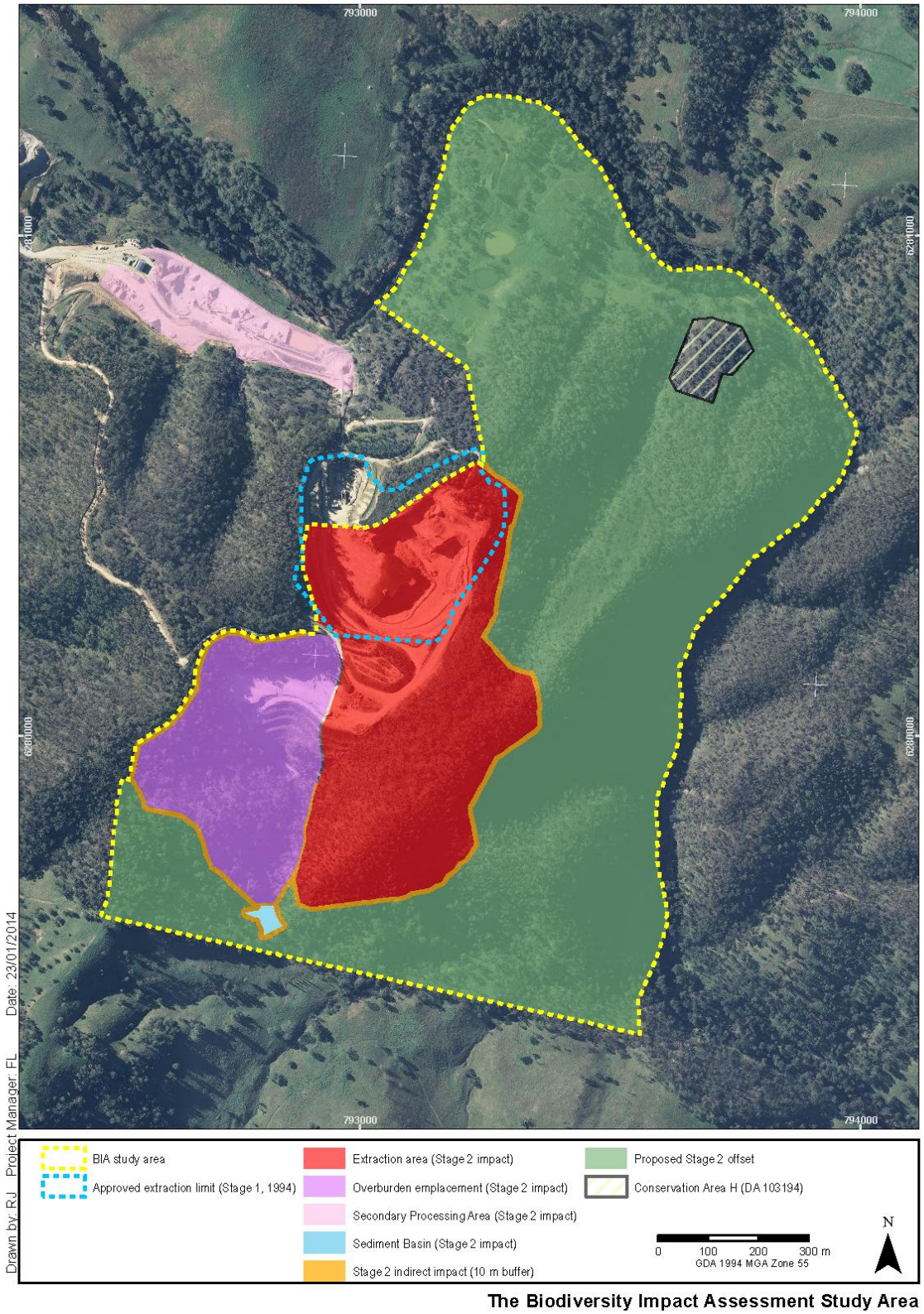

The Biodiversity Impact Assessment Study Area

Austen Quarry Stage 2 Extension Biodiversity Impact Assessment

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FIGURE 4

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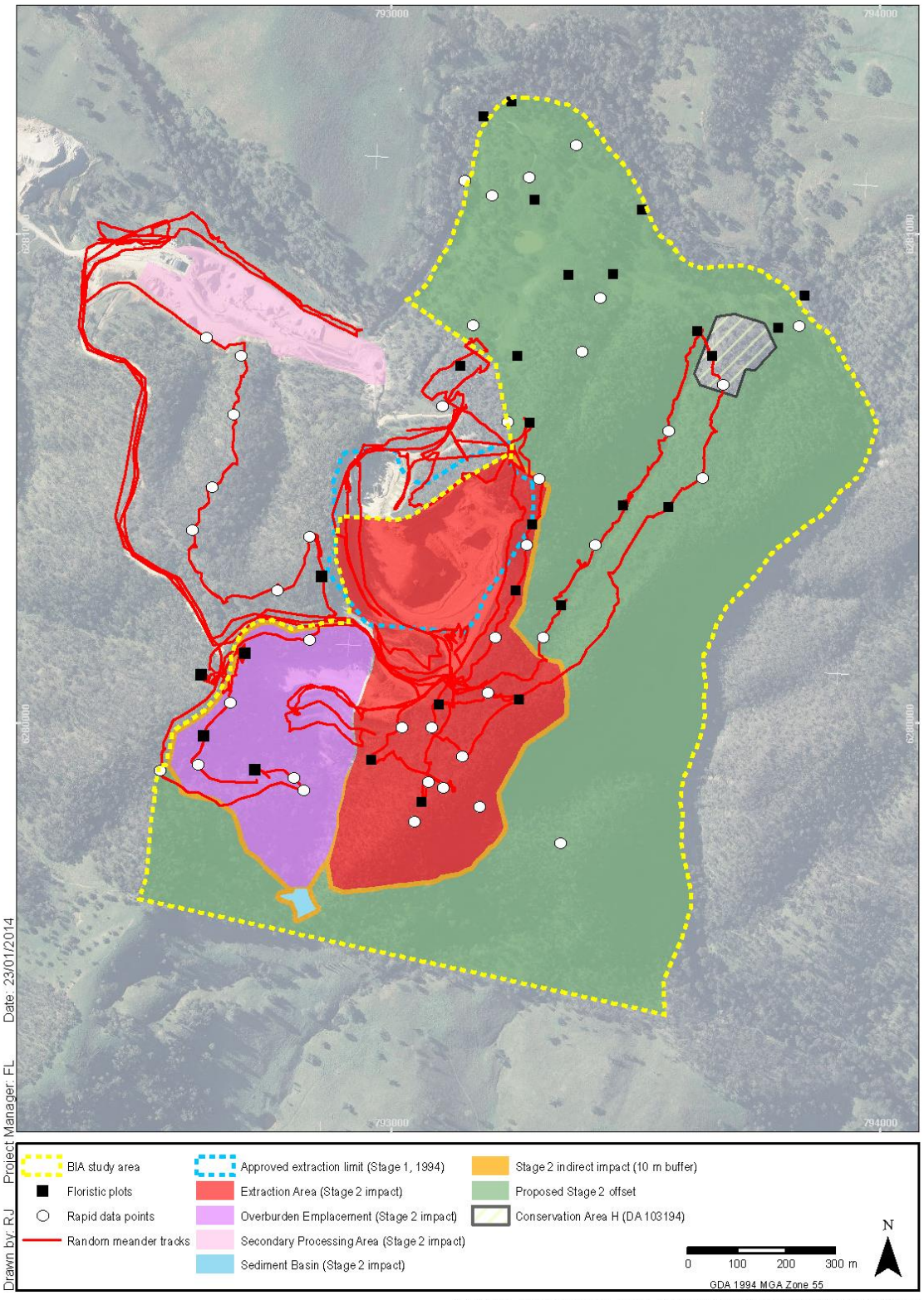

Native vegetation and threatened flora survey effort

Austen Quarry Stage 2 Extension Biodiversity Impact Assessment

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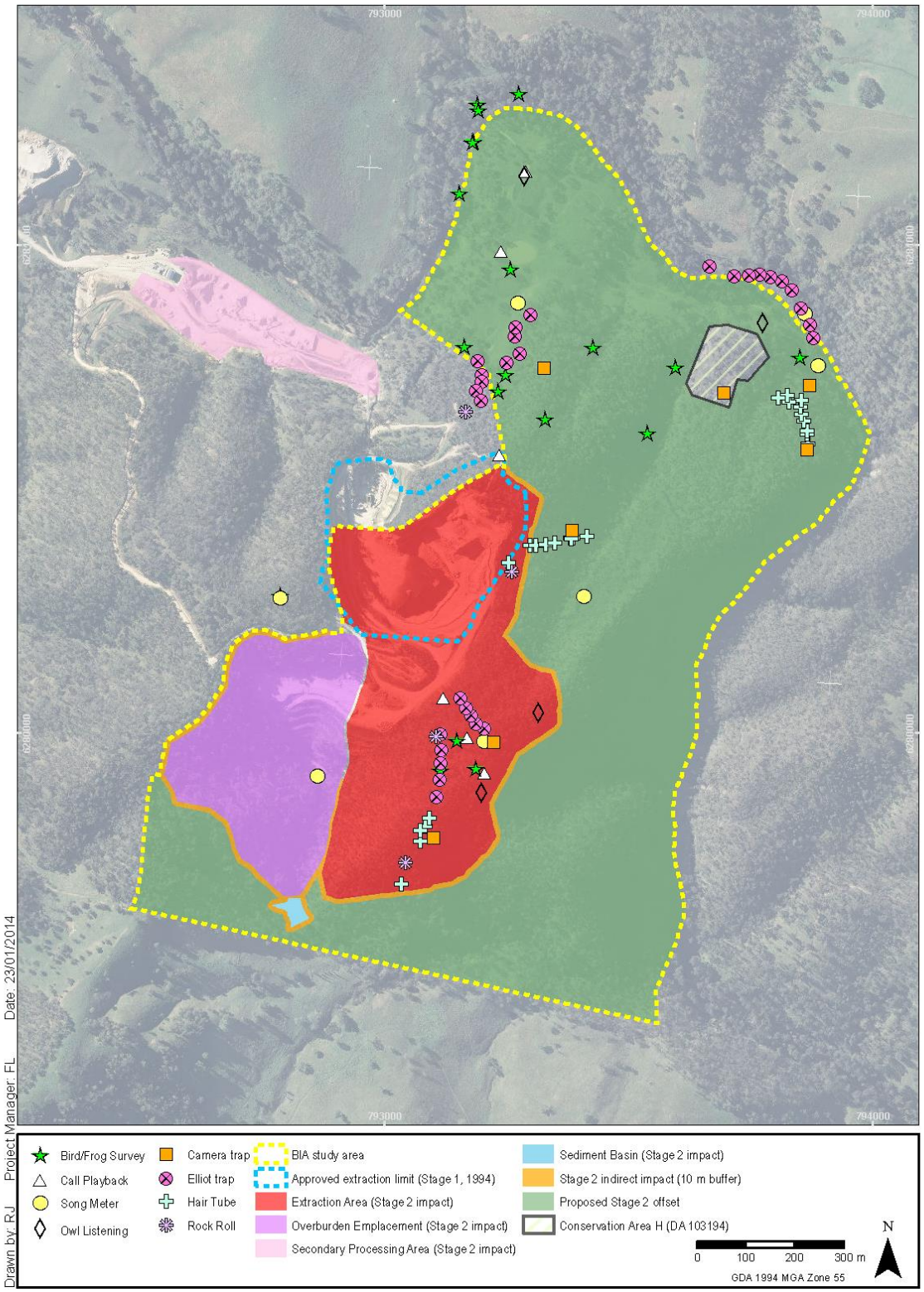
FIGURE 5

Imagery: (c) 2012-04-14 GeoSpectrum



Fauna survey effort

Austen Quarry Stage 2 Extension Biodiversity Impact Assessment

FIGURE 6

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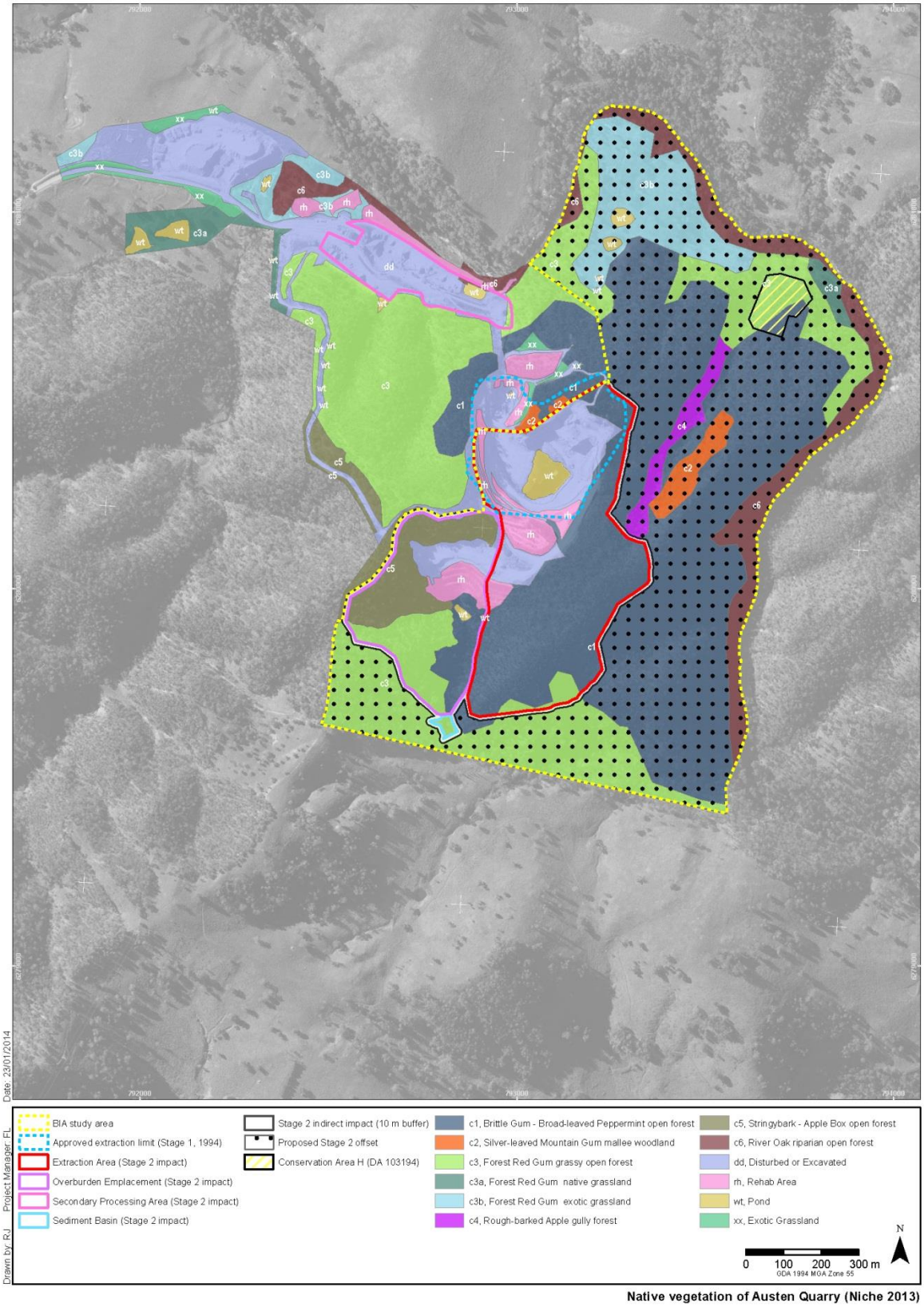

Native vegetation of Austen Quarry (Niche 2013)

Austen Quarry Stage 2 Extension Biodiversity Impact Assessment

FIGURE 7

Imagery: (c) 2012-04-14 GeoSpectrum

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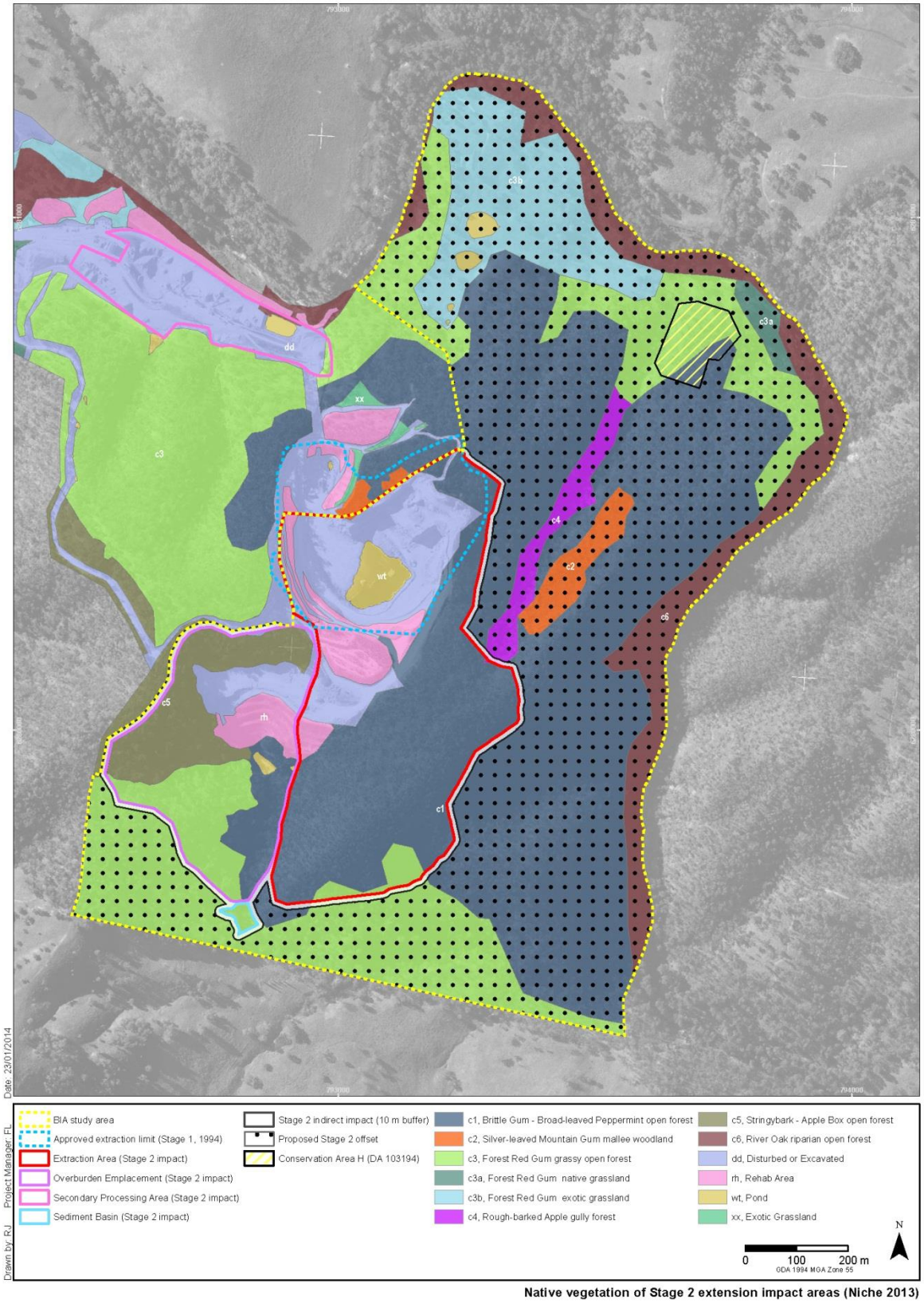

Native vegetation of Stage 2 extension impact areas (Niche 2013)

Austen Quarry Stage 2 Extension Biodiversity Impact Assessment

FIGURE 8

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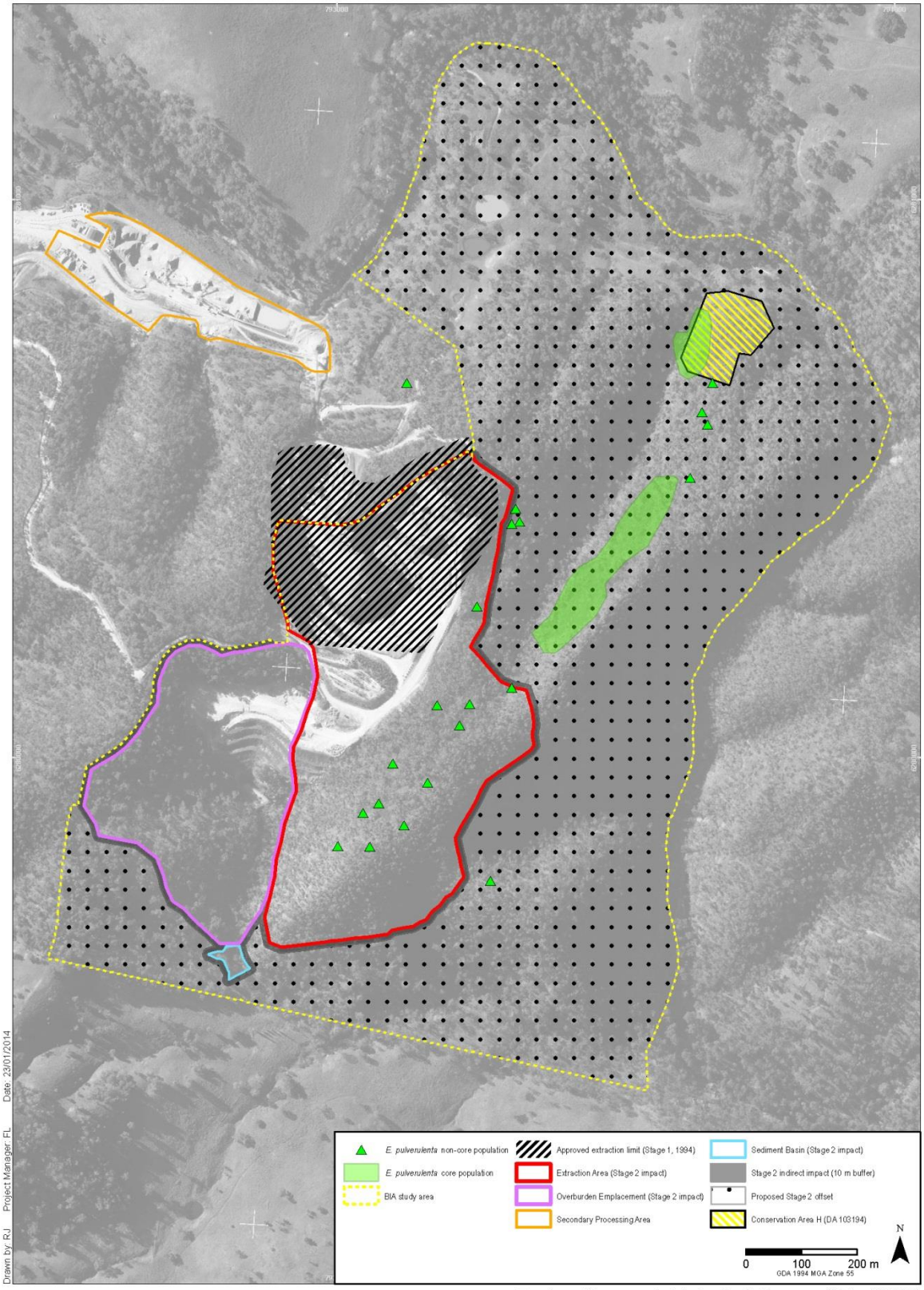

Threatened flora recorded during the field surveys (Niche 2012/13)

Austen Quarry Stage 2 Extension Biodiversity Impact Assessment

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Environment and Heritage
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FIGURE 9

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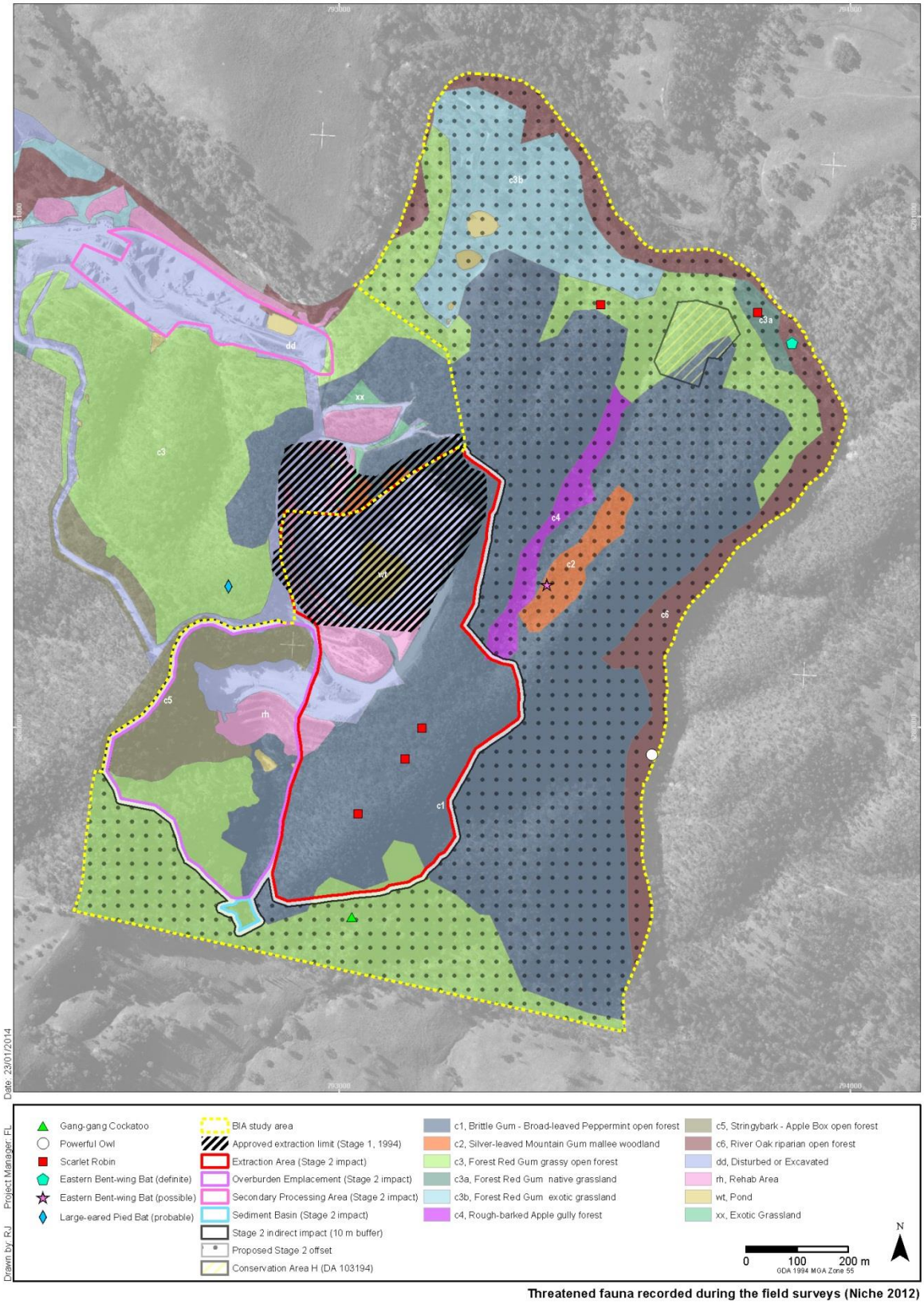

Threatened fauna recorded during the field surveys (Niche 2012)

Austen Quarry Stage 2 Extension Biodiversity Impact Assessment

niche Environment and Heritage
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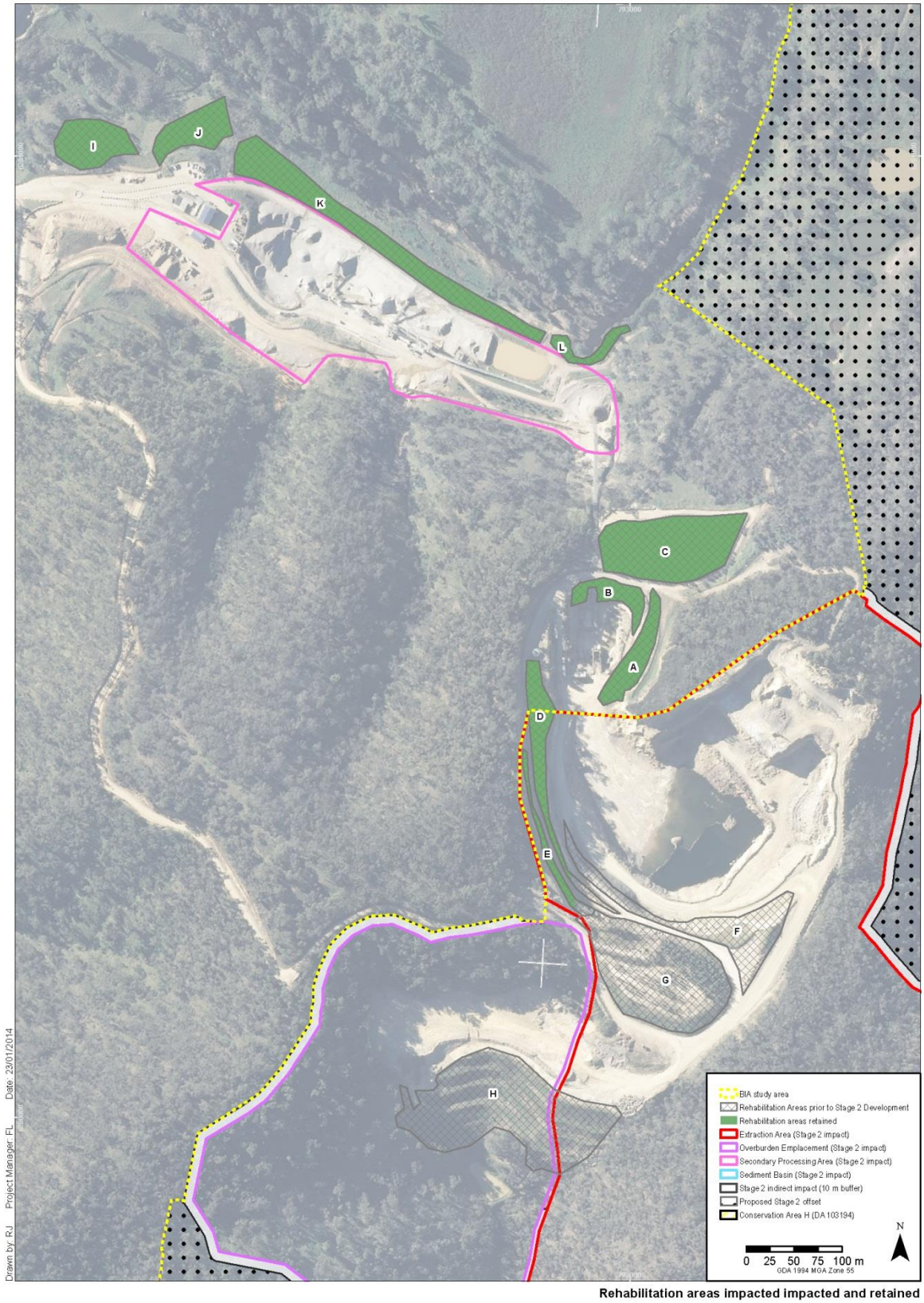
FIGURE 10

Imagery: (c) 2012-04-14 GeoSpectrum



Rehabilitation areas impacted impacted and retained

Austen Quarry Stage 2 Extension Biodiversity Impact Assessment

niche Environment and Heritage

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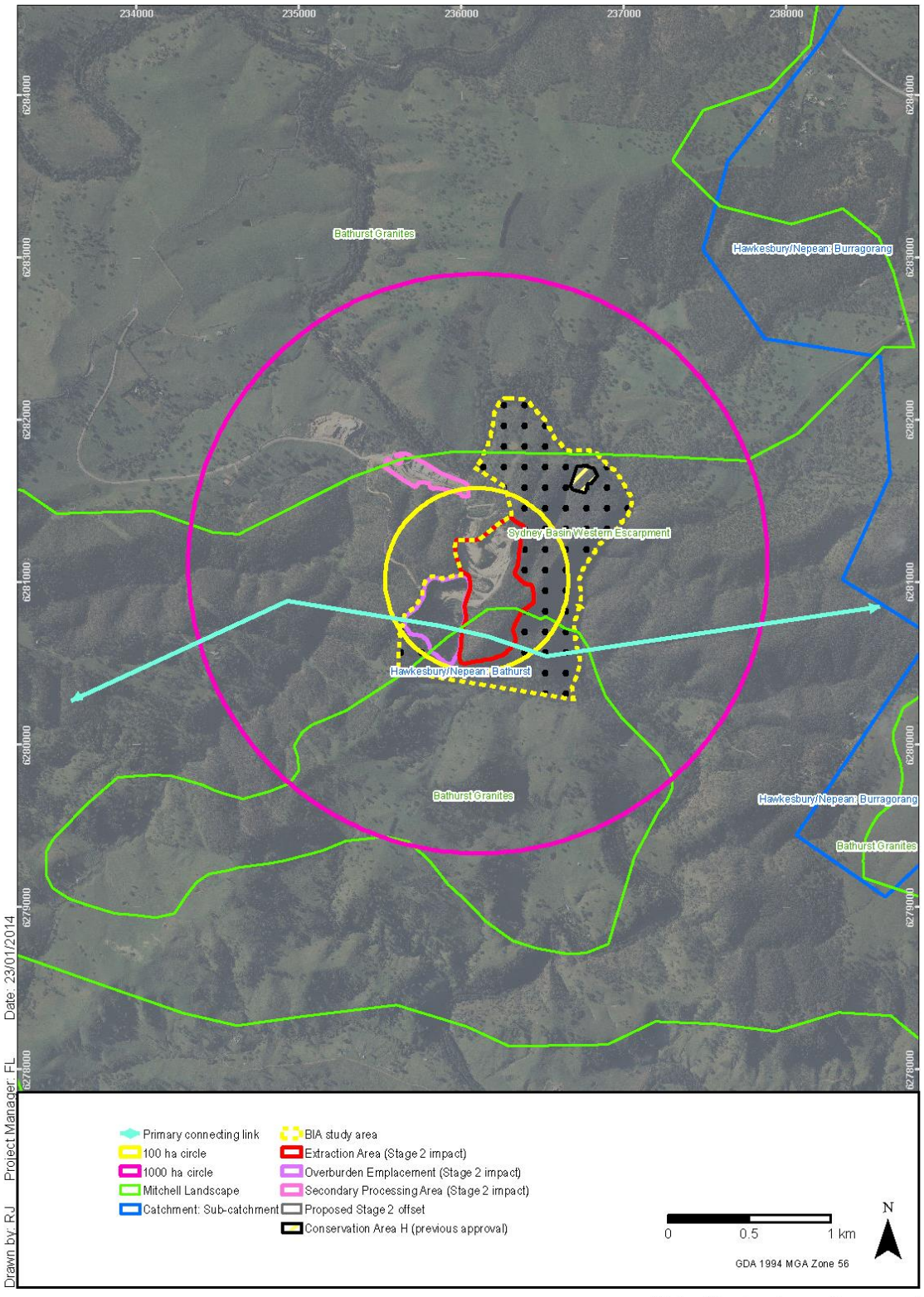
FIGURE 11

Imagery: (c) 2012-04-14 GeoSpectrum



Biobanking Landscape Assessment

Austen Quarry Stage 2 Extension Biodiversity Impact Assessment

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FIGURE 12

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APPENDICES

NOTE: APPENDICES 1, 2, 12, 13 AND 14 ARE ONLY AVAILABLE ON THE PROJECT CD

Appendix 1: Atlas of NSW Wildlife database search for threatened species, accessed 24 December 2013

Species	No. of records*	No. of individuals*
Fauna		
Bathurst Copper Butterfly *Paralucia spinifera*	23	606
Blue-billed Duck *Oxyura australis*	3	10
Broad-headed Snake *Hoplocephalus bungaroides*	1	1
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	2	1
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	1	0 (presumably at least 1)
Eastern Freetail-bat *Mormopterus norfolkensis*	1	0 (presumably at least 1)
Gang-gang Cockatoo *Callocephalon fimbriatum*	7	22
Giant Dragonfly *Petalura gigantea*	1	5
Glossy Black-cockatoo *Calyptorhynchus lathami*	2	6
Greater Broad-nosed Bat *Scoteanax rueppellii*	2	1
Koala *Phascolarctos cinereus*	1	0 (presumably at least 1)
Little Lorikeet *Glossopsitta pusilla*	1	0 (presumably at least 1)
Powerful Owl *Ninox strenua*	1	0 (presumably at least 1)
Red-crowned Toadlet *Pseudophryne australis*	5	9
Southern Myotis *Myotis macropus*	4	32
Spotted-tailed Quoll *Dasyurus maculatus*	19	18
Squirrel Glider *Petaurus norfolcensis*	1	1
Tasmanian Bettong *Bettongia gaimardi*	1	1
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	1	1
Flora		
Acacia bynoeana	2	0 (presumably at least 2)
Acacia flocktoniae	6	0 (presumably at least 6)
Asterolasia buxifolia	5	572
Derwentia blakelyi	1	0 (presumably at least 1)
Diuris aequalis	1	0 (presumably at least 1)
Eucalyptus aggregata	6	0 (presumably at least 6)
Eucalyptus pulverulenta	42	1 (presumably at least 42)
Persoonia acerosa	6	1 (presumably at least 6)
Prasophyllum fuscum	1	0 (presumably at least 1)
Pultenaea glabra	2	0 (presumably at least 2)
Velleia perfoliata	1	0 (presumably at least 1)

** Number within 10 km radius of centre point of study area*

Appendix 2: EPBC Act Protected Matters database search for threatened species, accessed 2 January 2014

Australian Government
Department of the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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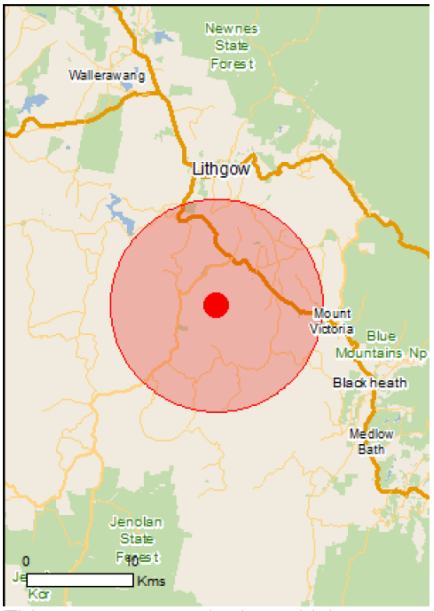

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
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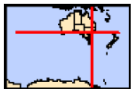


Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	37
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	3
Commonwealth Heritage Places:	None
Listed Marine Species:	13
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	27
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	39
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

National Heritage Properties [Resource Information]

Name	State	Status
Historic		
Former Commonwealth Small Arms Factory Lithgow	NSW	Nominated place

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Temperate Highland Peat Swamps on Sandstone	Endangered	Community known to occur within area
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Fish		
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
Frogs		

Name	Status	Type of Presence
Heleioporus australiacus		
Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
Litoria booroolongensis		
Booroolong Frog [1844]	Endangered	Species or species habitat likely to occur within area
Litoria littlejohni		
Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within area
Insects		
Paralucia spinifera		
Bathurst Copper Butterfly, Purple Copper Butterfly, Bathurst Copper, Bathurst Copper Wing, Bathurst-Lithgow Copper, Purple Copper [26335]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Chalinolobus dwyeri		
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Isoodon obesulus obesulus		
Southern Brown Bandicoot (Eastern) [68050]	Endangered	Species or species habitat may occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus		
Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat may occur within area
Pseudomys fumeus		
Konoom, Smoky Mouse [88]	Endangered	Species or species habitat may occur within area
Pseudomys novaehollandiae		
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
Acacia bynoeana		
Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat likely to occur within area
Acacia flocktoniae		
Flockton Wattle [3134]	Vulnerable	Species or species habitat likely to occur within area
Asterolasia elegans		
[56780]	Endangered	Species or species habitat may occur within area
Boronia deanei		
Deane's Boronia [8397]	Vulnerable	Species or species habitat likely to occur within area
Caladenia tessellata		
Thick-lipped Spider-orchid, Daddy Long-legs	Vulnerable	Species or species

Name	Status	Type of Presence
[2119]		habitat likely to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area
Eucalyptus pulverulenta Silver-leaved Mountain Gum, Silver-leaved Gum [21537]	Vulnerable	Species or species habitat likely to occur within area
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat may occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat may occur within area
Pelargonium sp. Striatellum (G.W.Carr 10345) Omeo Stork's-bill [84065]	Endangered	Species or species habitat likely to occur within area
Persoonia acerosa Needle Geebung [7232]	Vulnerable	Species or species habitat likely to occur within area
Persoonia hirsuta Hairy Persoonia [19006]	Endangered	Species or species habitat may occur within area
Prasophyllum fuscum Tawny Leek-orchid, Slaty Leek-orchid [19455]	Vulnerable	Species or species habitat likely to occur within area
Pultenaea glabra Smooth Bush-pea, Swamp Bush-pea [11887]	Vulnerable	Species or species habitat likely to occur within area
Rhizanthella slateri Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area
Streblus pendulinus Siah's Backbone, Sia's Backbone, Isaac Wood [21618]	Endangered	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Eulamprus leuraensis Blue Mountains Water Skink [59199]	Endangered	Species or species habitat likely to occur within area
Hoplocephalus bungaroides Broad-headed Snake [1182]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat known to occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat known to occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Xanthomyza phrygia		
Regent Honeyeater [430]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Migratory Wetlands Species		
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat likely to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Commonwealth Bank of Australia

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat likely to occur

Name	Threatened	Type of Presence within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Mount Boyce Area	NSW	Indicative Place
Historic		
Federation Garden Group	NSW	Indicative Place
Lithgow General Cemetery	NSW	Indicative Place
Mitchell Memorial	NSW	Indicative Place
Monte Vista graves	NSW	Indicative Place
Mount York Conservation Precinct	NSW	Indicative Place
Mount York Obelisk	NSW	Indicative Place
Old Catholic Cemetery	NSW	Indicative Place
Old Catholic Cemetery	NSW	Indicative Place
Australian Arms Inn (former) Group	NSW	Registered
Ben Avon	NSW	Registered
Collits Cemetery	NSW	Registered
Collits Inn	NSW	Registered

Name	State	Status
De La Salle College	NSW	Registered
Hartley Courthouse (former)	NSW	Registered
Hartley Historic Site	NSW	Registered
Lithgow Small Arms Factory	NSW	Registered
Lithgow Valley Pottery Kiln Site	NSW	Registered
Meads Farm	NSW	Registered
Presbyterian Church Group	NSW	Registered
Royal Hotel (former)	NSW	Registered
Somerset House	NSW	Registered
St Bernards Catholic Church Group	NSW	Registered
St Bernards Presbytery	NSW	Registered
St John the Evangelist Church	NSW	Registered
Victoria Inn (former)	NSW	Registered
Williams Store (former)	NSW	Registered

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom		Species or species habitat likely to occur

Name	Status	Type of Presence
[20126]		within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Coordinates

-33.5766 150.15354

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of Sustainability, Environment, Water, Population and Communities
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

Appendix 3: Likelihood of occurrence for threatened species within the BIA study area

Note: Fauna that are exclusively dependant on marine environments, including near shore environments, were removed from the table. Non-referenced habitat information has been sourced from: *Threatened Species Profiles for threatened species, endangered populations and endangered ecological communities listed under the NSW Threatened Species Conservation Act 1999* (OEH undated). The table has been compiled from data downloaded from the Atlas of NSW Wildlife (accessed 24 December 2013), the EPBC Act Protected Matters Search Tool (accessed 2 January 2014) and from information in previous EA reports and monitoring surveys from the Austen Quarry site.

Key: CE = Critically Endangered; E, E1 = Endangered; EP = Endangered Population; V = Vulnerable.

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Amphibians				
Booroolong Frog *Litoria booroolongensis*	E	E	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. Breeding occurs in spring and early summer and tadpoles metamorphose in late summer to early autumn. Eggs are laid in submerged rock crevices and tadpoles grow in slow-flowing connected or isolated pools.	Low
Giant Burrowing Frog *Heleioporus australiacus*	V	V	Prefers hanging swamps on sandstone shelves adjacent to perennial non-flooding creeks. Can also occur within shale outcrops within sandstone formations. In the southern part of its range can occur in wet and dry forests, montane sclerophyll woodland and montane riparian woodland. Individuals can be found around sandy creek banks or foraging along ridge-tops during or directly after heavy rain. Males often call from burrows located in sandy banks next to water.	Low
Littlejohn's Tree Frog *Litoria littlejohni*	V	V	Occurs in wet and dry sclerophyll forests associated with sandstone outcrops between 280 and 1000 m on the eastern slopes of the Great Dividing Range. Prefers rock flowing streams, but individuals have also been collected from semi-permanent dams with some emergent vegetation. Forages both in the tree canopy and on the ground, and has been observed sheltering under rocks on high exposed ridges during summer. It is not known from coastal habitats.	Low
Red-crowned Toadlet *Pseudophryne australis*	V	-	Occurs on wetter ridge tops and upper slopes of sandstone formations on which the predominant vegetation is dry open forests and heaths. This species typically breeds within small ephemeral creeks that feed into larger semi-perennial streams. After rain these creeks are characterised by a series of shallow pools lined by dense grasses, ferns and low shrubs.	Low
Birds				
Australian Painted Snipe *Rostratula australis*	E	E, M	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves.	Low
Black-faced Monarch *Monarcha melanopsis*	-	M	A migratory species found during the breeding season in damp gullies in temperate rainforests. Disperses after breeding into more open woodland.	Low

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Blue-billed Duck *Oxyura australis*	V	-	The Blue-billed Duck is endemic to south-eastern and south-western Australia. It is widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation.	None
Cattle Egret *Ardea ibis*	-	M	Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands.	Low
Flame Robin *Petroica phoenicea*	V	-	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. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains).	**Known** from previous work on-site
Fork-tailed Swift *Apus pacificus*	-	M	Almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. Occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. Prefer dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh.	Moderate (fly over only)
Gang-gang Cockatoo *Callocephalon fimbriatum*	V	-	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.	**Known**. Recorded from study area during this survey.
Glossy Black-cockatoo *Calyptorhynchus lathami*	V	-	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. *Allocasuarina littoralis* and *A. torulosa* are important foods. Inland populations feed on a wide range of sheoaks, including *A. diminuta*, and *A. gymnathera*. *A. cristata* is also utilised and may be a critical food source for some populations. Dependent on large hollow-bearing eucalypts for nest sites.	Low (lack of she-oak species in impact area)
Great Egret *Ardea alba*	-	M	Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands.	Low
Hooded Robin *Melanodryas cucullata*	V	-	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	**Known** from previous work on-site
Latham's Snipe *Gallinago hardwickii*	-	M	Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration.	Low
Little Lorikeet *Glossopsitta pusilla*	V	-	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.	**High**

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Painted Snipe (Australian subspecies) *Rostratula benghalensis*	E	V,M	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	Low
Powerful Owl *Ninox strenua*	V	-	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within Red Turpentine in tall open forests and Black She-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.	**Known**
Rainbow Bee-eater *Merops ornatus*	-	M	Usually occurs in open or lightly timbered areas, often near water.	**High**
Regent Honeyeater *Anthochaera phrygia*	CE	E,M	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	Low
Rufous Fantail *Rhipidura rufifrons*	-	M	Migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. During migration it can stray into gardens and more open areas.	Low
Satin Flycatcher *Myiagra cyanoleuca*	-	M	Migratory species that occurs in coastal forests, woodlands and scrubs during migration. Breeds in heavily vegetated gullies.	**Known** - recorded during survey around riparian area.
Scarlet Robin *Petroica boodang*	V	-	The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	**Known** - recorded during study
Swift Parrot *Lathamus discolor*	E	E	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	Low
Varied Sittella *Daphoenositta chrysoptera*	V	-	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.	**Known** from previous work on-site
White-bellied Sea-Eagle *Haliaeetus leucogaster*	-	M	Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna.	Low

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
White-throated Needletail *Hirundapus caudacutus*	-	M	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges.	**Moderate**, foraging habitat only
Invertebrates				
Bathurst Copper Butterfly *Paralucia spinifera*	E	V	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*.	Low – well within known range of species but the site is mostly below 790 metres and *Bursaria spinulosa* var. *lasiophylla* has not been recorded on the site.
Giant Dragonfly *Petalura gigantea*	E	-	The Giant Dragonfly is found along the east coast of NSW from the Victorian border to northern NSW. It is not found west of the Great Dividing Range. There are known occurrences in the Blue Mountains and Southern Highlands, in the Clarence River catchment, and on a few coastal swamps from north of Coffs Harbour to Nadgee in the south. Live in permanent swamps and bogs with some free water and open vegetation. Adults emerge from late October and are short-lived, surviving for one summer after emergence.	None
Mammals				
Brush-tailed Rock-wallaby *Petrogale penicillata*	E	V	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves and crevices.	Low
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	V	-	Eastern Bent-wing Bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	**Known**, recorded from study area. Roosts in caves and artificial structures.
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	V	-	Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20 m high. Two observations have been made of roosts in stem holes of living eucalypts. There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor. This species also appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites.	**Known**, previously recorded from study area.
Eastern Freetail-bat *Mormopterus norfolkensis*	V	-	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits.	**Known**, previously recorded from study area.
Greater Broad-nosed Bat *Scoteanax rueppellii*	V	-	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches.	**Known**, previously recorded from study area.
Grey-headed Flying-fox *Pteropus poliocephalus*	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.	**Moderate**, widespread foraging.

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Large-eared Pied Bat *Chalinolobus dwyeri*	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals.	**Known**, recorded during the field surveys.
Koala *Phascolarctos cinereus*	V	V	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall.	Low
Long-nosed Potoroo *Potorous tridactylus*	V	-	Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy.	Low
New Holland Mouse *Pseudomys novaehollandiae*	-	V	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	None
Smoky Mouse *Pseudomys fumeus*	CE	E	Sparse to patchy distribution from Victoria to ACT in dry sclerophyll forest on ridges with heath and tussock grass understorey, coastal heath and sub-alpine heath	None
Southern Brown Bandicoot (eastern) *Isoodon obesulus*	E	-	Prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time (Braithwaite, 1995 344 /id). A mosaic of post fire vegetation is important for this species.	Low
Southern Myotis *Myotis macropus*	V	-	Found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	**High**, recorded within riparian zone adjacent to study area
Spotted-tailed Quoll *Dasyurus maculatus*	V	E	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.	**High** – many records east and west of the BIA study area in connected bushland. Some records from Little Hartley area around 2004 – 2006.
Squirrel Glider *Petaurus norfolcensis*	V	-	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range. Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias. There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked. Endangered population in the Wagga Wagga LGA.	**Moderate**
Tasmanian Bettong *Bettongia gaimardi*	Extinct	-	Grassland areas, heathlands and sclerophyll woodland. May have built densely woven nests of dry grass and bark.	None

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	V	-	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	High
Reptiles				
Blue Mountains Water Skink *Eulamprus leuraensis*	E	E	Occurs at high elevations between 560 m and 1060 m. 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.	Low
Broad-headed Snake *Hoplocephalus bungaroides*	E	V	Mainly occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer.	Low
Fish				
Australian Grayling *Prototroctes maraena*	-	V	Spends part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Adults (including pre spawning and spawning adults) inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones such as the Tambo River, which is also known to have granite outcrops. The species has also been associated with clear, gravel-bottomed habitats in the Mitchell and Wonnangatta Rivers (Victoria) and in a muddy-bottomed, heavily silted habitat in the Tarwin River (Victoria). The species has been found over 100 km upstream from the sea.	None
Macquarie Perch *Macquaria australasica*	E (FM Act)	E	Macquarie perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury and Shoalhaven . Macquarie perch are found in both river and lake habitats, especially the upper reaches of rivers and their tributaries	None
Plants				
Acacia bynoeana	E	V	Grows mainly in heath and dry sclerophyll forest in sandy soils. Mainly south of Dora Creek-Morisset area to Berrima and the Illawarra region, west to the Blue Mountains, also recorded from near Kurri Kurri in the Hunter Valley and from Morton National Park. ROTAP: 3VC-	Low
Acacia flocktoniae	V	V	Grows in dry sclerophyll forest on sandstone.	Low
Asterolasia buxifolia	E	-	Known from a single site at a granite outcrop in the riparian zone of the Lett River. Apparently restricted to dense riparian scrub along rocky watercourses with a granitic substrate.	Low
Asterolasia elegans	E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve. Occurs on Hawkesbury sandstone in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. The canopy at known sites includes *Syncarpia glomulifera* subsp. *glomulifera, Angophora costata, Eucalyptus piperita, Allocasuarina torulosa* and *Ceratopetalum gummiferum*.	Low

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Boronia deanei	V	V	Scattered populations occur 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. Grows in wet heath, often at the margins of open forest adjoining swamps or along streams.	Low
Caladenia tessellata	E	V	Found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. ROTAP: 3V	Low
Cryptostylis hunteriana Leafless Tongue-orchid	V	V	Grows in swamp-heath on sandy soils, chiefly in coastal districts, south from the Gibraltar Range.	Low
Derwentia blakelyi	V	-	Restricted to the western Blue Mountains, near Clarence, near Mt Horrible, on Nullo Mountain and in the Coricudgy Range. Occurs at fewer than 20 locations, none of which is in a conservation reserve. Occurs in eucalypt forest, often in moist areas.	Low
Diuris aequalis	E	V	Recorded in forest, low open woodland with grassy understorey and secondary grassland on the higher parts of the Southern and Central Tablelands (especially on the Great Dividing Range).	Low
Eucalyptus aggregata Black Gum	V	-	Found in the NSW Central and Southern Tablelands, with small isolated populations in Victoria and the ACT. Has a moderately narrow distribution, occurring mainly in the wetter, cooler and higher parts of the tablelands. Grows in the lowest parts of the landscape, 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 *Eucalyptus pauciflora, E. viminalis, E. rubida, E. stellulata* and *E. ovata*. Usually occurs in an open woodland formation with a grassy groundlayer dominated either by *Poa labillardierei* or *Themeda australis*, but with few shrubs. Also occurs as isolated paddock trees in modified native or exotic pastures.	**Moderate**, six records within 10 km and habitat present
Eucalyptus pulverulenta	V	V	*E. pulverulenta* is found around Lithgow and Bathurst and on the Monaro. It grows in shallow soils as an understorey plant in open forest typically dominated by *E. mannifera, E. macrorhyncha, E. dives, E. sieberi* and *E. bridgesiana*.	**Known**
Euphrasia arguta	CE	CE	Historic records of the species noted the following habitats: 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', and 'in meadows near rivers'. Plants from the Nundle area have been reported from eucalypt forest with a mixed grass and shrub understorey; here, plants were most dense in an open disturbed area and along the roadside, indicating the species had regenerated following disturbance. Near Nundle, local populations had apparently declined at sites that had been disturbed twice within three years, in contrast with sites that were disturbed only once. Has an annual habit and has been observed to die off over the winter months, with active growth and flowering occurring between January and April. Semi-parasitic and attaches to the roots of other associated plants.	Low
Haloragis exalata subsp. *exalata*		V	Occurs in 4 widely scattered localities in eastern NSW. Distributed in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. Appears to require protected and shaded damp situations in riparian habitats. Flowers from November to January.	
Pelargonium sp. Striatellum Omeo's Stork's-bill		E	Flowering occurs from October to March. Occurs in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds. The species is known to form clonal colonies by rhizomatous propagation.	None

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Persoonia acerosa	V	V	Occurs in dry sclerophyll forest, scrubby low-woodland and heath on low fertility soils. Recorded only on the central coast and in the Blue Mountains, from Mt Tomah in the north to as far south as Hill Top where it is now believed to be extinct. Mainly in the Katoomba, Wentworth Falls, Springwood area.	Low
Persoonia hirsuta Hairy Geebung	E	E	Distributed from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to the west. A large area of occurrence, but occurs in small populations, increasing fragmentation in the landscape. Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. Usually present as isolated individuals or very small populations. Probably killed by fire (as other Persoonia spp. are) but will regenerate from seed.	None
Prasophyllum fuscum	CE	V	Confined to the Blue Mountains, Hawkesbury sandstone, and the Burrawang district, NSW. This species grows on the margins of swamps at moderate altitudes, about 500–700 m above sea level. Grows in wet low heathland on gentle slopes, in brown silty loam or in moist heath, often along seepage lines.	Low
Pultenaea glabra	V	V	Grows in swamp margins, slopes, gullies and creek banks and occurs within dry sclerophyll forest and tall damp heath on sandstone. Restricted to the higher Blue Mountains.	Low
Rhizanthella slateri	V	E	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed. Flowers October to November.	Low
Streblus pendulinus Siah's Backbone	-	E	Tree or large shrub that grows to 6 m in height. Found in warmer rainforests, chiefly along watercourses	None
Thesium australe	V	V	Found in very populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland.	Low
Velleia perfoliata	V	V	The species is only known from the Hawkesbury District and Upper Hunter Valley in the Central Coast botanical subdivision of NSW. Grows in heath on shallow sandy soil over Sandstone. It is currently known to exist in 9 populations. Five of these populations are reserved whilst a further population is partly reserved. Four of the reserved sites are situated adjacent to fire trails.	Low

Appendix 4: Fauna survey effort

Activity	Area^	Effort	Units	27/02/ 2012	28/02 /2012		13/03/ 2012	14/03/ 2012	15/03/ 2012	16/03/ 2012		21/03 /2012	22/03/ 2012
Elliot Traps (120 nights total)													
Elliot 1 (Quarry Eastern Ridge)	SS	40	nights	10			10	10	10				
Elliot 2 (Riparian)	SA	40	nights	10			10	10	10				
Elliot 3 (Northern Slopes)	SS/SA	40	nights	10			10	10	10				
Camera Traps (124 nights total)													
Camera 1 (Quarry Eastern Ridge)	SS	24	nights	1	1		1	1	1	1		1	
Camera 2 (Quarry Eastern Ridge)	SS	24	nights	1	1		1	1	1	1		1	
Camera 3 (near River)	SA	24	nights	1	1		1	1	1	1		1	
Camera 4 (NW plateau)	SA	23	nights		1		1	1	1	1		1	
Camera 5 (Northern slopes)	SS	12	nights	1	1								
Camera 6 (Adjacent to Heath)	SA	9	nights				1	1	1	1		1	
Camera 7 (Gully East of Quarry)	SA	8	nights					1	1	1		1	
Hair Tubes (685 nights total)													
Hair Tube 1 (South of Quarry)	SS/SA	345	nights		15		15	15	15	15		15	
Hair Tube 2 (Northeast)	SA	180	nights				20	20	20	20		20	
Hair Tube 3 (East of Quarry)	SS/SA	160	nights					20	20	20		20	
Bat Echolocation Recorder (27 nights total)													
Anabat 1 (Quarry Eastern Ridge then River)	SS/SA	14	nights	1	1		1	1	1	1		1	
Anabat 2 (Dam SW moved to Quarry West HT)	SA	8	nights	1	1			1	1	1			
Anabat 3 (Northern Dam -moved to Heath)	SA	5	nights		1		1	1	1	1			
Bat Trip line	SA	1	nights	1									
Spotlighting (10.25 hours total)													
Spotlight (Northern Dam and Hills)	SA/SS	0.75	hours	0.75									
Spotlight (Quarry SW - outside SA)	SA/Loc	1	hours		1								
Spotlight (Quarry Entrance Road)	Loc	1	hours					1					
Spotlight (Quarry West Hilltop)	SA	3.5	hours				2.5	1					

No Field Survey Remote Recording Devices Only

No Field Survey Remote Recording Devices Only

Activity	Area^	Effort	Units	27/02/ 2012	28/02 /2012	13/03/ 2012	14/03/ 2012	15/03/ 2012	16/03/ 2012	21/03 /2012	22/03/ 2012
Spotlight (Quarry Eastern Ridge)	SS	2	hours		0.75		1				0.25
Spotlight (Quarry Nth)	SS	1	hours					1			
Spotlight River and low slopes (NW)	SA	1	hours								1
Frog Survey (4.25 hours total)											
Frog Survey (Northern Dams)	SA	1	hours	1							
Frog Survey (Coxs River)	SA	1.5	hours	0.5				1			
Frog Survey (Northeast Gully)	SA	1	hours			1					
Frog Survey (Quarry Entrance Rd)	SA	0.75	hours	0.25			0.5				
Rock Rolling (5 hours total)											
Rock Roll (Quarry Eastern Ridge)	SS	2.5	hours					1.5	1		
Rock Roll (Northern Slopes)	SS/SA	2.5	hours				1	1			0.5
Bird Survey (5.5 hours total)											
Bird (Quarry Eastern Ridge)	SS	2.75	hours		0.5		0.75	0.5			1
Bird (Northern Slopes)	SS/SA	2	hours					0.5	0.5		1
Bird (Quarry West HT)	SA	0.75	hours						0.75		
Owl Survey (9 hours total)											
CPB (Quarry Northern Edge)	SS	0.75	hours					0.75			
CPB (Quarry Eastern Ridge)	SS	2.75	hours		0.75		0.75			0.75	0.5
CPB (Northern Dam)	SA	2.5	hours	1		0.75	0.75				
Owl Listening (Quarry Eastern Ridge)	SS	1.5	hours							0.75	0.75
Owl Listening (River and foothills- north west)	SA	1.5	hours								1.5

^ SS = Subject Site; SA = study area; Loc = Locality (adjacent to study area).

Appendix 5: Prevailing weather conditions during targeted fauna surveys

NB: dates for field survey visits are highlighted.

Date (2012)	Min temp (°C)	Max temp (°C)	Rainfall (mm)	9am relative humidity (%)	9am cloud amount (oktas)	9am wind direction	9am wind speed (km/h)	3pm Temp (°C)	3pm wind direction	3pm wind speed (km/h)
24/02	9.2	25.5	0	81	0		Calm	25	E	2
25/02	7.7	25.7	0	34	1	E	6	24	NE	2
26/02	16.1	20.4	1.6	96	8		Calm	18.2	NW	11
27/02	16.9	23.2	7	82	8	NNW	2	22.8	NNW	6
28/02	17.3	23.5	0.4	77	7	NNW	9	22.6	WNW	13
29/02	17.7	20.7	1.8	90	8		Calm	15.7	S	4
1/03	15.6	24.6	49.6	92	6	NW	15	23.8	NW	37
2/03	12.9	13.6	32	97	8	SSE	11	12.4	E	11
3/03	11.5	17.5	29.8	94	8	E	4	14.5	E	4
4/03	12.1	23.7	1.6	87	6	NW	15			
5/03	13	23.5	11.2	74	0	W	6	22	NE	4
6/03	12.1	18.3	0.6	89	8	SE	6	16.2	SE	7
7/03	9.8	13.7	1.6	74	6	SSE	30	11.9	SE	6
8/03	10.1	15.6	21	96	7		Calm	14.6	SW	11
9/03	10.9	19.8	0.8	90	6	WNW	7	17.6	W	7
10/03	7.5	22.6	0	74	0	S	2	21.1	SSW	4
11/03	12	22.5	0	86	1		Calm	20.7	SW	2
12/03	12.2	21	0	72	7	ENE	7	19.2	E	4
13/03	7.6	23.1	0	97	5		Calm	22.5		Calm
14/03	8.6	23.4	0	94	6		Calm	22.3	SE	7
15/03	11.7	23.2	0	93	5		Calm	22.6	E	6
16/03	11.7	24.9	0	85	1	NNW	2	23	SW	7
17/03	15.4	21.9	20.2	98	8	E	4	17.2	SE	9
18/03	11.7	17.9	0.4	75	3	SE	11	16.5	SE	15
19/03	12.1	17.2	4	95	8	SE	13	15.4	SE	15
20/03	12.4	19.6	2.2	90	7	E	4	18.5	E	6
21/03	13.2	23.8	0	88	5	NW	6	22.1	W	7
22/03	12.2	18.2	9.2	98	8		Calm	17.2	N	9

Appendix 6: Flora recorded within the BIA study area during the field survey

Family	*Species*	Common Name
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower
Adiantaceae	*Cheilanthes sieberi*	Rock Fern
Apiaceae	*Actinotus helianthi*	Flannel Flower
Apiaceae	*Centella asiatica*	Indian Pennywort
Apiaceae	*Conium maculatum**	Hemlock
Apiaceae	*Hydrocotyle algida*	Pennywort
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort
Apiaceae	*Hydrocotyle sibthorpioides*	
Asteraceae	*Calotis cuneata*	Mountain Burr-Daisy
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy
Asteraceae	*Cirsium vulgare**	Spear Thistle
Asteraceae	*Conyza bonariensis**	Flaxleaf Fleabane
Asteraceae	*Conyza sumatrensis**	Tall fleabane
Asteraceae	*Cymbonotus lawsonianus*	Bear's Ear
Asteraceae	*Euchiton involucratus*	Star Cudweed
Asteraceae	*Glossocardia bidens*	Cobbler's Tack
Asteraceae	*Hypochaeris radicata**	Catsear
Asteraceae	*Lagenophora stipitata*	Common Lagenophora
Asteraceae	*Leucochrysum albicans*	
Asteraceae	*Onopordum acanthium* subsp. *acanthium**	Scotch Thistle
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood
Asteraceae	*Senecio hispidulus*	Hill Fireweed
Asteraceae	*Senecio linearifolius*	Fireweed Groundsel
Asteraceae	*Senecio madagascariensis**	Fireweed
Asteraceae	*Senecio quadridentatus*	Cotton Fireweed
Asteraceae	*Silybum marianum**	Variegated Thistle
Asteraceae	*Sonchus asper* subsp. *glaucescens**	Prickly Sowthistle
Asteraceae	*Sonchus oleraceus**	Common Sowthistle
Asteraceae	*Tagetes minuta**	Stinking Roger
Asteraceae	*Taraxacum officinale**	Dandelion
Asteraceae	*Vittadinia cuneata*	A Fuzzweed
Boraginaceae	*Echium vulgare**	Viper's Bugloss
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell
Caryophyllaceae	*Scleranthus biflorus*	Two-flowered Knawel
Caryophyllaceae	*Stellaria media**	Common Chickweed
Casuarinaceae	*Casuarina cunninghamiana* subsp. *cunninghamiana*	River Oak
Chenopodiaceae	*Chenopodium album**	Fat Hen
Chenopodiaceae	*Einadia hastata*	Berry Saltbush
Clusiaceae	*Hypericum gramineum*	Small St John's Wort
Clusiaceae	*Hypericum perforatum**	St. Johns Wort
Commelinaceae	*Commelina cyanea*	Commelina

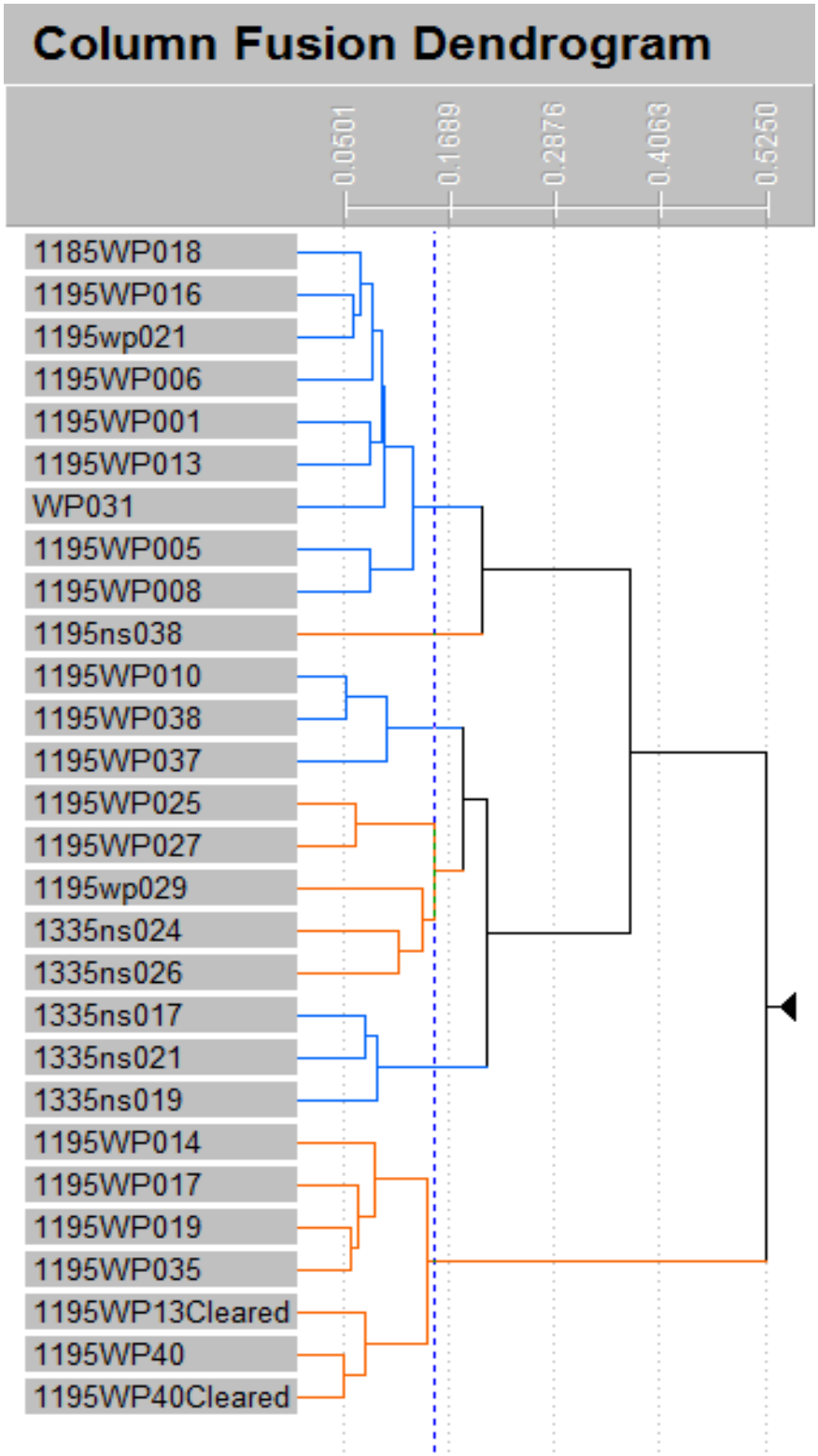
Family	*Species*	Common Name
Convolvulaceae	*Convolvulus erubescens*	Pink Bindweed
Convolvulaceae	*Dichondra repens*	Kidney Weed
Cyperaceae	*Carex appressa*	Tall Sedge
Cyperaceae	*Carex inversa*	Knob Sedge
Cyperaceae	*Carex longebrachiata*	
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge
Cyperaceae	*Cyperus polystachyos*	
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge
Cyperaceae	*Isolepis inundata*	Club-rush
Cyperaceae	*Lepidosperma filiforme*	
Cyperaceae	*Lepidosperma gunnii*	
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge
Cyperaceae	*Schoenus ericetorum*	
Cyperaceae	*Schoenus imberbis*	
Cyperaceae	*Schoenus paludosus*	
Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Dilleniaceae	*Hibbertia empetrifolia* subsp. *empetrifolia*	
Dilleniaceae	*Hibbertia obtusifolia*	Hoary Guinea Flower
Dilleniaceae	*Hibbertia riparia*	
Dilleniaceae	*Hibbertia vestita*	
Ericaceae	*Brachyloma daphnoides*	Daphne Heath
Ericaceae	*Lissanthe strigosa*	Peach Heath
Euphorbiaceae	*Euphorbia lathyris**	Caper Spurge
Euphorbiaceae	*Euphorbia peplus**	Petty Spurge
Fabaceae (Faboideae)	*Bossiaea buxifolia*	
Fabaceae (Faboideae)	*Bossiaea neo-anglica*	
Fabaceae (Faboideae)	*Daviesia acicularis*	
Fabaceae (Faboideae)	*Desmodium brachypodum*	Large Tick-trefoil
Fabaceae (Faboideae)	*Desmodium rhytidophyllum*	
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine
Fabaceae (Faboideae)	*Glycine tabacina*	Variable Glycine
Fabaceae (Faboideae)	*Hovea linearis*	
Fabaceae (Faboideae)	*Mirbelia platylobioides*	
Fabaceae (Faboideae)	*Mirbelia pungens*	Prickly Mirbelia
Fabaceae (Faboideae)	*Trifolium repens**	White Clover
Fabaceae (Mimosoideae)	*Acacia buxifolia*	Box-leaved Wattle
Fabaceae (Mimosoideae)	*Acacia falciformis*	Broad-leaved Hickory
Fabaceae (Mimosoideae)	*Acacia implexa*	Hickory Wattle
Gentianaceae	*Centaurium tenuiflorum**	Branched Centaury
Geraniaceae	*Geranium homeanum*	
Geraniaceae	*Geranium solanderi*	Native Geranium
Goodeniaceae	*Goodenia bellidifolia*	
Goodeniaceae	*Goodenia hederacea*	Ivy Goodenia
Goodeniaceae	*Goodenia stelligera*	Spiked Goodenia

Family	*Species*	Common Name
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort
Haloragaceae	*Gonocarpus teucrioides*	Germander Raspwort
Hypoxidaceae	*Hypoxis hygrometrica*	Golden Weather-grass
Iridaceae	*Patersonia sericea*	Silky Purple-Flag
Juncaceae	*Juncus usitatus*	
Lamiaceae	*Ajuga australis*	Austral Bugle
Lamiaceae	*Plectranthus parviflorus*	
Lamiaceae	*Prostanthera serpyllifolia* subsp. *microphylla*	Small-leaved Mint-Bush
Lauraceae	*Cassytha glabella*	
Linaceae	*Linum marginale*	Native Flax
Lindsaeaceae	*Lindsaea linearis*	Screw Fern
Lobeliaceae	*Pratia purpurascens*	Whiteroot
Loganiaceae	*Mitrasacme polymorpha*	
Lomandraceae	*Lomandra confertifolia*	Matrush
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*	
Lomandraceae	*Lomandra glauca*	Pale Mat-rush
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Myrtaceae	*Angophora floribunda*	Rough-barked Apple
Myrtaceae	*Calytrix tetragona*	Common Fringe-myrtle
Myrtaceae	*Eucalyptus blakelyi x tereticornis*	
Myrtaceae	*Eucalyptus bridgesiana*	Apple Box
Myrtaceae	*Eucalyptus dives*	Broad-leaved Peppermint
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark
Myrtaceae	*Eucalyptus mannifera*	Brittle Gum
Myrtaceae	*Eucalyptus melliodora*	Yellow Box
Myrtaceae	*Eucalyptus pulverulenta*	Silver-leaved Mountain Gum
Myrtaceae	*Eucalyptus rossii*	Inland Scribbly Gum
Myrtaceae	*Eucalyptus stellulata*	Black Sally
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Myrtaceae	*Eucalyptus viminalis*	Ribbon Gum
Myrtaceae	*Kunzea ambigua*	Tick Bush
Myrtaceae	*Leptospermum continentale*	Prickly Teatree
Myrtaceae	*Leptospermum parvifolium*	
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree
Orchidaceae	*Acianthus exsertus*	Mosquito Orchid
Orchidaceae	*Caladenia catenata*	White Caladenia
Orchidaceae	*Pterostylis reflexa*	Small Autumn Greenhood
Oxalidaceae	*Oxalis exilis*	
Oxalidaceae	*Oxalis perennans*	
Phormiaceae	*Dianella caerulea* var. *producta*	Blue Flax-lily
Phormiaceae	*Dianella longifolia*	Blueberry Lily

Family	*Species*	Common Name
Phormiaceae	*Dianella revoluta*	Blueberry Lily
Phormiaceae	*Stypandra glauca*	Nodding Blue Lily
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge
Phyllanthaceae	*Poranthera microphylla*	Small Poranthera
Plantaginaceae	*Plantago debilis*	Shade Plantain
Plantaginaceae	*Plantago lanceolata**	Lamb's Tongues
Plantaginaceae	*Veronica plebeia*	Trailing Speedwell
Poaceae	*Anisopogon avenaceus*	Oat Speargrass
Poaceae	*Aristida echinata*	
Poaceae	*Aristida ramosa*	Purple Wiregrass
Poaceae	*Aristida vagans*	Threeawn Speargrass
Poaceae	*Aristida warburgii*	
Poaceae	*Austrodanthonia penicillata*	Slender Wallaby Grass
Poaceae	*Austrodanthonia racemosa*	Wallaby Grass
Poaceae	*Austrodanthonia tenuior*	A Wallaby Grass
Poaceae	*Austrostipa ramosissima*	Stout Bamboo Grass
Poaceae	*Austrostipa rudis*	
Poaceae	*Austrostipa scabra*	Speargrass
Poaceae	*Avena fatua**	Wild Oats
Poaceae	*Axonopus compressus**	Broad-leaved Carpet Grass
Poaceae	*Bothriochloa decipiens* var. *decipiens*	Pitted Bluegrass
Poaceae	*Bothriochloa macra*	Red Grass
Poaceae	*Bromus catharticus**	Praire Grass
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass
Poaceae	*Dichelachne inaequiglumis*	
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass
Poaceae	*Dichelachne rara*	
Poaceae	*Dichelachne* spp.	A Plumegrass
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass
Poaceae	*Digitaria sanguinalis*	Crab Grass
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass
Poaceae	*Ehrharta erecta**	Panic Veldtgrass
Poaceae	*Eleusine indica**	Crowsfoot Grass
Poaceae	*Entolasia marginata*	Bordered Panic
Poaceae	*Entolasia stricta*	Wiry Panic
Poaceae	*Eragrostis brownii*	Brown's Lovegrass
Poaceae	*Eragrostis curvula*	African Lovegrass
Poaceae	*Eragrostis lehmanniana*	
Poaceae	*Imperata cylindrica*	Blady Grass
Poaceae	*Lolium perenne**	A Ryegrass
Poaceae	*Microlaena stipoides*	Weeping Grass
Poaceae	*Microlaena stipoides var. stipoides*	Weeping Grass
Poaceae	*Nassella trichotoma**	Serrated Tussock

Family	*Species*	Common Name
Poaceae	*Oryza sativa**	Rice
Poaceae	*Panicum simile*	Two-colour Panic
Poaceae	*Paspalum dilatatum**	Paspalum
Poaceae	*Phalaris aquatica**	Phalaris
Poaceae	*Poa sieberiana*	Snowgrass
Poaceae	*Setaria parviflora**	Summer Grass
Poaceae	*Setaria pumila**	Pale Pigeon Grass
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass
Poaceae	*Sporobolus fertilis**	Giant Parramatta Grass
Poaceae	*Themeda australis*	Kangaroo Grass
Poaceae	*Vulpia bromoides**	Squirrel Tail Fescue
Polygonaceae	*Persicaria decipiens*	Slender Knotweed
Polygonaceae	*Rumex brownii*	Swamp Dock
Polygonaceae	*Rumex crispus**	Curled Dock
Polygonaceae	*Rumex obtusifolius**	Broadleaf Dock
Portulacaceae	*Portulaca oleracea*	Pigweed
Proteaceae	*Banksia spinulosa*	Hairpin Banksia
Proteaceae	*Banksia spinulosa* var. *spinulosa*	
Proteaceae	*Conospermum* spp.	
Proteaceae	*Grevillea arenaria*	
Proteaceae	*Hakea dactyloides*	Finger Hakea
Proteaceae	*Lomatia myricoides*	River Lomatia
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung
Proteaceae	*Persoonia pinifolia*	Pine-leaved Geebung
Ranunculaceae	*Clematis aristata*	Old Man's Beard
Ranunculaceae	*Ranunculus lappaceus*	Common Buttercup
Rhamnaceae	*Cryptandra amara* var. *amara*	
Rhamnaceae	*Pomaderris ledifolia*	Sydney Pomaderris
Rosaceae	*Acaena novae-zelandiae*	Bidgee-widgee
Rosaceae	*Rosa rubiginosa**	Sweet Briar
Rosaceae	*Rubus fruticosus sp. agg.**	Blackberry complex
Rubiaceae	*Asperula conferta*	Common Woodruff
Rubiaceae	*Galium gaudichaudii*	Rough Bedstraw
Rubiaceae	*Opercularia diphylla*	Stinkweed
Rubiaceae	*Pomax umbellata*	Pomax
Solanaceae	*Solanum nigrum**	Black-berry Nightshade
Solanaceae	*Solanum prinophyllum*	Forest Nightshade
Stackhousiaceae	*Stackhousia viminea*	Slender Stackhousia
Urticaceae	*Urtica incisa*	Stinging Nettle
Verbenaceae	*Verbena bonariensis**	Purpletop
Violaceae	*Melicytus dentatus*	Tree Violet

Appendix 7: Vegetation community dendrogram



Appendix 8: Vegetation community alignment with EEC, RBVT, vegetation formation and vegetation class

Vegetation Community Unit (Niche)	Niche Type	EEC	Area of direct impact (ha)	Area of indirect impact (ha)	Proposed offset area (ha)	Total study area (ha)	RBVT Code	RBVT	Vegetation Formation	Vegetation Class
c1	Brittle Gum - Broad-leaved Peppermint open forest	Not an EEC	17.3	1.3	46.3	64.9	HN570	Red Stringybark - Brittle Gum - Brittle Gum dry open forest of the tablelands, South Eastern Highlands	Dry Sclerophyll Forests (Shrubby subformation)	Southern Tableland Dry Sclerophyll Forests
c2	Silver-leaved Mountain Gum mallee woodland	Not an EEC	-	-	1.9	1.9				
c3	Forest Red Gum grassy open forest	Not an EEC	4.4	0.8	22.8	28.0	HN527	Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands	Dry Sclerophyll Forests (Shrub/grass subformation)	Central Gorge Dry Sclerophyll Forests
c3a	Forest Red Gum native grassland	Not an EEC	-	-	0.8	0.8				
c3b	Forest Red Gum exotic grassland	Not an EEC	-	-	9.7	9.7				
c4	Rough-barked Apple gully forest	Not an EEC	-	-	2.4	2.4				
c5	Stringybark - Apple Box open forest	Not an EEC	4.8	0.4	-	5.2	HN501	Apple Box - Broad-leaved Peppermint dry open forest of the Abercrombie-Tarlo area, South Eastern Highlands	Grassy Woodlands	Southern Tableland Grassy Woodlands
c6	River Oak riparian open forest	Not an EEC	-	-	10.4	10.4	HN574	River Oak open forest of major streams, Sydney Basin and South East Corner	Forested Wetlands	Eastern Riverine Forests
Total Native Vegetation			**26.5**	**2.5**	**94.3**	**123.3**				
dd	Disturbed and excavated	-	8.3	0.1	-	8.4				
rh	Rehabilitation area	-	3.0	-	-	3.0				
wt	Dams and ponds		0.3	-	-	0.3				
		Total area	*38.1*	*2.6*	*94.3*	*135.0*				

Appendix 9: Fauna recorded within the BIA study area during the field survey

Common Name	Scientific Name	Study Area	River and water bodies only	Subject Site
Amphibians				
Brown-striped Frog	*Limnodynastes peronii*	x		
Common Eastern Froglet	*Crinia signifera*			x
Eastern Banjo Frog	*Limnodynastes dumerilii*		x	
Smooth Toadlet	*Uperoleia laevigata*			x
Spotted Grass Frog	*Limnodynastes tasmaniensis*			x
Verreaux's Frog	*Litoria verreauxii*	x		
Birds				
Australasian Grebe	*Tachybaptus novaehollandiae*		x	
Australian Magpie	*Cracticus tibicen*	x		x
Australian Raven	*Corvus coronoides*	x		x
Australian Wood Duck	*Chenonetta jubata*		x	
Bell Miner	*Manorina melanophrys*	x		x
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	x		x
Brown Falcon	*Falco berigora*			x
Brown Thornbill	*Acanthiza pusilla*	x		x
Brown-headed Honeyeater	*Melithreptus brevirostris*	x		x
Buff-rumped Thornbill	*Acanthiza reguloides*	x		x
Crimson Rosella	*Platycercus elegans*	x		x
Eastern Whipbird	*Psophodes olivaceus*	x		
Eurasian Coot	*Fulica atra*		x	
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	x		
Gang-gang Cockatoo	***Callocephalon fimbriatum***	**x**		
Grey Butcherbird	*Cracticus torquatus*	x		x
Grey Fantail	*Rhipidura albiscapa*	x		x
Grey Teal	*Anas gracilis*		x	
Horsfield's Bronze-Cuckoo	*Chalcites basalis*			x
Laughing Kookaburra	*Dacelo novaeguineae*	x		
Masked Lapwing	*Vanellus miles*	x		
Noisy Friarbird	*Philemon corniculatus*			x
Pacific Black Duck	*Anas superciliosa*	x		
Pied Currawong	*Strepera graculina*			x
Powerful Owl	***Ninox strenua***	**x**		
Red Wattlebird	*Anthochaera carunculata*			x
Red-browed Finch	*Neochmia temporalis*	x		x
Rufous Whistler	*Pachycephala rufiventris*	x		x
Sacred Kingfisher	*Todiramphus sanctus*	x		
Satin Flycatcher	*Myiagra cyanoleuca*	x		
Scarlet Robin	***Petroica boodang***	**x**		**x**
Silvereye	*Zosterops lateralis*			x

Common Name	Scientific Name	Study Area	River and water bodies only	Subject Site
Spotted Pardalote	*Pardalotus punctatus*			x
Spotted Quail-thrush	*Cinclosoma punctatum*	x		
Striated Pardalote	*Pardalotus striatus*			x
Striated Thornbill	*Acanthiza lineata*			x
Sulphur-crested Cockatoo	*Cacatua galerita*	x		
Superb Fairy-wren	*Malurus cyaneus*			x
Tawny Frogmouth	*Podargus strigoides*			x
Wedge-tailed Eagle	*Aquila audax*	x		
Weebill	*Smicrornis brevirostris*			x
White-eared Honeyeater	*Lichenostomus leucotis*			x
White-necked Heron	*Ardea pacifica*		x	
White-plumed Honeyeater	*Lichenostomus penicillatus*			x
White-throated Treecreeper	*Cormobates leucophaea*	x		x
White-winged Chough	*Corcorax melanorhamphos*	x		x
Willie Wagtail	*Rhipidura leucophrys*			x
Yellow-faced Honeyeater	*Lichenostomus chrysops*	x		x
Yellow-plumed Honeyeater	*Lichenostomus ornatus*	x		
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*			x
Mammals				
Brown Antechinus	*Antechinus stuartii*			x
Chocolate Wattled Bat	Chalinolobus morio	x		x
Common Brushtail Possum	*Trichosurus vulpecula*	x		x
Common Ringtail Possum	*Pseudocheirus peregrinus*	x		
Common Wallaroo	*Macropus robustus*	x		
Common Wombat	*Vombatus ursinus*			x
Dog*	*Canis lupus familiaris*	x		
Eastern Bentwing-bat	***Miniopterus schreibersii oceanensis***	**x**		
Eastern Broad-nosed Bat	*Scotorepens orion*			
Eastern Grey Kangaroo	*Macropus giganteus*	x		
Fox*	*Vulpes vulpes*			x
Gould's Wattled Bat	*Chalinolobus gouldii*	x		x
Large Forest Bat	*Vespadelus darlingtoni*	x		x
Large-eared Pied Bat	***Chalinolobus dwyeri***			***x***
Little Forest Bat	*Vespadelus vulturnus*			x
Rat*	*Rattus sp.*			x
Red-necked Wallaby	*Macropus rufogriseus*	x		
Short-beaked Echidna	*Tachyglossus aculeatus*	x		
Southern Forest Bat	*Vespadelus regulus*	x		x
Sugar Glider	*Petaurus breviceps*			x
Swamp Wallaby	*Wallabia bicolor*	x		x
White-striped Free-tailed Bat	*Tadarida australis*	x		x
Nyctophilus	*Nyctophilus sp.*	x		x

Common Name	Scientific Name	Study Area	River and water bodies only	Subject Site
Reptiles				
Blackish Blind Snake	*Ramphotyphlops nigrescens*			x
Copper-tailed Skink	*Ctenotus taeniolatus*			x
Dark-flecked Garden Sunskink	*Lampropholis delicata*	x		x
Eastern Brown Snake	*Pseudonaja textilis*	x		
Eastern Snake-necked Turtle	*Chelodina longicollis*		x	
Eastern Water Dragon	*Physignathus lesueurii*		x	
Eastern Water-skink	*Eulamprus quoyii*	x		
Lace Monitor	*Varanus varius*	x		
Red-bellied Black Snake	*Pseudechis porphyriacus*	x		
Robust Ctenotus	*Ctenotus robustus*	x		x

KEY: * = introduced species; bold = listed as vulnerable under TSC Act; bold and italicised listed as vulnerable under TSC Act and EPBC Act.

Appendix 10: Seven Part Tests

Threatened Flora as listed on the TSC Act

***Eucalyptus pulverulenta* (Silver-leaved Mountain Gum)**	
Assessment of Significance criteria (Seven Part Test)	**Address of criteria**
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	**Viable local population** The local population of *Eucalyptus pulverulenta* is estimated by Niche, as a result of extensive surveys, at 3,612 individuals and is composed of: • 90 individuals impacted by the Stage 2 development in remnant non-core habitat; • 631 planted individuals impacted by the Stage 2 development in existing rehabilitation areas; • 1,850 individuals in remnant bushland that would be conserved in the adjacent proposed offset area as a result of the Stage 2 Extension (1,718 individuals in core habitat areas); • 286 individuals in an area of core habitat that are currently managed in Conservation Area H on the site as a part of a previous approval; and • 755 individuals that were planted in rehab areas throughout the site. The local population also includes 279 individuals within remnant areas on the northern edge of the existing Stage 1 extraction area. It is assumed that these plants have been approved for removal and therefore have not been included as a part of the local population for the purposes of this assessment. **Life cycle factors** Benson and McDougall (1998) describe *Eucalyptus pulverulenta* as potentially being reproductively mature with a completely 'juvenile' crown. This suggests the species flowers and fruits within a few years of germination and establishment. The species has a longevity of more than 100 years and it resprouts after fire from a lignotuber and epicormic buds (Benson and McDougall 1998). The species is self-sterile (Benson and McDougall 1998), meaning individual plants cannot pollinate themselves, thus guaranteeing genetic outcrossing. Seed is dispersed locally by wind or gravity and Crimson Rosella feed on the fruit (Benson and McDougall 1998). **Assessment** The action proposed would remove 90 individuals or 2.5 per cent of the local remnant population and remove a further 631 individuals that had been planted previously in on-site rehabilitation areas (17.5 per cent of the local population). Combined, this results in the removal of approximately 20 per cent of the local population from non-core habitat and rehabilitation areas. Apart from the removal of 20 per cent of the local population, the Stage 2 Extension would not directly impact on any of the life cycle factors described above. It is considered unlikely that the Stage 2 Extension would place a viable local population of the species at risk, as the Stage 2 Extension would result in a managed and secure in-perpetuity offset of 1,850 individuals in remnant on-site populations (i.e. not planted in rehabilitation areas) and therefore lead to an improve or maintain outcome 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	n/a

***Eucalyptus pulverulenta* (Silver-leaved Mountain Gum)**	
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	n/a
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.	**i. Extent of impact on habitat** Approximately 15.6 hectares of non-core natural habitat for the species would be impacted by the Stage 2 Extension; Brittle Gum - Broad-leaved Peppermint open forest. Within this impacted area, 90 individuals of the species would be removed. Within the proposed offset area, 132 individuals would be conserved in non-core habitat areas and 1,718 within core habitat areas dominated by the species. **ii. Habitat fragmentation** The Stage 2 Extension expands an existing southern and western disturbed edge of a remnant area of habitat and, therefore, no habitat fragmentation for the species is likely to occur. **iii. Importance of habitat to be impacted** The habitat removed is important habitat for the species. However, in the context of the provision of a managed and secured in-perpetuity offset for the species, which contains an important area of core habitat with 1,718 individuals, the habitat to be impacted is of relatively less importance to the long-term survival of the species than is the provision of the proposed offset area. The long-term survival of the species within the locality would be assured through the provision of the adjacent offset area.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	n/a
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	No Recovery Plan exists for this species. No Threat Abatement Plans are relevant to the conservation of this species.
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	Section 5.1.2 describes the four KTPs that are likely to be exacerbated by the Stage 2 Extension: 1. Clearing of native vegetation; 2. Climate change (human-caused); 3. Loss of hollow-bearing trees; and 4. Removal of dead wood and dead trees. Specific reference is only made to *Eucalyptus pulverulenta* in Appendix 1 of the Clearing of Native Vegetation KTP as a threatened species that is adversely affected by this process. Amelioration of the removal of native vegetation as a result of the Stage 2 Extension has been described in Section 6. Through the provision of a managed and secured in-perpetuity offset, the Stage 2 Extension would achieve an 'improve or maintain' outcome for the species.

***Eucalyptus aggregata* (Black Gum)**	
Assessment of Significance criteria (Seven Part Test)	**Address of criteria**
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	*Eucalyptus aggregata* was not detected within the BIA study area during the field surveys. It is a conspicuous species and is unlikely to have remained undetected. Therefore, it is considered unlikely that the action proposed would 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
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	n/a
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: 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	n/a
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.	**i. Extent of impact on habitat** Approximately 15.6 hectares of habitat for the species would be impacted by the Stage 2 Extension; Brittle Gum - Broad-leaved Peppermint open forest. Within this impacted area, no individuals of the species were detected. It is a conspicuous species and is considered unlikely to have remained undetected. Section 7 of this report has demonstrated that impacts on native vegetation would be suitably offset according to the State Significant Development offsetting policy and the proposed offset area would include 46.3 hectares of the same vegetation unit. **ii. Habitat fragmentation** The Stage 2 Extension expands an existing southern and western disturbed edge of a remnant area of habitat and, therefore, no habitat fragmentation for the species is likely to occur. **iii. Importance of habitat to be impacted** *Eucalyptus aggregata* was not detected within the BIA study area during the field surveys. It is a conspicuous species and is considered unlikely to have remained undetected. Therefore, it is considered that the 15.6 hectares of habitat for the species that would be removed is of relatively low importance to the long-term survival of the species within the locality.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	n/a
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	No Recovery Plan exists for this species. No Threat Abatement Plans are relevant to the conservation of this species.

***Eucalyptus aggregata* (Black Gum)**	
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	Section 5.1.2 describes the four KTPs that are likely to be exacerbated by the Stage 2 Extension: 1. Clearing of native vegetation; 2. Climate change (human-caused); 3. Loss of hollow-bearing trees; and 4. Removal of dead wood and dead trees. No reference is made to *Eucalyptus aggregata* in any of the Final Determinations for these KTPs.

Threatened microbats: Hollow dependant - Eastern False Pipistrelle *Falsistrellus tasmaniensis*, Eastern Freetail-bat *Mormopterus norfolkensis,* Greater Broad-nosed Bat *Scoteanax rueppellii* , Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* and Southern Myotis *Myotis macropus* **Cave dependant** - Large-eared Pied Bat *Chalinolobus dwyeri,,* Southern Myotis *Myotis macropus*, Eastern Bentwing-bat *Miniopterus schreibersii oceanensis.*	
Assessment of Significance criteria (Seven Part Test)	**Address of criteria**
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	**Viable local populations** Of the microbats considered in this assessment only Large-eared Pied Bat and Eastern Bentwing-bat were detected within the BIA study area during field surveys. Atlas of NSW Wildlife records exist for a further five species of microbats within 10 km of the BIA study area; Greater Broad-nosed Bat, Eastern Freetail-bat, Eastern False Pipistrelle, Southern Myotis and Yellow-bellied Sheathtail-bat. Despite the cryptic nature of these species, it is considered that viable local populations of all species exist within the locality. Greater Broad-nosed Bat and Eastern Freetail-bat were recorded on the site previously, and Southern Myotis was recorded within riparian zone adjacent to study area. **Cave dependant** Large-eared Pied Bat, Eastern Bentwing-bat and Southern Myotis are cave-dwelling species. Whilst some areas within the BIA study area had some outcropping, embedded and loose surface rock, no substantial or good quality roosting habitat in the form of caves or crevices was identified during the field surveys. This suggests that individuals recorded within the BIA study area were using the habitat for foraging only and that the action is unlikely to impact on a roosting and/or breeding population. **Hollow dependant** Approximately 471 hollow bearing trees within 26.5 hectares of native vegetation would be removed as part of the proposed action. Greater Broad-nosed Bat, Eastern False Pipistrelle, Yellow-bellied Sheathtail-bat and Eastern Freetail-bat are tree hollow roosting species. The southern Myotis uses both hollows and caves for roosting. Both the Greater Broad-nosed Bat and Eastern False Pipistrelle prefer moister riparian habitats, both to roost and forage, and the Southern Myotis prefers hollows adjacent to water bodies. A substantial amount of good condition habitat for both species exists as River Oak riparian forest along the Coxs River which forms the eastern and northern edges of the proposed offset area. None of this riparian habitat adjacent to the subject site would be impacted by the Stage 2 Extension and, in fact, much of it would be conserved within the proposed offset area. The Eastern Freetail-Bat prefers tree hollows for roosting and dry sclerophyll habitats for foraging. All of the 26.5 hectares of native vegetation to be removed by the Stage 2 Extension is dry sclerophyll forest. Yellow-bellied Sheathtail-bat roosts in tree hollows across a wide range of habitats and is likely to use the impact area for foraging and roosting. It is unlikely that the Stage 2 Extension would have an adverse impact on the life cycle of the Eastern Freetail or Yellow-bellied Sheathtail- bats, as the tree hollow roosting habitat within the subject site represents a small percentage of available habitat within the locality. The proposed offset area provides 94.3 hectares of foraging habitat for the cave and hollow dwelling species, as well as potential roosting habitat for the hollow dependent 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	n/a

Threatened microbats: Hollow dependant - Eastern False Pipistrelle *Falsistrellus tasmaniensis*, Eastern Freetail-bat *Mormopterus norfolkensis,* Greater Broad-nosed Bat *Scoteanax rueppellii* , Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* and Southern Myotis *Myotis macropus* **Cave dependant** - Large-eared Pied Bat *Chalinolobus dwyeri,,* Southern Myotis *Myotis macropus*, Eastern Bentwing-bat *Miniopterus schreibersii oceanensis.*	
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	n/a
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.	**i. Extent of impact on habitat** Approximately 26.5 hectares of foraging and roosting habitat for hollow-dependant species would be removed as a result of the Stage 2 Extension, as well as foraging habitat for cave dependant bat species. This represents a very small proportion of similar retained habitat within the locality. Furthermore, the proposed offset area provides 94.3 hectares of habitat for these species. . **ii. Habitat fragmentation** The Stage 2 Extension expands an existing southern and western disturbed edge of a remnant area of habitat and therefore, no habitat fragmentation for the species is likely to occur. **iii. Importance of habitat to be impacted** The 26.5 hectares of dry sclerophyll forest to be removed by the Stage 2 Extension may potentially affect the hollow dependant species. Cave dependant species may use the area for foraging but no substantial local populations of any of these species are considered to roost within the BIA study area. Therefore, the habitat to be removed is considered to be of moderate importance to the long-term survival of these species within the locality. Furthermore, the proposed offset area provides 94.3 hectares of foraging habitat for all these microbat species, as well as potential roosting habitat for the hollow-roosting species.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	Under the TSC Act, the Director-General maintains a Register of critical habitat. To date, no critical habitat has been declared for any of these bat species.

Threatened microbats: Hollow dependant - Eastern False Pipistrelle *Falsistrellus tasmaniensis*, Eastern Freetail-bat *Mormopterus norfolkensis,* Greater Broad-nosed Bat *Scoteanax rueppellii* , Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* and Southern Myotis *Myotis macropus* **Cave dependant** - Large-eared Pied Bat *Chalinolobus dwyeri,,* Southern Myotis *Myotis macropus*, Eastern Bentwing-bat *Miniopterus schreibersii oceanensis.*	
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	**Cave dependant** - A National recovery plan has been prepared for the Large-eared Pied Bat (SEWPaC 2011). The overall objective of this recovery plan is to ensure the persistence of viable populations of the large-eared pied bat throughout its geographic range. The specific objectives of the recovery plan are (SEWPaC 2011): ❒ Identify priority roost and maternity sites for protection; ❒ Implement conservation and management strategies for priority sites; ❒ Educate the community and industry to understand and participate in the conservation of the large-eared pied bat; ❒ Research the large-eared pied bat to augment biological and ecological data to enable conservation management; and ❒ Determine the meta-population dynamics throughout the distribution of the large-eared pied bat. To date, no recovery plans have been prepared for the Eastern Bentwing Bat, Eastern Cave Bat or Southern Myotis. However, the threatened species profiles for these species list a number of recovery actions to assist in the recovery of the species. Those that may be relevant to the Stage 2 Extension include: ❒ Identify and protect natural roost habitat such as caves and overhangs; ❒ Promote roosting habitat in new artificial structures within the species range; ❒ Survey areas of potential habitat; ❒ Promote roosting habitat in new artificial structures within the species range; ❒ Encourage recovery of natural hydrological regimes, including retention and rehabilitation of riparian vegetation; and ❒ Ensure protection of caves and overhangs in area of suitable geology when undertaking PVP assessments (offsets should include nearby remnants in high productivity) or other land assessment tools. **Hollow dependant** - To date, no recovery plans have been prepared for these bat species. However, the threatened species profiles for these bat species list a number of priority action to assist in the recovery of these species. Those relevant to the Stage 2 Extension are: ❒ Ensure largest hollow bearing trees, including dead trees and paddock trees are given highest priority for retention in PVP assessments (offsets should include remnants in high productivity) and/or other land assessment tools. Specific to Southern Myotis: ❒ Promote roosting habitat in new artificial structures within the species range. ❒ Encourage recovery of natural hydrological regimes, including retention and rehabilitation of riparian vegetation. The Stage 2 Extension is considered consistent with the recovery plans for these species, particularly the conservation of riparian habitat within the proposed offset area.
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	Section 5.1.2 describes the four KTPs that are likely to be exacerbated by the Stage 2 Extension: 1. Clearing of native vegetation; 2. Climate change (human-caused); 3. Loss of hollow-bearing trees; and 4. Removal of dead wood and dead trees. With the exception of the Eastern Bentwing-Bat, each of the threatened microbat species considered in this assessment are listed under either (1), (3) or (4) above.

Grey-headed Flying-fox *Pteropus poliocephalus*	
Assessment of Significance criteria (Seven Part Test)	**Address of criteria**
h) 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	Grey-headed Flying-fox (GHFF) were not recorded during field survey, and no Atlas records exist of this species within 10 km of the BIA study area. GHFF are a conspicuous species when present, roosting in large colonies (camps), and calling at night during foraging. Due to the prominence of the species when present, it is considered that GHFF would not have remained undetected within the BIA study area during the field surveys. For this reason a viable local roosting population is not considered to be present within the BIA study area or the broader locality. As such, it is considered unlikely that the Stage 2 Extension would 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.
i) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	n/a
j) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: iii. 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 iv. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	n/a
k) In relation to the habitat of a threatened species, population or ecological community: iv. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and v. 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 vi. 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.	**i. Extent of impact on habitat** Approximately 26.5 hectares of foraging habitat for the GHFF would be removed as a result of the Stage 2 Extension. This represents a very small proportion of similar retained habitat within the locality. Furthermore, the proposed offset area provides 94.3 hectares of habitat for these species. **ii. Habitat fragmentation** The clearing of vegetation for the Stage 2 Extension is not expected to further fragmentation or cause a barrier to movement for the species. The Stage 2 Extension expands an existing southern and western disturbed edge of a remnant area of habitat and therefore, no fragmentation of habitat for this species is likely to occur. **iii. Importance of habitat to be impacted** Given that no records for the species occur within the BIA study area or locality and that the habitat present does not contain specialist feeding resources, other than flowering eucalypts, the habitat to be removed is of low to moderate importance to the survival of the GHFF.
l) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	Under the TSC Act, the Director-General maintains a Register of critical habitat. To date, no critical habitat has been declared for the GHFF.

Grey-headed Flying-fox *Pteropus poliocephalus*	
m) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	No Recovery Plan exists for this species. No Threat Abatement Plans are relevant to the conservation of this species.
n) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	Section 5.1.2 describes the four KTPs that are likely to be exacerbated by the Stage 2 Extension: 5. Clearing of native vegetation; 6. Climate change (human-caused); 7. Loss of hollow-bearing trees; and 8. Removal of dead wood and dead trees. Of these, only (1) above lists GHFF in its Final Determination.

Koala *Phascolarctos cinereus*	
Assessment of Significance criteria (Seven Part Test)	**Address of criteria**
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	The Koala was not recorded during field survey and detailed studies of the lower Blue Mountains area have failed to identify a population of Koala within this region, despite suitable habitat. Two Atlas records of individuals occur within 10 km of the BIA study area but it is likely these are records of individuals dispersing from the known northern Blue Mountains populations. Given the lack of records, it is unlikely that an important and viable local population occurs within the BIA study area. Therefore, the Stage 2 Extension is unlikely 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.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	n/a
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: 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	n/a
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.	**i. Extent of impact on habitat** Approximately 26.5 hectares of potential foraging habitat for the Koala would be removed as a result of the Stage 2 Extension. This represents a very small proportion of similar retained habitat within the locality. Furthermore, the proposed offset area provides 94.3 hectares of habitat for Koala. Note that this does not reflect potential Koala habitat as defined in SEPP 44, which is strictly defined the presence or absence of certain feed tree species. **ii. Habitat fragmentation** The clearing of vegetation for the Stage 2 Extension is not expected to further fragmentation or cause a barrier to movement for the Koala. The Stage 2 Extension expands an existing southern and western disturbed edge of a remnant area of habitat and therefore, no fragmentation of habitat for the species is likely to occur. **iii. Importance of habitat to be impacted** Identified Koala feed trees such as *Eucalyptus tereticornis* and *E. mannifera* occur within the BIA study area, and constitute potential habitat for the species (DECC 2008b). It is unlikely that the habitat is important to the survival of the species as a Koala population is not currently dependant on the resources within the BIA study area, reflected by the lack of species records despite targeted survey.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	Under the TSC Act, the Director-General maintains a Register of critical habitat. To date, no critical habitat has been declared for the Koala.

Koala *Phascolarctos cinereus*	
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	A recovery plan for the Koala has been prepared (DECC 2008b). The overall objective of the recovery plan is to reverse the decline of the koala in NSW, to ensure adequate protection, management and restoration of koala habitat, and to maintain healthy breeding populations of koalas throughout their current range (DECC 2008b). The specific objectives of the recovery plan are: ❒ To conserve koalas in their existing habitat; ❒ To rehabilitate and restore koala habitat and populations; ❒ To develop a better understanding of the conservation biology of koalas; ❒ To ensure that the community has access to factual information about the distribution, conservation and management of koalas at a national, state and local scale; ❒ To manage captive, sick or injured koalas and orphaned wild koalas to ensure consistent and high standards of care; ❒ To manage over browsing to prevent both koala starvation and ecosystem damage in discrete patches of habitat; and ❒ To coordinate, promote the implementation, and monitor the effectiveness of the NSW Koala Recovery Plan across NSW. The Stage 2 Extension is considered consistent with the recovery plan for this species.
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	Section 5.1.2 describes the four KTPs that are likely to be exacerbated by the Stage 2 Extension: 1. Clearing of native vegetation; 2. Climate change (human-caused); 3. Loss of hollow-bearing trees; and 4. Removal of dead wood and dead trees. The Stage 2 Extension would exacerbate 'Clearing of native vegetation', removing 26.5 hectares of potential habitat for the Koala.

Woodland Birds – Flame Robin *Petroica phoenicea*, Hooded Robin *Melanodryas cucullata*, Scarlet Robin *Petroica boodang* and Varied Sittella *Daphoenisitta chrysoptera.*	
Assessment of Significance criteria (Seven Part Test)	**Address of criteria**
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	Scarlet Robin was recorded in five separate locations within the BIA study area, including three within the area of impact. It could therefore be reasonably said that a viable local population exists within the locality, despite not having been previously recorded within 10 km of the BIA study area. Flame Robin, Hooded Robin and Varied Sittella were also recorded within the BIA study area during previous work by Niche. The action proposed is likely to have an adverse effect on the life cycle of these species as breeding and foraging habitat would be removed. However, given that habitat for these species is abundant in the locality the removal of 17.3 hectares of Brittle Gum - Broad-leaved Peppermint open forest habitat for these species represents a very small proportion of that available habitat in the locality. Therefore, it is unlikely that a viable local population of these species is likely to be placed at risk of extinction by the Stage 2 Extension. Additionally, 46 hectares of Brittle Gum - Broad-leaved Peppermint open forest habitat would be conserved in the proposed offset area. These species are ecosystem credit species and Section 7 of this report has demonstrated that enough ecosystem credits exist from the proposed offset area, to ensure the Stage 2 Extension is offset within the rules of the State Significant Development offsets policy.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	n/a
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: 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	n/a

Woodland Birds – Flame Robin *Petroica phoenicea*, Hooded Robin *Melanodryas cucullata*, Scarlet Robin *Petroica boodang* and Varied Sittella *Daphoenisitta chrysoptera.*	
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.	**i. Extent of impact on habitat** The key habitat for these species tube removed by the Stage 2 Extension is the 17.3 hectares of Brittle Gum - Broad-leaved Peppermint open forest across the ridgeline of the site. Within the broader locality, the vegetation unit is extensive and therefore the relative extent of the impact on habitat is minor. Furthermore, approximately 46 hectares of this vegetation type would be conserved within the proposed offset area, thereby conserving habitat for these species locally. Section 7 of this report demonstrates that, under the offsetting policy for State Significant Development, the provision of such an offset would be adequate. **ii. Habitat fragmentation** The clearing of vegetation for the Stage 2 Extension is not expected to further fragmentation or cause a barrier to movement for these species. The Stage 2 Extension expands an existing southern and western disturbed edge of a remnant area of habitat and therefore, no fragmentation of habitat for these species is likely to occur. **iii. Importance of habitat to be impacted** Although the habitat to be removed for these species on the site appears to support a population of these species, or at least part of a population, the high abundance of similar habitat in the locality means that it is of moderate importance to the long-term survival of these species in the locality. It is unlikely that the removal of the habitat for the Stage 2 Extension would affect the survival of these species in the locality.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	Under the TSC Act, the Director-General maintains a Register of critical habitat. To date, no critical habitat has been declared for any of these species.
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	No Recovery Plan exists for these species. No Threat Abatement Plans are relevant to the conservation of this species.
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	Section 5.1.2 describes the four KTPs that are likely to be exacerbated by the Stage 2 Extension: 1. Clearing of native vegetation; 2. Climate change (human-caused); 3. Loss of hollow-bearing trees; and 4. Removal of dead wood and dead trees. The KTPs relevant to these species are 1 and 2.

Powerful Owl *Ninox strenua*	
Assessment of Significance criteria (Seven Part Test)	**Address of criteria**
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	A single Powerful Owl was recorded within the proposed offset area in River Oak riparian forest along Coxs River. This would coincide with the expected habitat for the species within the locality. The occurrence is likely to represent a resident breeding pair somewhere in dense vegetation along the Coxs River and therefore constitute a viable local population. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It feeds mostly on arboreal mammals, especially possums and gliders, as well as flying-foxes, birds, and large insects. 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 would defend a large home range of 400-1450 ha. The species nests in large tree hollows (at least 0.5 m deep, but up to 1 m wide and 2 m deep), in large eucalypts (dbh of 80-240 cm) that are at least 150 years old. The occurrence of the species locally is in dense riparian forest along the Coxs River where large, mature, emergent eucalypts are present. The removal of 26.5 hectares of native vegetation containing approximately 471 hollow bearing trees within the higher parts of the site is only likely to represent foraging habitat for Powerful Owl, of which there is an abundance in the broader locality. Therefore, the action proposed is unlikely 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. Indeed 94.3 hectares of habitat which includes approximately 9 hectares of River Oak riparian forest, would form the proposed offset area and aid the long term conservation of habitat for the species 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	n/a
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	n/a

Powerful Owl *Ninox strenua*	
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.	**i. Extent of impact on habitat** Approximately 26.5 hectares of Dry Sclerophyll Forest foraging habitat for Powerful Owl would be removed as a result of the Stage 2 Extension. This represents a very small proportion of similar retained habitat within the locality. Furthermore, the proposed offset area provides 94.3 hectares of habitat for the species, of which approximately 9 hectares is good condition, intact, riparian forest along the Coxs River. **ii. Habitat fragmentation** The clearing of vegetation for the Stage 2 Extension is not expected to further fragment habitat or cause a barrier to movement for the species. The Stage 2 Extension expands an existing southern and western disturbed edge of a remnant area of habitat and therefore, no fragmentation of habitat for the species is likely to occur. **iii. Importance of habitat to be impacted** The removal of 26.5 hectares foraging habitat for the Powerful Owl is not considered important to the long term survival of the species within the locality given the absence of suitable roosting hollows and the abundance of similar habitat in the locality.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	Under the TSC Act, the Director-General maintains a Register of critical habitat. To date, no critical habitat has been declared for the Powerful Owl.
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	A recovery plan has been prepared for the Sooty Owl, Powerful Owl and Masked Owl together in the *Recovery Plan for the Large Forest Owls* (DECC 2006). The overall objective of the recovery plan is to ensure that viable populations of the three species continue in the wild in NSW in each region where they presently occur (DECC 2006). The specific objectives of this recovery plan are: ❒ Assess the distribution and amount of high quality habitat for each owl species across public and private lands to get an estimate of the number and proportion of occupied territories of each species that are, and are not, protected; ❒ To monitor trends in population parameters (numbers, distribution, territory fidelity and breeding success) across the range of the three species and across different land tenures and disturbance histories; ❒ To assess the implementation and effectiveness of forest management prescriptions designed to mitigate the impact of timber-harvesting operations on the three owl species and, (if necessary), to use this information to refine the prescriptions so that forestry activities on state forests are not resulting in adverse changes in species abundance and breeding success; ❒ Ensure the impacts on large forest owls and their habitats are adequately assessed during planning and environmental assessment processes. ❒ Minimise further loss and fragmentation of habitat by protection and more informed management of significant owl habitat (including protection of individual nest sites); ❒ To improve the recovery and management of the three large forest owls based on an improved understanding of key areas of their biology and ecology; ❒ To raise awareness of the conservation requirements of the three large forest owls amongst the broader community, to involve the community in owl conservation efforts and in so doing increase the information base about owl habitats and biology; and ❒ To coordinate the implementation of the recovery plan and continually seek to integrate actions in this plan with actions in other recovery plans or conservation initiatives. The Stage 2 Extension is not considered inconsistent with the objectives of the Recovery Plan for this species.

Powerful Owl *Ninox strenua*	
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	Section 5.1.2 describes the four KTPs that are likely to be exacerbated by the Stage 2 Extension: 1. Clearing of native vegetation; 2. Climate change (human-caused); 3. Loss of hollow-bearing trees; and 4. Removal of dead wood and dead trees. Reference is made to Powerful Owl in the Final Determinations for (1) and (3) above as a threatened species that is adversely affected by these KTPs. Amelioration of the impacts of the Stage 2 Extension has been described in Section 6. Furthermore, the proposed offset area provides 94.3 hectares of habitat for the species, of which approximately 9 hectares is good condition, intact, riparian forest along the Coxs River.

Gang-gang Cockatoo *Callocephalon fimbriatum*	
Assessment of Significance criteria (Seven Part Test)	**Address of criteria**
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	Gang-gang Cockatoo was only detected within the proposed offset area, though it reasonable to expect that it would utilised the parts of 26.5 hectares of native vegetation that would be removed by the Stage 2 Extension. It is considered unlikely that the observation was of an individual breeding within the BIA study area due to the lack of large old growth trees with hollows. The species favours old growth attributes for nesting and roosting and nest sites tend to be in the trunks, limbs or dead spouts of tall living trees, especially eucalypts, often near water. Gang-gangs feeds on seeds obtained in trees and shrubs, mostly from eucalypts and wattles, though it eats some seeds of introduced trees and shrubs around human settlements in winter, and also insect larvae (galls, sawflies). Given that habitat for this species is abundant in the locality and that suitable breeding habitat is unlikely to be impacted, the removal of 26.5 hectares of habitat for this species represents a very small proportion of that available foraging habitat in the locality. Therefore, it is unlikely that a viable local population of these species is likely to be placed at risk of extinction by the Stage 2 Extension. . Furthermore, the proposed offset area provides 94.3 hectares of habitat for the species, of which approximately 9 hectares riparian forest along the Coxs River, which represents potential breeding habitat.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	n/a
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: 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	n/a

Gang-gang Cockatoo *Callocephalon fimbriatum*	
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.	**i. Extent of impact on habitat** Approximately 26.5 hectares of Dry Sclerophyll Forest foraging habitat for Gang-gang Cockatoo would be removed as a result of the Stage 2 Extension. This represents a very small proportion of similar retained habitat within the locality. Furthermore, the proposed offset area provides 94.3 hectares of habitat for the species, of which approximately 9 hectares riparian forest along the Coxs River, which represents potential breeding habitat. **ii. Habitat fragmentation** The clearing of vegetation for the Stage 2 Extension is not expected to further fragment habitat or cause a barrier to movement for the species. The Stage 2 Extension expands an existing southern and western disturbed edge of a remnant area of habitat and therefore, no fragmentation of habitat for the species is likely to occur. **iii. Importance of habitat to be impacted** The removal of 26.5 hectares of foraging habitat for the Gang-gang Cockatoo is not considered important to the long-term survival of the species within the locality given the absence of suitable nesting hollows and the abundance of similar habitat in the locality. It is unlikely that the removal of the habitat for the Stage 2 Extension would affect the survival of this species in the locality.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	Under the TSC Act, the Director-General maintains a Register of critical habitat. To date, no critical habitat has been declared for the Gang-gang Cockatoo.
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	No Recovery Plan exists for this species. No Threat Abatement Plans are relevant to the conservation of this species.
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	Section 5.1.2 describes the four KTPs that are likely to be exacerbated by the Stage 2 Extension: 1. Clearing of native vegetation; 2. Climate change (human-caused); 3. Loss of hollow-bearing trees; and 4. Removal of dead wood and dead trees. Reference is only made to Gang-gang Cockatoo in the Final Determination for (3) above as a threatened species that is adversely affected by this KTP.

Little Lorikeet *Glosspsitta pusilla*	
Assessment of Significance criteria (Seven Part Test)	**Address of criteria**
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	Little Lorikeet was not detected within the BIA study area, although the likelihood of occurrence is high due to the presence of suitable habitat, and previous records within the locality. Little Lorikeets use tree hollows for nesting and feed mainly on pollen in forest and woodland. Vegetation clearing as part of the Stage 2 Extension would remove approximately 26.5 hectares of habitat suitable for foraging and nesting, however this represents a small proportion of similar retained habitat within the locality. This, as well as the mobile nature of the species, suggests that it is unlikely that the Stage 2 Extension would 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.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	n/a
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: 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	n/a
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.	**i. Extent of impact on habitat** Approximately 26.5 hectares of Dry Sclerophyll Forest foraging habitat for Little Lorikeet would be removed as a result of the Stage 2 Extension. This represents a very small proportion of similar retained habitat within the locality. Furthermore, the proposed offset area provides 94.3 hectares of habitat for the species. **ii. Habitat fragmentation** The clearing of vegetation for the Stage 2 Extension is not expected to further fragment habitat or cause a barrier to movement for the species. The Stage 2 Extension expands an existing southern and western disturbed edge of a remnant area of habitat and therefore, no further fragmentation of habitat for the species is likely to occur. **iii. Importance of habitat to be impacted** Given the extent of habitat for the species within the BIA study area and the broader locality, the importance of the habitat to be removed by the Stage 2 Extension to the long-term survival of the species is considered to be moderate.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	Under the TSC Act, the Director-General maintains a Register of critical habitat. To date, no critical habitat has been declared for the Little Lorikeet.

Little Lorikeet *Glosspsitta pusilla*	
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	A recovery plan has not been prepared for the Little Lorikeet, however the threatened species profile lists a number of priority actions to assist in the recovery of the species, none of which are relevant to the Stage 2 Extension. The Stage 2 Extension is not likely to interfere with the recovery of the Little Lorikeet.
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	Section 5.1.2 describes the four KTPs that are likely to be exacerbated by the Stage 2 Extension: 1. Clearing of native vegetation; 2. Climate change (human-caused); 3. Loss of hollow-bearing trees; and 4. Removal of dead wood and dead trees. The KTPs relevant to this species are 1 and 2.

Spotted-tailed Quoll *Dasyurus maculatus*	
Assessment of Significance criteria (Seven Part Test)	**Address of criteria**
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	The Spotted-tailed Quoll (STQ) was not detected within the BIA study area, although species records exist within adjacent areas and it is possible that the species would use the 26.5 hectares of vegetation to be directly impacted by the Stage 2 Extension. The species uses hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Some areas within the BIA study area had a high proportion of outcropping, embedded and loose surface rock, but good quality denning habitat was not identified in the form of caves and crevices. The BIA study area had habitat suitable for den sites in the form of hollow bearing trees and fallen logs. The species would also use this habitat for foraging. Vegetation clearing as part of the Stage 2 Extension would remove approximately 26.5 hectares of habitat suitable for foraging and den sites, however this represents a small proportion of similar retained habitat within the locality. This, as well as the absence of good quality caves and crevices within the BIA study area suggests that it is unlikely that the Stage 2 Extension would 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.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	n/a
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: 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	n/a

Spotted-tailed Quoll *Dasyurus maculatus*	
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.	**i. Extent of impact on habitat** Approximately 26.5 hectares of Dry Sclerophyll Forest foraging and marginal denning habitat for STQ would be removed as a result of the Stage 2 Extension. This represents a very small proportion of similar retained habitat within the locality. Furthermore, the proposed offset area provides 94.3 hectares of similar habitat for the species. **ii. Habitat fragmentation** The clearing of vegetation for the Stage 2 Extension is not expected to further fragment habitat or cause a barrier to movement for the species. The Stage 2 Extension expands an existing southern and western disturbed edge of a remnant area of habitat and therefore, no further fragmentation of habitat for the species is likely to occur. **iii. Importance of habitat to be impacted** Given the extent of habitat for the species within the BIA study area and the broader locality, and the absence of caves and crevices within the Stage 2 Extension impact area the habitat to be removed is not considered of low importance to the long term survival of the species within the locality.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	Under the TSC Act, the Director-General maintains a Register of critical habitat. To date, no critical habitat has been declared for the STQ.
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	The proposed action is not consistent with one objective of the recovery plan (Long & Nelson 2008), namely, to reduce the rate of habitat loss and fragmentation on private land. The remaining objectives of this recovery plan are: ❒ Determine the distribution and status of Spotted-tailed Quoll populations throughout the Range; ❒ Increase knowledge of the biology and ecology of the Spotted-tailed Quoll throughout its range to refine management of the species and its habitat; ❒ Evaluate and manage the risk posed by silvicultural practices; ❒ Determine and manage the threat posed by introduced predators (foxes, cats, wild dogs) and of predator control practices on Spotted-tailed Quoll populations; ❒ Determine and manage the impact of fire regimes on Spotted-tailed Quoll populations; ❒ Reduce deliberate killings of Spotted-tailed Quolls; ❒ Reduce the frequency of Spotted-tailed Quoll road mortality; ❒ Assess the threat Cane Toads pose to Spotted-tailed Quolls and develop threat abatement actions if necessary; ❒ Determine the likely impact of climate change on Spotted-tailed Quoll populations; and ❒ Increase community awareness of the Spotted-tailed Quoll and involvement in the Recovery Program.
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	Section 5.1.2 describes the five KTPs that are likely to be exacerbated by the Stage 2 Extension: 1. Clearing of native vegetation (26.5 hectares); 2. Climate change (human-caused); 3. Removal of bush rock; 4. Loss of hollow-bearing trees; and 5. Removal of dead wood and dead trees. The KTPs relevant to this species are 1, 2, 4 and 5.

***Petaurus norfolcensis* (Squirrel Glider)**	
Description The Squirrel Glider is listed as vulnerable on the TSC Act and is not listed on the EPBC Act. Endangered populations for the species, as listed on the TSC Act, exist for the species in the Wagga Wagga and Pittwater LGAs. Within NSW, Squirrel Glider is found along the entirety of the coastal plain, ranges and western slopes of NSW in dry sclerophyll forest and adjacent riparian corridors and also damp coastal eucalypt and banksia forest (Menkhorst and Knight 2001). Records diminish further to the west and into the western plains (roughly west of a line from Texas on the QLD border to Pilliga, Dubbo and then Euchla along the Murray River (Atlas of NSW Wildlife 2014).	
Assessment of Significance criteria (the Seven Part Test)	**Address of criteria**
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	**Life cycle of the species** (from OEH 2014) West of the Great Dividing Range, the Squirrel Glider requires abundant tree hollows in mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest for refuge and nest sites. Births occur between March and November with females occasionally breeding twice a year. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein. Mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest do not exist within the study area. **Viable local population** The species was not detected within the study area during the surveys conducted by Niche and the nearest record is of a single individual approximately eight kilometres to the east, at Mt Victoria in 1986 (Atlas of NSW Wildlife 2014) and is clearly associated with a wider population that exists within the Blue Mountains. The Atlas of NSW Wildlife also shows that, other than a single record from just south of the Mt Canobolas State Forest in 2002, the Austen Quarry site sits largely within a 'shadow' region of records for Squirrel Glider west of the dividing range from Mt Victoria west to Parkes (approximately 190 kilometres) and roughly from Dubbo south to Cooma (approximately 450 kilometres). Therefore, it is considered unlikely that a viable local population of the Squirrel Glider exists within the study area or broader locality. **Assessment** Key refuge and nesting habitat in the form of mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest does not exist within the study area, Squirrel Glider was not detected during the field surveys by Niche and the Atlas of NSW Wildlife (2014) shows that a viable population of the species is unlikely to exist regionally, let alone locally. Therefore, the action proposed is considered unlikely 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.
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 e more extinction	N/A

***Petaurus norfolcensis* (Squirrel Glider)**	
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	N/A
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.	**Extent of habitat** West of the Great Dividing Range, the Squirrel Glider requires abundant tree hollows in mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest for refuge and nest sites (OEH 2014). Whilst none of this key breeding habitat is present within the study area and a viable local population is unlikely to exist (see Part A above), the species could be said to have potential habitat in the form of foraging habitat in the dry eucalypt forest and woodland on the site. Approximately 26.5 hectares of potential dry sclerophyll foraging habitat will be removed by the proposed development and a further 2.5 hectares will be indirectly impacted through edge effects. Edge effects are not likely to affect Squirrel Glider in this instance given the likely absence of a viable local population. The adjacent conservation area will reserve 83.9 hectares of potential habitat and will be managed and secured in perpetuity. **Fragmentation** The Stage 2 Extension expands an existing southern and western disturbed edge of a remnant area of habitat and therefore, no additional habitat fragmentation or isolation for the species is likely to occur. **Importance of habitat** The Stage 2 Extension will result in the removal of 26.5 hectares of potential foraging habitat for Squirrel Glider. Despite this, it is considered that the habitat to be impacted within the site is unlikely to be important to the long-term survival of the Squirrel Glider in the locality for the following reasons: ❑ The absence of key breeding habitat in the form of mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest; ❑ The likely absence of a viable local population; and ❑ The potential habitat for the species will not be fragmented or isolated by the proposal.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	No areas of critical habitat for the Squirrel Glider have been recommended or declared in NSW.
f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or TAP	There is currently no recovery plan or TAP for the Squirrel Glider.
g) Whether the action proposed constitutes or is part of a KTP or is likely to result in the operation of, or increase the impact of, a KTP	Section 5.1.2 describes the four KTPs that are likely to be exacerbated by the Stage 2 Extension: ❑ Clearing of native vegetation; ❑ Climate change (human-caused); ❑ Loss of hollow-bearing trees; and ❑ Removal of dead wood and dead trees. Squirrel Glider is listed under (1), (3) and (4) above.

***Petaurus norfolcensis* (Squirrel Glider)**
Conclusion: The proposed Stage 2 Extension is unlikely to have a significant impact on Squirrel Glider for the following reasons: ❑ The absence of key breeding habitat in the form of mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest; ❑ The likely absence of a viable local population as the species was not detected during field surveys and is mostly absent within the locality and region (Atlas of NSW Wildlife 2014); ❑ The habitat to be impacted within the site is unlikely to be important to the long-term survival of the Squirrel Glider in the locality; and ❑ The potential habitat for the species will not be fragmented or isolated by the proposal.

Appendix 11: EPBC Act Significant Impact Criteria

Definitions

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

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

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

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

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

Vulnerable species

***Eucalyptus pulverulenta* (Silver-leaved Mountain Gum)**		
The local population of *Eucalyptus pulverulenta* is estimated by Niche, as a result of extensive surveys, at 3,612 individuals and is composed of: • 90 individuals impacted by the Stage 2 development in remnant non-core habitat; • 631 planted individuals impacted by the Stage 2 development in existing rehabilitation areas; • 1,850 individuals in remnant bushland that would be conserved in the adjacent offset area as a result of the Stage 2 Extension (1,718 individuals in core habitat areas); • 286 individuals in an area of core habitat that are currently managed in Conservation Area H on the site as a part of a previous approval; and • 755 individuals that were planted in rehab areas throughout the site. The local population also includes 279 individuals within remnant areas on the northern edge of the existing Stage 1 extraction area. It is assumed that these plants have been approved for removal and therefore have not been included as a part of the local population for the purposes of this assessment. This population is considered to be an important population under the EPBC Act.		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
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 local population of *Eucalyptus pulverulenta* would be reduced by: • 90 individuals impacted by the Stage 2 development in remnant non-core habitat; and • 631 planted individuals impacted by the Stage 2 development in existing rehabilitation areas. This impact amounts to 20 per cent of the local population and would lead to a long-term decrease in the size of an important population of a species.	Likely
• reduce the area of occupancy of an important population	Approximately 15.6 hectares of non-core natural habitat for the species would be impacted by the Stage 2 Extension within the Brittle Gum - Broad-leaved Peppermint open forest vegetation unit. Within this impacted area 90 individuals of the species would be removed. An additional 631 planted individuals which occupy 3.54 hectares of rehabilitation would also be removed. Therefore, the Stage 2 Extension would reduce the area of occupancy of an important population. Within the proposed offset area 132 individuals would be conserved in non-core habitat areas and 1,718 within core habitat areas dominated by the species.	Likely
• fragment an existing important population into two or more populations	The Stage 2 Extension expands an existing southern and western disturbed edge of a remnant area of habitat and therefore, no fragmentation of an existing important population of the species is likely to occur.	Unlikely
• adversely affect habitat critical to the survival of a species	No Critical Habitat as listed on the EPBC Act exists for this species. Whilst the size and area of occupancy of an important population of the species would be reduced, all critical habitat for the species locally, 2.8 hectares of core habitat, would be conserved, secured and managed in perpetuity.	Unlikely

***Eucalyptus pulverulenta* (Silver-leaved Mountain Gum)**		
• disrupt the breeding cycle of an important population	Benson and McDougall (1998) describe *Eucalyptus pulverulenta* as potentially being reproductively mature with a completely 'juvenile' crown. This suggests the species flowers and fruits within a few years of germination and establishment. The species has a longevity of more than 100 years and it resprouts after fire from a lignotuber and epicormic buds (Benson and McDougall 1998). The species is self-sterile (Benson and McDougall 1998), meaning individual plants cannot pollinate themselves, thus guaranteeing genetic outcrossing. Seed is dispersed locally by wind or gravity and Crimson Rosella feed on the fruit (Benson and McDougall 1998). Apart from the removal of 20 per cent of the local population, the Stage 2 Extension would not directly impact on any of the life cycle factors described above. It is considered unlikely that the Stage 2 Extension would disrupt the breeding cycle of an important population. Indeed, the Stage 2 Extension would result in a managed and secure in-perpetuity offset of 1,850 individuals in remnant on-site populations (i.e., not planted in rehabilitation areas) and therefore lead to an 'improve or maintain' outcome for the species.	Unlikely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Approximately 15.6 hectares of non-core natural habitat for the species would be impacted by the Stage 2 Extension within the Brittle Gum - Broad-leaved Peppermint open forest vegetation unit. Within this impacted area, 90 individuals of the species would be removed. An additional 631 planted individuals which occupy 3.54 hectares of rehabilitation would also be removed. Therefore, the Stage 2 Extension would decrease the availability and quality of habitat. However, due to the offsetting strategy proposed, this would not occur to the extent that the species is likely to decline. The provision of a managed and secured in-perpetuity offset for the species, which contains an important area of core habitat containing 1,718 individuals, would mean that habitat for the species is protected and managed in-perpetuity.	Unlikely
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	A series of amelioration measures and on-site management actions, including weed management, would mitigate against any indirect impacts associated with the Stage 2 Extension (e.g., the introduction of invasive species).	Unlikely
• introduce disease that may cause the species to decline, or	A series of amelioration measures and on-site management actions would mitigate against any indirect impacts associated with the Stage 2 Extension (e.g., the introduction of disease).	Unlikely
• interfere substantially with the recovery of the species.	No Recovery Plan exists for this species. The habitat removed is important habitat for the species. However, in the context of the provision of a managed and secured in-perpetuity offset for the species, which contains an important area of core habitat containing 1,718 individuals, the habitat to be impacted is of relatively less importance to the long-term survival of the species than that contained within the proposed offset area. The long-term survival of the species within the locality would be assured through the protection of the individuals within the adjacent offset area.	Unlikely
Conclusion: Given the offsetting strategy proposed and the results from the EPBC Offsets Calculator, the proposed action is unlikely to have a significant impact on *Eucalyptus pulverulenta*. Based on the EPBC Offset Policy he offset provided would offset the species to the tune of 244 per cent, well above the 100 per cent required. The proposed offset area would be managed and secured in-perpetuity.		

***Pteropus poliocephalus* (Grey-headed Flying-fox)**		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
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	Grey-headed Flying-fox (GHFF) were not recorded during field survey, and no Atlas records exist of this species within 10 km of the BIA study area. GHFF are a conspicuous species when present, roosting in large colonies (camps), and calling at night during foraging (DECCW 2009b). GHFF's also have a high fidelity to roost sites, returning to the same location seasonally each year (DECCW 2009b). Potential roosting and foraging habitat does occur within the BIA study area, but it is unlikely that an important population exists within the impact area due to the absence of records. Individual's mays utilise available foraging habitat within the BIA study area. Any potential impacts to individuals would predominantly be via vegetation clearing. GHFF are highly mobile and any individuals utilising the BIA study area have the capacity to move to adjacent habitat. The removal of vegetation within the BIA study area constitutes a negligible area of available foraging habitat for the species compared with similar or better quality habitat within the locality. There is also the potential of sporadic death and injury to occur through electrocution and ensnarement in barbed-wire (OEH 2014). Barbed-wire should not be used at any time during construction or post-construction activities as its use would increase the risk of mortality or injury to GHFF or other animals through ensnarement. The Stage 2 Extension is unlikely to lead to a long-term decrease in the size of any population of GHFF.	Unlikely
• reduce the area of occupancy of an important population	The removal of vegetation for the Stage 2 Extension is not considered likely to cause a decline in the abundance of GHFF, as it is unlikely that an important population is dependent on the resources available within the BIA study area. As such, there would be no reduction in area of occupancy for an important population of the species.	Unlikely
• fragment an existing important population into two or more populations	The GHFF is a highly mobile species known to move through disturbed and urban environments. The clearing of vegetation for the Stage 2 Extension is not expected to further fragmentation or cause a barrier to movement for the species.	Unlikely

***Pteropus poliocephalus* (Grey-headed Flying-fox)**		
• adversely affect habitat critical to the survival of a species	Critical foraging habitat identified under the national recovery plan for the species is as follows: • productive during winter; • within 50 kilometres of a population of GHFF that can at times number 30,000 individuals; • productive from September to May; and • supports a continuously occupied camp. It is unlikely that a camp of GHFF occurs within 50 kilometres of the BIA study area due to the absence of Atlas records within this area. Dominant trees flowering through winter or between September and May do occur within the BIA study area, and therefore constitute critical habitat for any GHFF present. The habitat within the BIA study area constitutes a very small proportion of that available within the locality and is not considered a key component of that habitat as would be represented by areas along recognised foraging routes or within the immediate vicinity of known roosts. As such, it is considered that removal of the vegetation within the subject site, and any indirect impacts of the Stage 2 Extension, are not of sufficient magnitude to adversely affect habitat critical to the survival of the species.	Unlikely
• disrupt the breeding cycle of an important population	It is unlikely that a maternity camp site occurs within 10 km of the BIA study area due to an absence of species records. Therefore, mating, birthing and raising of juveniles is unlikely to be impacted by the Stage 2 Extension. As such, disruption of the breeding cycle of a GHFF population is not considered a likely outcome of the Stage 2 Extension.	Unlikely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Approximately 26.5 hectares of native vegetation would be removed or modified as a result of the Stage 2 Extension. This represents a very small proportion of similar retained habitat within the locality. The removal of such habitat on the scale proposed is unlikely to cause the species to decline.	Unlikely
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	There is some chance that invasive species may increase within the BIA study area due to the disturbance caused by the Stage 2 Extension, however this would have limited impacts on the quality of foraging habitat for the GHFF. The study site currently has a high level of disturbance, including invasive species. Additionally, weed management measures would be incorporated into environmental management of the site.	Unlikely
• introduce disease that may cause the species to decline, or	The Stage 2 Extension is not likely to result in the introduction or spread of diseases known to impact the GHFF.	
• interfere substantially with the recovery of the species.	The Stage 2 Extension is considered unlikely to interfere substantially with the recovery of the species as it is sufficiently distant (10.5 km) from the nearest known roosting habitat and would remove a very small area of foraging habitat.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on the Grey-headed Flying-fox.		

***Phascolarctos cinereus* (Koala)**		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
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 Koala was not recorded during field surveys and detailed studies of the lower Blue Mountains area have failed to identify a population of Koala within this region, despite suitable habitat (DECC 2008b). Two Atlas records of individuals occur within 10 km of the BIA study area, but it is likely these are records of individuals dispersing from known northern Blue Mountains populations. Given the lack of records, it is unlikely that an important population occurs within the BIA study area. The major threat to the Koala in NSW is habitat loss (NRMMC 2009). Impacts associated with vegetation clearing may affect individuals present within the BIA study area, but it is unlikely that the Stage 2 Extension would lead to a long-term decrease in the size of a population.	Unlikely
• reduce the area of occupancy of an important population	The removal of vegetation for the Stage 2 Extension is not considered likely to cause a decline in the abundance of Koala, as it is unlikely that an important population is dependent on the resources available within the BIA study area. As such, there would be no reduction in area of occupancy for an important population of the species.	Unlikely
• fragment an existing important population into two or more populations	The Stage 2 Extension may impact individual Koala dispersal reducing the width of vegetation (corridor) between suitable areas of habitat. However, the clearing of vegetation for the Stage 2 Extension does not create a barrier and is not expected to further fragmentation or cause a barrier to movement for the species within an important population.	Unlikely
• adversely affect habitat critical to the survival of a species	Identified Koala feed trees such as *Eucalyptus tereticornis* and *E. mannifera* occur within the BIA study area, and constitute potential habitat for the species (DECC 2008b). It is unlikely that the habitat is critical to the survival of the species as a Koala population is not currently dependant on the resources within the BIA study area, reflected by the lack of species records despite targeted survey.	Unlikely
• disrupt the breeding cycle of an important population	An important population of Koala has not been identified within the locality, and It is unlikely that the Koala occurs in any great number within the BIA study area. As such, disruption of the breeding cycle of a Koala population is not considered a likely outcome of the Stage 2 Extension.	Unlikely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Approximately 17.3 hectares of Brittle Gum and 4.4 hectares of Forest Red Gum would be removed or modified as a result of the Stage 2 Extension. This represents a very small proportion of similar retained habitat within the locality. The removal of such habitat on the scale proposed is unlikely to cause the species to decline.	Unlikely
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	There is some chance that invasive species may increase within the BIA study area due to the disturbance caused by the Stage 2 Extension, but this would have limited impacts on the quality of habitat for the Koala. Additionally, weed management measures would be incorporated into environmental management of the site.	Unlikely
• introduce disease that may cause the species to decline, or	The Stage 2 Extension is not likely to result in the introduction or spread of diseases known to impact the Koala.	Unlikely

***Phascolarctos cinereus* (Koala)**		
• interfere substantially with the recovery of the species.	The Stage 2 Extension is considered unlikely to lead to a substantial interference with the recovery of the species as an important population is unlikely to occur within the BIA study area or locality. The vegetation removal proposed would constitute the removal of a small area of suitable Koala habitat, but it is unlikely to be habitat critical to the survival of any nearby populations.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on the Koala.		

***Chalinolobus dwyeri* (Large-eared Pied Bat)**		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
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 Large-eared Pied Bat (LEPB) was detected within the BIA study area during field survey. No Atlas records of this species exist within 10 km of the BIA study area, suggesting limited data on this species within the locality. The species roosts in caves and crevices in cliffs, as well as mine shafts and disused Fairy Martin nests (OEH 2014). Some areas within the BIA study area had a high proportion of outcropping, embedded and loose surface rock, but good quality roosting habitat was not identified in the form of caves and crevices. A key threat to the species is removal of vegetation adjacent to diurnal roosting sites, in particular maternity roosts (SEWPaC 2011). Vegetation clearing as part of the Stage 2 Extension would remove some foraging habitat for this species, but this represents a small proportion of similar retained habitat within the locality. This, as well as the absence of roosting habitat within the BIA study area suggests that it is unlikely that a significant population of LEPB would be impacted by the Stage 2 Extension.	Unlikely
• reduce the area of occupancy of an important population	The removal of vegetation for the Stage 2 Extension is unlikely to cause a decline in the abundance of LEPB, as it is unlikely that an important population is dependent on the resources available within the BIA study area. As such, there would be no reduction in area of occupancy for the species.	Unlikely
• fragment an existing important population into two or more populations	The clearing of vegetation for the Stage 2 Extension is not expected to further fragmentation or cause a barrier to movement for the LEPB, as the species is highly mobile.	Unlikely
• adversely affect habitat critical to the survival of a species	The LEPB is dependent on diurnal roosts with adjacent foraging habitat. Although suitable roosting habitat was not located within the BIA study area, it is likely that the species roosts within the locality and utilises the BIA study area for foraging. As such, foraging habitat adjacent to roost sites may be impacted by the Stage 2 Extension, however this represents a small proportion of available habitat within the locality. Therefore, it is considered that removal of the vegetation within the subject site, and any indirect impacts of the Stage 2 Extension, are unlikely to be of sufficient magnitude to adversely affect habitat critical to the survival of the species.	Unlikely
• disrupt the breeding cycle of an important population	Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years (OEH 2014). The structure of maternity roosts appears to be very specific (arch caves with dome roofs) (SEWPaC 2011). Such maternity roosts may occur outside of the BIA study area but would not be impacted by the Stage 2 Extension. As such, it is unlikely that the Stage 2 Extension would impact a maternity roost and so disrupt the breeding cycle of the species within the locality.	Unlikely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Approximately 38.1 hectares of vegetation and suitable foraging habitat for the LEPB would be removed or modified as a result of the Stage 2 Extension. This represents a small proportion of similar retained habitat within the locality. The removal of such habitat on the scale proposed is unlikely to cause the species to decline.	Unlikely

***Chalinolobus dwyeri* (Large-eared Pied Bat)**		
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	There is some chance that invasive species may increase within the BIA study area due to the disturbance caused by the Stage 2 Extension, but this would have limited impacts on the quality of habitat for the LEPB. Additionally, weed management measures would be incorporated into environmental management of the site.	Unlikely
• introduce disease that may cause the species to decline, or	The Stage 2 Extension is not likely to result in the introduction or spread of diseases known to impact the LEPB.	Unlikely
• interfere substantially with the recovery of the species.	The Stage 2 Extension is considered unlikely to lead to interfere substantially with the recovery of the LEPB. An important population may occur within locality and utilise foraging habitat within the BIA study area and project area. The vegetation removal proposed would constitute the removal of a small area of suitable LEPB habitat, but it is unlikely to be habitat critical to the survival of any nearby populations.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on the Large-eared Pied Bat.		

Endangered species

Spotted-tailed Quoll (*Dasyurus maculatus*)		
Criteria (Endangered and Critically Endangered Species)	**Address of Criteria**	**Likelihood**
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 Spotted-tailed Quoll (STQ) was not recorded during field survey, however many recent records exist east and west of the BIA study area within connected bushland. The species uses hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Some areas within the BIA study area had a high proportion of outcropping, embedded and loose surface rock, but good quality denning habitat was not identified in the form of caves and large crevices. The BIA study area had habitat suitable for den sites in the form of hollow bearing trees and fallen logs. The species may also use this habitat for foraging. Vegetation clearing as part of the Stage 2 Extension would remove approximately 26.5 hectares (native vegetation and rehabilitation areas) of potential habitat suitable for foraging and den sites, but this represents a small proportion of similar retained habitat within the locality. This, as well as the absence of good quality caves and crevices within the BIA study area suggests that the Stage 2 Extension is unlikely to lead to a long-term decrease in the size of a population of the species.	Unlikely
• reduce the area of occupancy of the species	The removal of vegetation for the Stage 2 Extension is unlikely to cause a decline in the abundance of STQ, as it is unlikely that an important population is dependent on the resources available within the BIA study area. As such, there would be no reduction in area of occupancy for the species.	Unlikely
• fragment an existing population into two or more populations	The Stage 2 Extension may impact individual STQ dispersal by reducing the width of vegetation (corridor) between suitable areas of habitat. However, the clearing of vegetation for the Stage 2 Extension does not create a barrier and is not expected to further fragmentation or cause a barrier to movement for the species within an important population.	Unlikely
• adversely affect habitat critical to the survival of a species	No critical habitat has been listed for the species on the EPBC Act Register of Critical Habitat. Given that STQ home ranges are between 750 hectares and 3,500 hectares (for females and males respectively), the removal of 26.5 hectares of potential habitat represents a very small proportion of that available in the locality. Given that limited denning habitat is available in the BIA study area and that only a small proportion of potential foraging habitat would be impacted, it is unlikely that the Stage 2 Extension would affect habitat critical to the survival of the species.	Unlikely
• disrupt the breeding cycle of a population	The species uses hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Average litter size is five; sexual maturity is reached at about one year of age. The Stage 2 Extension is unlikely to disrupt the breeding cycle of a local population of the species as there is an absence of good quality caves and crevices for denning within the project area. Any den habitat that does exist within the BIA study area would represent a small proportion of similar or better quality habitat retained within the locality.	Unlikely

Spotted-tailed Quoll (*Dasyurus maculatus*)		
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Approximately 26.5 hectares of vegetation and suitable foraging habitat for the STQ would be removed or modified as a result of the Stage 2 Extension. This represents a small proportion of similar retained habitat within the locality. The removal of such habitat on the scale proposed is unlikely to cause the species to decline.	Unlikely
• result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Critically Endangered or Endangered species' habitat	It is unlikely that the Stage 2 Extension would result in the establishment of invasive species in STQ habitat, particularly given that the site would have a weed management plan implemented.	Unlikely
• introduce disease that may cause the species to decline, or	It is unlikely that the Stage 2 Extension would result in the introduction of a disease that may cause the species to decline.	Unlikely
• interfere substantially with the recovery of the species.	The Stage 2 Extension is considered highly unlikely to interfere substantially with the recovery of the STQ. An important population may occur within locality and utilise foraging habitat within the BIA study area. The vegetation removal proposed constitutes a small area of suitable STQ habitat, but it is unlikely to be habitat critical to the survival of any nearby or present populations.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on the Spotted-tailed Quoll.		

Migratory species

Migratory Birds – Fork-tailed Swift (*Apus pacificus*), Rainbow Bee-eater (*Merops ornatus*), Satin Flycatcher (*Myiagra cyanoleuca*) and White-throated Needletail (*Hirundapus caudacutus*)		
Criteria (Migratory Species)	**Address of Criteria**	**Likelihood**
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:		
• substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an important area of habitat for a migratory species.	The impact of the Stage 2 Extension may reduce potential habitat by 26.5 hectares. It is unlikely that the loss of potential habitat within the project area would reduce the area of important habitat for a population of any of these bird species. Whilst the Stage 2 Extension would reduce the width of vegetation (corridor) between areas of habitat, these species are highly mobile and therefore unlikely to be impacted by fragmentation. It is unlikely that the Stage 2 Extension would substantially modify, destroy or isolate an important area of habitat for any of these species.	Unlikely
• seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecological significant proportion of the population of a migratory species.	The Stage 2 Extension is unlikely to disrupt the lifecycle of an important population as none of these species are likely to have ecologically significant proportions of the population reliant upon the project area. The species' are mobile and likely to move to and utilise other areas of potential habitat. Fork-tailed Swift and White-throated Needletail do not breed in Australia. Forging capacity of these species is not likely to be impacted by the Stage 2 Extension to the extent that migration and breeding would be affected.	Unlikely
• result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	There is the potential for the Stage 2 Extension to result in an increase in invasive species such as introduced weeds into adjacent habitat. However, mitigation measures such as the implementation of a weed management plan are proposed. This would reduce the potential for any impacts of the habitat of the species.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on the Fork-tailed Swift, Rainbow Bee-eater, Satin Flycatcher or White-throated Needletail.		

Appendix 12: Development Site Full Credit Report and Full Credit Extract

BioBanking Credit Calculator

Ecosystem credits

Proposal ID :	0047/2012/0076D
Proposal name :	Austen Quarry Extraction Extension
Assessor name :	Nathan Smith
Assessor accreditation number :	0047
Tool version :	v2.1
Report created :	07/01/2014 15:01

Assessment circle name	Landscape Score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for biodiversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
Circle 1	16.10	HN570_Moderate/Good	Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest of the tablelands, South Eastern Highlands	Moderate/Good	No	MZ1	17.30	78.65	0.00	78.65	410	604	Greater Broad-nosed Bat	55.56	0.45	604
Circle 1	16.10	HN570_Moderate/Good	Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest of the tablelands, South Eastern Highlands	Moderate/Good	No	MZ2	1.30	78.65	65.15	13.50	16	9	Grey-headed Flying-fox	0.00	0.92	15
Circle 1	16.10	HN527_Moderate/Good	Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands	Moderate/Good	No	mz5	4.40	63.53	0.00	63.53	90	123	Greater Broad-nosed Bat	44.44	0.45	123
Circle 1	16.10	HN527_Moderate/Good	Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands	Moderate/Good	No	mz6	0.80	63.53	54.83	8.70	5	3	Grey-headed Flying-fox	0.00	0.92	5
Circle 1	16.10	HN501_Moderate/Good	Apple Box - Broad-leaved Peppermint dry open forest of the Abercrombie-Tarlo area, South Eastern Highlands	Moderate/Good	No	mz3	4.80	68.23	0.00	68.23	97	145	Greater Broad-nosed Bat	50.00	0.45	145
Circle 1	16.10	HN501_Moderate/Good	Apple Box - Broad-leaved Peppermint dry open forest of the Abercrombie-Tarlo area, South Eastern Highlands	Moderate/Good	No	mz4	0.40	68.23	64.06	4.17	2	2	Grey-headed Flying-fox	0.00	0.93	2

BioBanking Credit Calculator

Species credits

Office of Environment & Heritage

Proposal ID :	0047/2012/0076D
Proposal name :	Austen Quarry Extraction Extension
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Tool version :	v2.1
Report created :	07/01/2014 15:01

Scientific name	Common name	Species TG value	Identified population?	Can Id. popn. be offset?	Area / number of loss	Negligible loss	Red flag status	Number of credits
Eucalyptus pulverulenta	Silver-leafed Gum	0.65	No		721.00	5.00	Yes	11,092

Appendix 13: BioBank Site Full Credit Report and Full Credit Extract

BioBanking Credit Calculator

NSW GOVERNMENT Office of Environment & Heritage

Ecosystem credits

Proposal ID :	0047/2012/0101B
Proposal name :	Austen Quarry Offset Site
Assessor name :	Nathan Smith
Assessor accreditation number :	0047
Tool version :	v2.1
Report created :	07/01/2014 14:59

Assessment circle name	Landscape score	TS subzone number	Vegetation zone name	Vegetation type name	Condition	Management zone name	Management zone area	Current site value	Future site value	Gain in site value	Total credit created for management zone
A	15.60	ts3	HN527_Moderate/Good_High	Forest Red Gum - Yellow Box woodland of dry gorge slopes southern Sydney Basin and South Eastern Highlands	Moderate/Good_High	VZ3	22.89	51.45	83.09	31.64	299
A	15.60	ts2	HN570_Moderate/Good_Other	Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest of the tablelands South Eastern Highlands	Moderate/Good_Other	VZ2	1.00	50.52	66.40	3.00	15
A	15.60	ts4	HN527_Moderate/Good_Medium	Forest Red Gum - Yellow Box woodland of dry gorge slopes southern Sydney Basin and South Eastern Highlands	Moderate/Good_Medium	VZ4	3.00	57.97	80.68	22.71	9
A	15.60	ts5	HN527_Low	Forest Red Gum - Yellow Box woodland of dry gorge slopes southern Sydney Basin and South Eastern Highlands	Low	VZ5	3.70	9.42	38.41	28.99	110
A	15.60	ts6	HN574_Moderate/Good_High	River Oak open forest of major streams Sydney Basin and South East Corner	Moderate/Good_High	VZ6	10.49	57.25	75.10	18.85	103
A	15.60	ts7	HN527_Moderate/Good_Other	Forest Red Gum - Yellow Box woodland of dry gorge slopes southern Sydney Basin and South Eastern Highlands	Moderate/Good_Other	VZ7	2.40	79.71	91.80	11.50	27
A	15.60	ts1	HN570_Moderate/Good_High	Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest of the tablelands South Eastern Highlands	Moderate/Good_High	VZ1	48.30	78.65	92.72	15.10	446

BioBanking Credit Calculator

NSW GOVERNMENT | Office of Environment & Heritage

Species credits

Proposal ID :	0047/2012/0101B
Proposal name :	Austen Quarry Offset Site
Assessor name :	Nathan Smith
Assessor accreditation number :	0047
Tool version :	v2.1
Report created :	07/01/2014 14:59

Scientific name	Common name	Species TG value	Biobank on identified population?	Number Units found?	Number of credits
Eucalyptus pulverulenta	Silver-leafed Gum	0.65	No	1,850.00 indiv	11,100

Appendix 14: Application of the SSD offsetting policy to ecosystem credits

Niche veg	Proposed offset (ha)	Credits Created; all veg	Impact Area (ha)	Credits Required	BVT_Code	BVT_Name	Keith Formation	Credits Created; RBVT total	Credits Required; RBVT total	Credit Status; RBVT	Credit Status; Keith Formation
c4: Rough-barked Apple gully forest	2.4	21	0.0	0	HN527	Forest Red Gum - Yellow Box woodland of dry gorge slopes	Dry Sclerophyll Forests	439	134	305	146
c3b: Forest Red Gum exotic grassland	9.7	110	0.0	0							
c3a: Forest Red Gum native grassland	0.8	9	0.0	0							
c3: Forest Red Gum grassy open forest	22.8	299	5.2	134							
c1: Brittle Gum - Broad-leaved Peppermint open forest	46.3	446	18.6	620	HN570	Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest		461	620	-159	0
c2: Silver-leaved Mountain Gum mallee woodland	1.9	15	0.0	0							
c5: Stringybark - Apple Box open forest	0.0	0	5.2	148	HN501	Apple Box - Broad-leaved Peppermint dry open forest	Grassy Woodlands	0	148	-148	-148
c6: River Oak riparian open forest	10.4	103	0.0	0	HN574	River Oak open forest	Forested Wetlands	103	0	103	103
	94.30	**1,003**	**29.00**	**902**				**1,003**	**902**	**Surplus credits**	**101**

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