APPENDIX D

BIODIVERSITY ASSESSMENT REPORT

APPENDIX D

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Peppertree Quarry Modification 4

Biodiversity Assessment Report

Prepared for Boral Resources (NSW) Pty Ltd

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Cover photograph: study area for the Peppertree Quarry Modification 4 site

Executive summary

Context

Boral Resources (NSW) Pty Ltd (Boral) owns and operates the Peppertree Quarry (the Quarry), a hard rock quarry located in Marulan South, NSW. Boral is seeking to modify the current Project Approval (PA 06_0074) under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act), to provide for the following (hereafter referred to as the Project):

- Establish an additional overburden emplacement area to the south of the existing approved eastern overburden emplacement area which would operate in accordance with the Project Approval i.e. 7.00am to 7.00pm;
- Extend the operating hours for in-pit works (currently approved from 7.00am to 7.00pm) by six hours. The new operating hours for in-pit works would be from 5am to 11pm, therefore occurring in the evening and night time periods.

The modification proposed above will constitute Modification 4 to the current Project Approval. The Minister for Planning is the consent authority for the proposed modification.

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Boral to assess the ecological values and impacts associated with the Peppertree Quarry MOD4 Project, and provide a Biodiversity Assessment Report (BAR). This BAR has applied the Framework for Biodiversity Assessment (FBA) to describe and assess the ecological values within the study area and surrounds, and determine how the Project is likely to have an impact on threatened biodiversity listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act). This report also assessed the potential impacts of the Project on Matters of National Environmental Significance (MNES) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This assessment has been completed using the BioBanking Credit Calculator (BBCC) Version 2.0 [14 September 2015] and relevant updates that accompany Version 4.0 of the BBCC.

The assessment has focused on potential impacts associated with establishing an additional overburden emplacement, as it was ascertained through specialist investigations that the extension in operating hours for in-pit works is unlikely to result in any additional impacts on biodiversity than the approved quarry operations as extending the operating hours for in-pit works is unlikely to result in any substantial or perceptible change in:

- Noise levels emitted from the Quarry.
- Dust emissions from the Quarry.
- Light spill from the Quarry.

Study area

The study area is approximately 12.9 ha, consisting of highly disturbed paddock vegetation (containing scattered native trees and native ground cover) and exotic pasture grasses. A number of small farm dams also occur. Much of the site is currently grazed by cattle.

The study area includes the disturbance footprint of the proposed southern overburden emplacement as well as associated haul roads and sediment basins.

The study area occurs within the South Eastern Highlands Interim Biogeographic Regionalisation for Australia (IBRA) region, and within the Bungonia IBRA subregion. One Mitchell landscape occurs across the study area: Bungonia Tableland and Gorge.

No riparian buffers, State Biodiversity Links or Regional Biodiversity Links occur within the study area.

Survey effort

A survey was carried out by a botanist and ecologist from the 19th to the 21st of May 2015. The survey effort involved the following:

- BioBanking plots and transects as per the FBA with additional information recorded (abundance, structure etc.) on the basis of current best practice flora survey guidelines for an assessment of a large site, particularly OEH's Working Draft *Threatened Biodiversity Survey and Assessment – Guidelines for Developments and Activities* (DEC 2004).
- Random meanders for threatened flora.
- Fauna survey including: Ultrasonic call recording for bats, diurnal bird surveys, spotlighting, call playback and listening, frog chorus survey and aquatic habitat surveys, stag watching, Koala Spot assessments and opportunistic survey.

Native vegetation assessment

Vegetation within the study area has been mapped previously as part of the Native Vegetation of South Eastern NSW (Tozer et al. 2006). Vegetation validation of this mapping was undertaken. The validation confirmed that the study area contained one exotic vegetation type, and one native vegetation community – Blakely's Red Gum – Yellow Box – Grassy open woodland. This community aligns to the Plant Community Type (PCT) SR670 Yellow Box grassy woodland of the northern Monaro and Upper Shoalhaven area, South Eastern Highlands Bioregion. Different condition classes were given to the native vegetation community where obvious differences in structure and quality existed. The PCT is listed as a Threatened Ecological Community (TEC) under the TSC Act and EPBC Act. This alignment was confirmed and discussed on-site during consultation with OEH on the 16th June 2015.

Threatened flora

Based on the results of a data review, 21 threatened flora species have been recorded within 10 km of the study area.

During the field survey, one threatened flora listed on the TSC Act was recorded outside of the study area: *Solanum celatum*. Approximately 20 plants were recorded within Dry Sclerophyll Shrubby Forest immediately to the east of the study area within bushland habitat. None of these plants will be impacted by the Project. The site survey confirmed that the study area did not contain the species or any other threatened flora. It is therefore unlikely that any threatened flora would occur within the study area.

Threatened fauna

Fifty-two threatened fauna have been recorded or are predicted to occur within 10 km of the study area. Of those species listed under the TSC Act, 15 are regarded as 'Species Credit Species' which unlike 'Ecosystem Credit Species' cannot be assumed to be present based on the presence of habitat surrogates. Six threatened fauna species were recorded from the survey area (Diamond Firetail, Scarlet Robin, Varied Sittella, Eastern Bentwing Bat, Greater Broad-nosed Bat and Large-eared Pied Bat). All threatened species recorded are listed as vulnerable threatened species under the TSC Act and one (Large-eared Pied Bat) is also listed as vulnerable under the EPBC Act.

A number of additional threatened fauna have the potential to occur within the study area but were not recorded, most likely due to their potential use of the study area or wider locality being limited to sporadic occurrences (e.g. nomadic birds). Species include: Gang-gang Cockatoo, Speckled Warbler, Rainbow Bee-eater, Black-faced Monarch, Flame Robin, Rufous Fantail, Eastern False Pipistrelle, Koala and Grey-headed Flying-fox.

Impacts - Vegetation

The main impact on biodiversity associated with the Project is clearing of native vegetation and removal of habitat within the study area. The extent of clearing of native vegetation communities is conservatively estimated at 8.1 ha. A further 4.8 ha of exotic pasture and existing cleared land will be developed as a result of the Project.

One TEC will be impacted by the Project – White Box Yellow Box Blakely's Red Gum Grassy Woodland, which is listed as an Endangered Ecological Community (EEC) under the TSC Act and Critically Endangered Ecological Community (CEEC) under the EPBC Act. Approximately 8.1 ha of the TEC would be impacted, with the majority of the vegetation being comprised of highly degraded condition classes and derived grassland.

An offset for the impact has been provided for this community as per the requirements of the FBA. An Assessment of Significance under the EPBC Act has also been conducted for the impact on the TEC. The Assessment concluded the Project is unlikely to significantly impact the CEEC.

Impacts – Threatened flora

No threatened flora are likely to be impacted by the Project given the lack of suitable habitat and results of the field survey. The population of *Solanum celatum* which was recorded outside of the study area is unlikely to be impacted by the Project. It is therefore unlikely that the Project will result in a significant impact to any threatened flora.

Impacts – Threatened fauna

Fifteen threatened and migratory fauna are considered to be affected by the Project. Most of these species are likely to utilise the foraging habitat of the study area on an intermittent basis. These species are regarded as Ecosystem Credit Species under the FBA which do not require further assessment of impact as they would be offset with their associated PCTs.

The Koala is the only listed Species Credit species which has a low to moderate likelihood of occurring within the study area. However, given that the species was not recorded on-site, that there were no signs of previous occurrence and the fact that there is a relatively low likelihood of occurrence for the species on the site, an offset for the species is not proposed under the FBA. No Species Credit species will therefore be impacted by the Project.

Those threatened fauna which are listed under the EPBC Act include Vulnerable species: the Koala, Large-eared Pied Bat and Grey-headed Flying Fox; and Migratory species: Cattle Egret, Rainbow Bee-eater, Rufous Fantail and Black-faced Monarch. An EPBC Act Assessment of Significance for each of these species has been completed and concluded that a significant impact to any EPBC Act listed threatened fauna is unlikely.

Avoidance and minimisation

Site selection for the Project has been largely dictated by the availability of Boral owned land, within the development consent boundary, that is not required for other quarry operations, is located as far as possible from neighbouring residences and does not impact on land with higher biodiversity values i.e. is

located on grazing lands that have been highly modified through historic agricultural practices. The proposed southern overburden emplacement has been designed to avoid/minimise impacts to adjacent areas of higher biodiversity value by:

- Maintaining a suitable buffer to the woodland associated with the neighbouring Barbers Creek Gorge.
- Developing a stormwater management system that will attenuate stormwater and trap sediment during emplacement establishment.
- Progressive and final revegetation and rehabilitation to create a stable landform that does not result in the sediment laden runoff, fugitive dust emissions, blends well with the adjacent natural landscapes of the Morton National Park and re-establishes a native bushland dominated by White Box Yellow Box Blakely's Red Gum Grassy Woodland species.

Mitigation and management

The Project will reduce impacts to biodiversity through:

- Undertaking vegetation clearing in accordance with the Vegetation Clearance Protocol described in section 6.4.2 (impacts arising from the construction will primarily relate to vegetation clearing).
- Fencing and signposting erected as close as possible to the edge of the proposed southern overburden emplacement disturbance footprint as described in section 6.4.2.
- Educating employees and/or contractors involved in the construction of the southern overburden emplacement.
- Construction of the proposed sediment basins and stormwater management system prior to the commencement of overburden emplacement.
- Update and implementation of the existing Peppertree Quarry Landscape and Rehabilitation Management Plan as described in section 6.4.9.
- Dust suppression.
- Procedures for the management of spills throughout the study area including the requirements for vehicles to carry spill kits.
- Management and removal of all rubbish from the study area.

Credit calculations

The Ecosystem credits required to offset the Project equate to 225 Credits for SR670 Yellow Box - Blakely's Red Gum grassy woodland of the northern Monaro and Upper Shoalhaven area, South Eastern Highlands Bioregion.

Offsetting

As part of the Project, Niche has completed an assessment of a proposed offset area which is located within Boral Landholdings. The survey and calculations were to the level specified in the FBA. A total of 291 Credits for SR670 Yellow Box - Blakely's Red Gum grassy woodland may be generated from the proposed offset area. Boral are in the formal stages of determining the precise layout of the offset area. At present the offset area meets 129 percent the offset liability of the Project. The final layout would ensure that 100 percent of the offset liability for the Project would be met. The final layout would be formally established as a BioBank site following approval.

Glossary

Term	Definition
Critical habitat	A critical habitat as defined under the *Threatened Species Conservation Act 1995* includes, the whole or any part or parts of the area or areas of land comprising the habitat of an endangered species, population or ecological community or critically endangered species or ecological community that is critical to the survival of the species, population or ecological community.
Cumulative impacts	Combination of individual effects of the same kind due to multiple actions from various sources over time.
Direct impacts	Those that directly affect habitat and individuals of a species, population or ecological community. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat. In the context of the Project, direct impacts will result in the direct removal of 8.1 hectares of native vegetation.
Habitat critical to survival (EPBC Act)	'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.
Indirect impacts	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.
Key threatening process (TSC Act)	As defined under the *Threatened Species Conservation Act 1995* a key threatening process is any process listed under the Act that adversely affects threatened species, populations or ecological communities, or that could cause species, populations or ecological communities that are not threatened to become threatened.
Key threatening process (EPBC Act)	As defined under the *Environment Protection and Biodiversity Conservation Act 1999* a key threatening process is any process listed under the Act that threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community.
Local population:	The population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions. The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area. The local population of resident fauna comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area. The local population of migratory or nomadic fauna comprises those individuals that are likely to occur in the study area from time to time.
study area	Means the subject site and area of indirect impacts.
Subject site:	Means the area directly affected by the Peppertree Quarry Modification 4 Project.
Threatened ecological community (TEC)	An ecological community identified by the NSW *Threatened Species Conservation Act 1995* or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* as critically endangered, endangered or vulnerable.

Abbreviations

Acronym	Term/Definition
BAR	Biodiversity Assessment Report
BBAM	BioBanking Assessment Methodology
BMP	Biodiversity Management Plan
CMA	Catchment Management Authority
CEEC	Critically Endangered Ecological Community
Dbh	Diametre breast height
DoE	Commonwealth Department of Environment (formerly SEWPAC, DEWHA)
DPE	Department of Planning and Environment
FBA	Framework for Biodiversity Assessment
EEC	Endangered Ecological Community
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FBA	Framework for Biodiversity Assessment
ha	Hectare/s
IBRA	Interim Biogeographic Regionalisation for Australia
JAMBA	Japan-Australia Migratory Bird Agreement
Km	Kilometre
KTP	Key Threatening Process
LGA	Local Government Area
Mm	Millimetre
MNES	Matters of National Environmental Significance (from the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*).
NPWS	National Parks and Wildlife Service
OEH	Office of Environment and Heritage (formerly DECCW, DECC, DEC)
PCT	Plant Community Type
REF	Review of Environmental Factors
RUKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SEPP 44	*State Environmental Planning Policy 44 – Koala Habitat Protection*
TEC	Threatened Ecological Community
TSC Act	*Threatened Species Conservation Act 1995* (NSW)

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1. Introduction

1.1 Overview

Boral Resources (NSW) Pty Ltd (Boral) owns and operates the Peppertree Quarry (the Quarry), a hard rock quarry located in Marulan South, New South Wales.

Boral is seeking to modify the current Project Approval (PA 06_0074) under Section 75W of the Environmental Planning and Assessment Act 1979 (EP&A Act), to provide for the following (hereafter referred to as the Project)

- Extend daily in-pit operating hours at the Quarry by 6 hours; and
- Develop a new overburden emplacement area.

The modification proposed above will constitute Modification 4 to the current Project Approval.

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Boral to assess the ecological values and impacts associated with the Peppertree Quarry MOD4 Project, and provide a Biodiversity Assessment Report. The primary objective of this report is to use the methodology provided in the *Framework for Biodiversity Assessment - NSW Biodiversity Offsets Policy for Major Projects Office of Environment and Heritage* (FBA) (OEH 2014) to describe and assess the ecological values within the confines of the area required for the Project, and determine how the Project is likely to impact on threatened biodiversity listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This report also identifies avoidance, mitigation and offsets for the Project.

1.2 The Project

The Quarry is located in Marulan South, 10 kilometres (km) southeast of Marulan, 35 km east of Goulburn and approximately 175 km south-west of Sydney, within the Goulburn Mulwaree Local Government Area (LGA) in the Southern Tablelands of NSW (Figure 1 and Figure 2).

Access is via Marulan South Road, which connects the Quarry and Boral's Marulan South Limestone Mine with the Hume Highway approximately 9 km to the northwest. Boral's private rail line connects the Quarry and Limestone Mine with the Main Southern Railway approximately 6 km to the north.

The Quarry is located on Boral owned land approximately 650 hectares (ha) in size, which includes the Quarry site, approximately 70ha in size, additional granodiorite resources to the south and surrounding land. The site is zoned RU1 - Primary Production zone under the Goulburn Mulwaree Local Environmental Plan (LEP) 2009. Mining and extractive industries are permissible in this zone with consent.

The Quarry is bordered to the south by the Limestone Mine, to the east by Morton National Park and by rural properties to the north and west. Surrounding land uses include mining, grazing, rural properties including an agricultural lime manufacturing facility, fireworks storage facility, turkey farm and rural residential. The main access for these properties is via Marulan South Road. Rural residential properties are also located to the northeast of the Quarry along Long Point Road. These properties are separated from the Quarry by the deep Barbers Creek gorge.

The site of the former village of Marulan South is located between the Quarry and the Limestone Mine on Boral owned land. The village was established principally to service the Limestone Mine but has been uninhabited since the late 1990's. The majority of the village's infrastructure has been removed and only a

village hall and former bowling club remains. The bowling club has been converted into administration offices for the Limestone Mine.

1.3 Approved Project

1.3.1 Quarry Activities and Infrastructure

The approved quarrying activities are for extraction of 105 million tonnes of granodiorite over 30 years at an initial rate of 1 - 2 million tonnes per annum (Mtpa) and a maximum rate of 3.5 Mtpa. Granodiorite is an intrusive igneous rock suitable for use as a construction and building material. The hard rock aggregates produced at the site are a range of different shapes and sizes for different purposes. Primary production is of concrete and asphalt aggregates (10 mm) and railway ballast (28 - 50 mm) with capacity to produce larger aggregates (>100 mm) for rock armour and gabion baskets. Fines (generally <5 mm) produced during crushing of product are blended with limestone sand from Boral's adjacent Limestone Mine or Penrose Quarry to produce a marketable manufactured sand.

Infrastructure at the Quarry includes a processing plant, rail loop and loading facilities, two water storage dams, an in-pit mobile crushing plant, overburden emplacement areas, noise and visual bunding, product stockpiles, and staff facilities.

Work to establish the Quarry commenced in July 2011. Production commenced early in 2014 following a lengthy commissioning and proving phase. The Quarry has approval to operate until the end of 2038.

1.3.2 Transport of Product

Product from the Quarry is transported entirely by rail except in an emergency where it would be transported by road with the written approval of the Secretary of DP&E. The Quarry has approval to transport up to 3.5 Mtpa of product from the site. At full production the Quarry will operate up to four trains per day which will transport product north to the Sydney market and other customers. In addition, the Limestone Mine currently operates up to six trains per day transporting product north to Berrima and Maldon and east to Port Kembla.

Trains to the Quarry and the Limestone Mine access Boral's private rail line from the Main Southern Railway at the Medway Junction. The rail line is mostly single track with a 1 km length of triple line track used for shunting and train loading. A rail loop has been constructed at the Quarry for separation of rail movements on the rail line between the two Boral sites. Rail loading facilities were also established on the rail loop adjacent to the Quarry's processing plant.

Loading of product from the Quarry onto trains and train movements occur 24 hours, seven days a week. This enables train trips on the Main Southern Railway to be scheduled away from peak commuter times.

1.3.3 Operating Hours and Workforce

The Quarry operates 24 hours, 7 days a week with in-pit activities restricted to the hours of 7am to 7pm. Approved operating hours are outlined in detail in Table 1.

Table 1. Approved operating hours

Activity	Day	Time
Construction works	Monday-Friday Saturday Sunday and public holidays	7.00am to 6.00pm 8.00am to 1.00pm None
Topsoil/overburden removal/emplacement	Any day	7.00am to 7.00pm
Blasting	Monday-Saturday Sunday and public holidays	9.00am to 5.00pm None
In-pit activities (including drilling, extraction, processing, and transfer of material out of the pit)	Any day	7.00am to 7.00pm
Out-of-pit activities (including processing, stockpiling, train loading and distribution, and maintenance)	Any day	24 hours

1.4 Proposed modifications

1.4.1 Description of the Proposed Modifications

Boral is seeking to modify the current Project Approval to:

- Extend in-pit operating hours at the Quarry by 6 hours; and
- Develop a new overburden emplacement area.

1.4.2 Extension of in-pit Operating Hours

Peppertree Quarry currently has approval to operate in-pit activities for 12 hours per day between 7am and 7pm. In-pit activities include:

- Drilling and blasting;
- Extraction;
- Delivering blast rock to the mobile crusher;
- Crushing of rock;
- Conveying crushed rock out of the pit.

Boral is seeking to extend these in-pit operating hours by 6 hours per day in order to account for scalping of overburden material in early phases of pit development and meet annual production volumes up to the approved limit of 3.5 million tonnes per annum. Boral are proposing to extend the approved 7am - 7pm in-pit operating hours to 5am - 11pm.

Blasting will however continue within the current approved blasting hours of 9am - 5pm Monday to Saturday.

1.4.3 New Southern Overburden Emplacement

Overburden emplacement at the Quarry is currently approved within noise bunds located along the northern and eastern boundaries of the site, an emplacement area to the east of the approved quarry pit and a western emplacement area and noise bund to the west of the Quarry across Boral's private railway

line. Remaining overburden was proposed to be emplaced within the south pit of Boral's adjoining Limestone Mine.

The noise bunds were completed during construction of the Quarry, and the eastern overburden emplacement area will reach capacity in early 2016. Mine planning for the Limestone Mine has ruled out emplacement within the south pit. The Limestone Mine, under its forthcoming development application, is seeking to hold 5 million m3 (approximately 13 Mt) of overburden for the Quarry, however, this will not be approved until late 2016. As an interim measure, Boral is seeking to place approximately 1 million m3 of overburden within a new overburden emplacement, to the south of the approved 30 year quarry pit (refer to Figure 7). Overburden stripped from the pit will be transported by trucks along the most direct haul route possible (refer to Figure 3). This new overburden emplacement area will be needed in early 2016 and will take approximately 12 months to establish.

The proposed new overburden emplacement will be located within the south-eastern extent of the future hard rock (granodiorite) resource, which extends south from the existing Quarry pit, to the northern end of the Limestone Mine's north pit. A significant granodiorite resource also exists on Boral's lands to the north of the existing Quarry pit, extending northwards from Tangarang Creek. The proposed southern overburden emplacement will not sterilise resource as Boral will relocate this southern emplacement in the future if the southern granodiorite resource needs to be accessed. Although the southern overburden emplacement may be relocated in the future, this is unlikely to be required for at least the next 25 years. The proposed emplacement will therefore be landscaped and rehabilitated in accordance with the existing Peppertree Quarry Landscape and Rehabilitation Management Plan.

1.5 The study area

The study area occurs within the Southern Rivers Catchment Management Area (CMA), South Eastern Highlands IBRA Bioregion (Interim Biogeographic Regionalisation for Australia), and, Bungonia Tableland and Gorge Mitchell Landscape (Figure 4 and Figure 5).

The study area is approximately 12.9 ha, and includes the following key Project elements, described in subsequent sections:

- Southern Overburden Emplacement
- Sediment basins.

Within the study area, the land directly disturbed by the Project is referred to as the subject site. The area of direct and indirect impact is referred to as the study area.

1.6 Approval process

1.6.1 Application of the FBA

This Biodiversity Assessment Report has applied the FBA to describe and assess the ecological values within the study area and surrounds, and determine how the Project is likely to have an impact on threatened biodiversity listed under the TSC Act and the EPBC Act.

This assessment has been completed using the BioBanking Credit Calculator (BBCC) Version 2.0 [14 September 2015] and relevant updates that accompany Version 4.0 of the BBCC.

1.6.2 Commonwealth requirements

This report follows the FBA. Those species which are listed under the EPBC Act have also been addressed in this report. Assessments of Significance for those Matters of National Environmental Significance (MNES)

potentially impacted by the Project have been provided. Matters to be offset will be in accordance with the Bilateral Agreement. Offsets have been discussed in section 8.

1.6.3 Secretary's Environmental Assessment Requirements (SEARs)

No SEARs were provided for this assessment. Correspondence from Department of Planning and Environment (DPE) in response to the Modification Application accepted the scope of the biodiversity assessment as outlined in the Background Scoping Document (BSD) for the Project. However, DPE required that the Biodiversity Assessment be consistent with the Framework for Biodiversity Assessment (FBA): NSW Offsets Policy for Major Projects (2014), and that development of an offset strategy (if considered necessary), would be required in terms of the FBA.

1.7 Consultation

Given SEARs were not provided by DP&E, consultation with the Office of Environment and Heritage (OEH) was undertaken in preparing this Biodiversity Assessment Report. Table 2 below summarises they key issues covered during correspondence.

Table 2. Consultation with OEH

Dates of consultation	Relevant key issues/discussion points	How are the issues addressed in this report?
17/04/2015	17th of April 2015 Phone call with Catherine Ellis of OEH to discuss approval pathways and suggested approach to biodiversity assessment.	Report has been undertaken using methods consistent with the FBA.
04/06/2015	Phone call with Miles Boak (OEH) regarding White Box Yellow Box Blakely's Red Gum Woodland and other threatened species matters. Phone call with Audrey Kutzner (NSW NPWS) regarding mapping of White Box Yellow Box Blakely's Red Gum Woodland.	Information incorporated into assessments of significance for relevant threatened species matters.
09/06/2015 11/06/2015	Phone call with Stewart Lloyd (GM Council). Enquired as to any Council mapping of vegetation with emphasis on EEC/CEECs. Council's mapping is limited – there is some collaboration between Council and the recent mapping project by OEH led by John Briggs with a focus on identification of White Box Yellow Box Blakely's Red Gum Woodland.	Consultation with OEH on latest mapping project. Ensures vegetation mapping used for wider locality is the best available and that corridors are identified. Enabled Council's input regarding any concerns or issues for addressing.
16/06/2015	Site meeting at Peppertree Quarry Southern Overburden Emplacement sites: Rod Wallace (Boral); Miles Boak, Allison Treweek and Susan Lamb (OEH); Simon Tweed (Niche). General overview of Project and field assessment conducted. Site inspection focusing on Box Gum Woodland areas. OEH and NPWS agreed the condition of Box Gum Woodland was highly degraded. Discussion of assistance OEH and NPWS could provide regarding further information for key assessment items and identification of future offset lands.	Information has been incorporated throughout reporting particularly in impact assessment and offsets strategy.

1.8 Assessment objectives

The primary objective of this assessment is to use the guidelines and methodology provided in the FBA to determine the impact the Project would have on biodiversity, and to calculate the Project's biodiversity offset requirement accordingly.

This Biodiversity Assessment Report has approached the three broad stages detailed in the FBA as follows:

Stage 1:

- Introduction to the biodiversity assessment
- Landscape features
- Native vegetation
- Threatened species

Stage 2:

- Avoid and minimise impacts
- Impact summary
- Biodiversity Credit Report

Stage 3:

- Offset identification
- Improvement of Biodiversity values at offset site
- Rehabilitation site identification

1.9 Assessment resources and assessor qualifications

This Biodiversity Assessment Report has been prepared by the following accredited assessors:

- Simon Tweed (Senior Ecologist): fauna field survey, data management, data entry, credit calculations, review of credit calculations, report preparation.
- Luke Baker (Senior Botanist): field survey, data management, data entry, credit calculations, review of credit calculations, report preparation.
- Nathan Smith (Senior Botanist): field survey, mapping, data analysis.
- Sian Griffiths (Senior Botanist): Review of report.

Other specialist staff involved in preparing the assessment include:

- Matthew Richardson (Director): report review, quality assurance.
- Dr Ross Jenkins (Team Leader GIS and Systems Analyst): mapping.
- Greg Tobin (GIS Analyst): mapping
- Matthew Stanton (Research Ecologist): field survey, Anabat analysis.

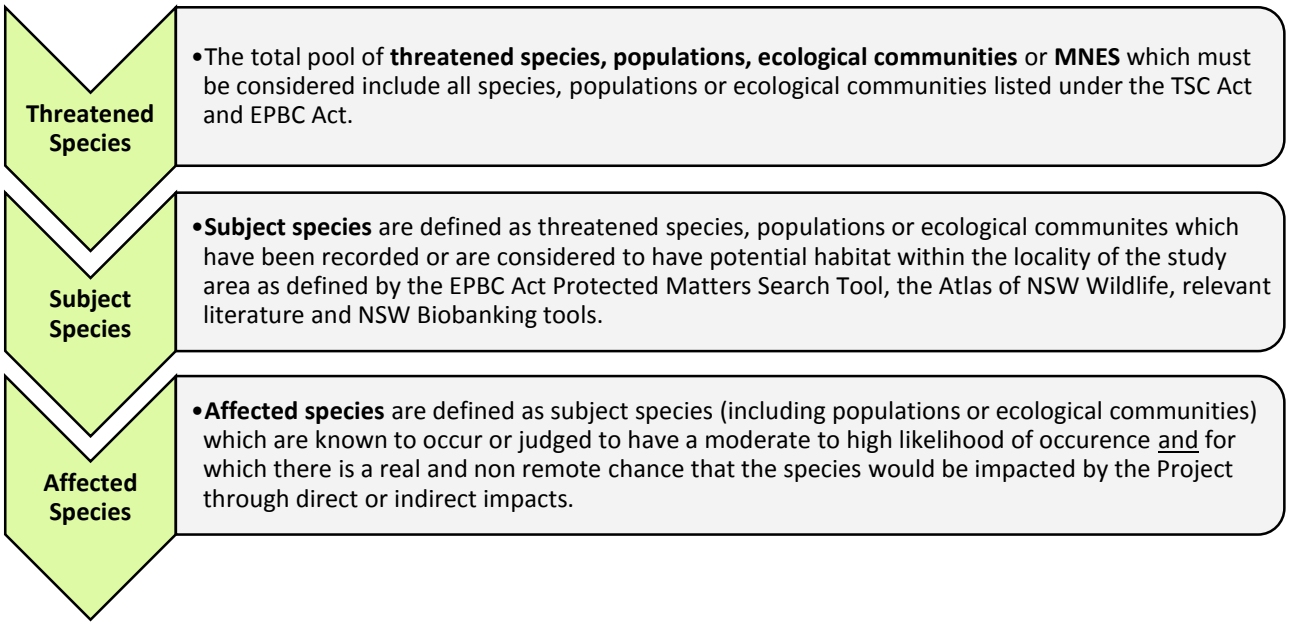
2. Background review

In completing this Biodiversity Assessment Report, a number of threatened species databases and previous documents relevant to the Project have been reviewed as detailed in this section.

2.1 Database searches

Threatened species potentially impacted by the Project (subject species) were identified through the database and literature review process detailed further below. The list of potentially impacted (affected) species was determined by considering the likelihood of occurrence and the likelihood of impacts for each of the subject species (see Diagram 1 below).

Diagram 1: The hierarchy of decision making to define the subject species for this assessment



Five categories for 'likelihood of occurrence' (Table 3) were attributed to the list of threatened species after consideration of criteria such as known records, presence or absence of important habitat features on the subject site, results of the field surveys and professional judgement. This process was completed on an individual species basis.

Species considered further were those in the 'Known' to 'Moderate' categories and where impacts for the species could reasonably occur from the Project.

Table 3. Likelihood of occurrence criteria

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

2.1.1 BioBanking Credit Calculator

Threatened species predicted to occur within the CMA subregion (BioBanking Threatened Species Profile Database) were reviewed and considered for inclusion within the Threatened Species Likelihood of Occurrence Tables (Appendix 1). The list of species predicted to occur within the CMA Subregion was refined for the study area within the Biobanking Credit Calculator (BBCC). This involved refining the list on the basis of the vegetation types, condition and habitat features within the study area. The details of the inputs to generate the list are provided below.

Geographic habitat features

The geographic and habitat features tab in the BBCC is designed to further filter threatened species that are likely to be relevant to the habitats present within the development footprint. Table 4 outlines the responses to geographic/habitat feature questions in the BBCC.

Table 4. Project relevant geographic and habitat questions

Impact?	Common name	Scientific name	Feature
Yes	Rosenbergs Goanna	*Varanus rosenbergi*	land within 250 m of termite mounds or rock outcrops
No	Large-eared Pied Bat	*Chalinolobus dwyeri*	land north of Batemans Bay in Bateman CMA subregion

The responses to the geographic and habitat questions generated the following list of non-ecosystem predicted species for consideration (Table 5).

Table 5. Non-ecosystem predicted species for consideration and survey time matrix

Common name	Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hoary Sunray	*Leucochrysum albicans* subsp. *tricolor*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Koala	*Phascolarctos cinereus*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Paddys River Box, Camden Woollybutt	*Eucalyptus macarthurii*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regent Honeyeater	*Anthochaera phrygia*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rosenbergs Goanna	*Varanus rosenbergi*	Yes	Yes									Yes	Yes

The responses to the geographic and habitat questions generated the following list of ecosystem predicted species, along with the associated TS offset multiplier score[1] (Table 6).

Table 6. Ecosystem predicted species

Common name	Scientific name	TS offset multiplier
Barking Owl	*Ninox connivens*	3.0
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis subsp. gularis*	1.3
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus subsp. victoriae*	2.0
Diamond Firetail	*Stagonopleura guttata*	1.3
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	2.2
Flame Robin	*Petroica phoenicea*	1.3
Gang-gang Cockatoo	*Callocephalon fimbriatum*	2.0
Hooded Robin (south-eastern form)	*Melanodryas cucullata subsp. cucullata*	1.7
Little Eagle	*Hieraaetus morphnoides*	1.4
Little Whip Snake	*Suta flagellum*	2.3
Scarlet Robin	*Petroica boodang*	1.3
Speckled Warbler	*Chthonicola sagittata*	2.6
Spotted-tailed Quoll	*Dasyurus maculatus*	2.6
Varied Sittella	*Daphoenositta chrysoptera*	1.3

2.1.2 Atlas of NSW Wildlife Database

A review of spatial records of threatened flora and fauna within the locality and wider region was undertaken using data obtained from the Atlas of NSW Wildlife. Records were obtained prior to field survey and searches of the Atlas updated in September 2015.

[1] The 'TS offset multiplier' is the component of the Ecosystem Credit calculation that directly relates to the value of the BVT as a surrogate for each particular species (OEH 2014a).

2.1.3 EPBC Act Protected Matters Search

A Protected Matters Search was carried out for a 10 km area around the study area. Results from the database searches have been incorporated into the Threatened Species Likelihood of Occurrence Tables (Appendix 1).

2.2 Review of Relevant Previous Reports

The following reports or surveys, that contain ecological information potentially relevant to the study area, were reviewed:

- Niche (2014). *Marulan limestone mine biodiversity feasibility assessment*. Report prepared for Element Environment and Boral Cement. Dated May 2014.
- RPS HSO (2009). Flora and fauna assessment for proposed waste emplacement at Marulan South Limestone Mine. Report prepared for Blue Circle Southern Cement. Dated May 2009.
- EMM (2012). *Peppertree Quarry modification 3 ecology assessment*. Prepared for Boral Resources. Dated 8 August 2012.

A summary of the relevant ecological information from these reports is provided below.

2.2.1 Niche (2014) Marulan limestone mine biodiversity feasibility assessment

Niche was commissioned by Boral to conduct a biodiversity feasibility assessment of Boral land holdings within and around the Marulan Limestone Mine which is located immediately adjacent to the current study area.

Ground-truthing and validation of the Tozer et al. (2006) vegetation mapping was conducted resulting in identification of White Box Yellow Box Blakely's Red Gum Grassy Woodland. This listed TEC under the TSC Act and EPBC Act was recorded surrounding areas of the Marulan Limestone Mine as well as within potential offset areas.

No threatened flora were recorded during the survey. However it was identified that *Solanum celatum* had previously been recorded to the direct east of the current study area on the steep slopes toward Barbers Creek.

Limited fauna surveys were completed including some survey targeting potentially occurring threatened species. This was combined with opportunistic observations and broad habitat assessment. Three threatened fauna were recorded during the survey including the Koala (recorded approximately 1.2km to the south of the study area), Diamond Firetail (recorded approximately 700m to the north-west of the study area) and Varied Sittella (recorded approximately 2.8 kms to the south-west of the study area).

2.2.2 RPS HSO (2009) Flora and fauna assessment for proposed waste emplacement at Marulan South Limestone Mine

This report addressed potential impacts on terrestrial ecology from the proposed filling of several surrounding gullies with overburden material. The area assessed did not cover the current study area however included parts of the area immediately adjacent.

Vegetation recorded during the survey included Brittle Gum Stringybark Forest, Forest Red gum Stringybark Woodland, Coastal Grey Box Smooth-bark Woodland and cleared disturbed land along with planted trees and shrubs.

The flora survey methodology consisted of a combination of quadrats, random meanders and targeted searches for threatened flora. No threatened flora were recorded during investigations.

Fauna habitat included two tree hollows and a winter flowering tree species: *Eucalyptus tereticornis*. No threatened fauna were recorded during surveys. Ten threatened fauna were considered likely to occur on at least an occasional basis.

RPS HSO did not record any 'Potential Koala Habitat' or "Core Koala Habitat" as defined by State Environment Planning Policy (SEPP) 44.

2.2.3 EMM (2012) Peppertree Quarry modification 3 ecology assessment

The assessment considered a proposed High Voltage (HV) distribution line approximately 1 km in length to the west of the Quarry and construction of a minor extension of Boral's private rail line.

No threatened fauna or flora were recorded during the field investigation. It was found that the subject site of the proposed HV line could provide some marginal foraging habitat and connectivity for threatened birds, arboreal mammals and bats. However, suitable roosting and nesting sites for large hollow dependent fauna were absent and a lack of hollow bearing trees was highlighted as a limiting factor for fauna.

The grassy woodland vegetation recorded within the proposed HV line route was assessed against the White Box Yellow Box Blakely Red Gum Grassy Woodland identification guidelines, as the community is listed under the TSC Act as an EEC. The assessment found that the areas with remnant canopy cover met the description of the EEC, however where the understorey was disturbed and where the canopy and regeneration was absent, the community onsite was not considered to meet the EEC description. EMM also concluded that the remnant woodland also represents the White Box Yellow Box Blakely Red Gum Grassy Woodlands and Derived Native Grasslands community listed as critically endangered under the EPBC Act.

3. Landscape assessment

3.1 Overview

As detailed in section 4 of the FBA (OEH 2014a), a Landscape Assessment is required to be entered into the BBCC. Landscape Value is an assessment of the spatial configuration of vegetation, including percent native vegetation cover, adjacent remnant area and connectivity. For each, there is one assessment of the current state of the landscape around the entire Project and one assessment of the state of the landscape if the Project were to proceed.

A calculation of the nature and extent of offset credits required due to the biodiversity impacts associated with the Project has been undertaken using Version 4.0 of the BBCC.

3.2 Landscape setting

The study area occurs within the South Eastern Highlands IBRA region, and within the Bungonia IBRA subregion (Figure 6).

One Mitchell landscape occurs across the study area: Bungonia Tableland and Gorge (Figure 6).

3.3 Native vegetation cover

GIS interrogation was used to determine the vegetation cover percentage as provided in Table 7.

Table 7. Native vegetation cover – assessment circles

Native vegetation cover class (%)			
Before development		**After development**	
1,000 ha	**100 ha**	**1,000 ha**	**100 ha**
71-75%	61-65%	71-75%	51-55%

3.3.1 Connectivity value

No riparian buffers, State Biodiversity Links or Regional Biodiversity Links would be impacted by the Project. The connecting link occurs to the west of the study area and would not be impacted by the Project. The connectivity scores will therefore remain the same before and after development. Details of the connectivity scores entered into the BBCC are provided in Table 8.

Table 8. Connectivity scores

Connectivity class/description in BBCC	Before development	After development
Connectivity Value Class	>30-100m	>30-100m
Overstorey Condition	Project foliage cover <25% of Lower Benchmark	Project foliage cover <25% of Lower Benchmark
Midstorey Condition	Project midstorey/ground cover >50%	Project midstorey/ground cover >50%

3.3.2 Landscape score calculation

The information presented in the above section was entered into the BBCC, resulting in a landscape score calculation of 13.80 for the development.

4. Assessing native vegetation

4.1 Vegetation verification and threatened flora survey

The flora survey methodology followed the BioBanking Assessment Methodology (BBAM) (OEH 2014) (consistent with the FBA), with additional information recorded (abundance, structure etc.) on the basis of current best practice flora survey guidelines for assessment of a large site, particularly OEH's Working Draft *Threatened Biodiversity Survey and Assessment – Guidelines for Developments and Activities* (DEC 2004).

The methodology was applied over the entire study area on the 19th to the 21st of May 2015. The aim was to adequately sample each of the vegetation community types across the study area using a combination of vegetation quadrats, transects, rapid data points and driving transects or walking meanders. The BioBanking plot requirements were calculated using the FBA. The number of plots required for each BioMetric Vegetation Type is provided in Table 9 and location provided in Figure 7.

BioBanking plots collected the following attributes:

- native species richness (20 x 20 m)
- native over-storey cover (projective foliage cover at 5 m intervals along 50 m transect)
- native mid-storey cover (projective foliage cover at 5 m intervals along 50 m transect)
- native ground cover (grasses) (frequency tally at 1 m intervals along 50 m transect)
- native ground cover (shrubs) (frequency tally at 1 m intervals along 50 m transect)
- native ground cover (other) (frequency tally at 1 m intervals along 50 m transect)
- exotic cover (as for native over-storey, mid-storey and groundcover)
- over-storey regeneration (proportion of overstorey dominants present as immature recruitment)
- number of trees with hollows (within 50 x 20 m plot)
- total length of fallen logs (within 50 x 20 m plot).

In addition to the prescribed BioBanking plot methodology above, within each 20 x 20 m plot all vascular plant species were identified (to species level where sufficient plant material was available) and assigned a cover abundance score using a six point scale:

1. rare, few individuals (three or less) present and cover <5 %
2. common (consistent throughout plot) and <5 %
3. cover 6-20 %
4. cover 21-50 %
5. cover 51-75 %
6. cover >75 %.

Rapid Data Points (RDPs) were conducted between plot locations or where habitat changes were present. RPDs were used to record vegetation structure, extent of modification, disturbance, sign of fire, weed invasion and condition of the vegetation.

Random meanders for threatened flora and their habitats were conducted between BioBanking plot, RDP locations, and fauna survey points.

4.1.1 Survey effort

Flora survey effort consisted of the following:

- A total of 10 BioBanking plots/transects within the study area.
- A total of 2 RDPs.

The plot data and species list obtained during the field assessment is provided in Appendix 2.

Walking meanders were undertaken between plot locations. At a minimum, the combined foot traverses complied with the recommended number and length of traverses per area of stratification unit (vegetation community) according to DEC (2004) survey guidelines. The walking meanders were also used to survey for threatened flora species across the study area. In particular the presence of *Solanum celatum* which occurs widely across the locality.

The plots undertaken along with the corresponding effort as specified in the FBA is provided in Table 9.

Table 9. Flora survey effort plot requirement

Niche vegetation mapping	Plant Community Type (PCT) best fit	Total (ha)	Plots required	Plots conducted
Blakely's Red Gum - Yellow Box - Grassy open woodland (Condition A – Trees with native forb and grass cover)	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	0.7	1	2
Blakely's Red Gum - Yellow Box - Grassy open woodland (Condition B - Trees with predominately native ground cover)	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	2.3	2	2
Blakely's Red Gum - Yellow Box - Grassy open woodland (Condition C – Scattered trees with introduced ground cover)	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	0.9	1	2
Blakely's Red Gum - Yellow Box - Grassy open woodland (Condition D – native grassland)	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	4.2	3	3
Exotic pasture/ Infrastructure	-	4.8	-	1
Total		12.9		
Total native vegetation		8.1	7	10

4.1.2 Limitations

The study area was adequately surveyed to document all vegetation types and major habitats. Aerial photography interpretation, combined with dendrogram results, plot data and BioBanking attribute data was used to map vegetation polygons.

While some target species are cryptic and detection can be difficult, the survey was considered to be sufficiently targeted in order to complete a robust biological assessment for the Project.

4.2 Vegetation community delineation and mapping

4.2.1 Previous mapping

Vegetation within the study area has been mapped previously as part of the Native vegetation of South Eastern NSW (Tozer et al. 2006) (Figure 8). The descriptions for each vegetation community mapped within or in the vicinity of the study area, based on Tozer et al. (2006), are provided in Table 10 below.

Table 10. Vegetation mapping (Tozer et al. 2006)

Code (Tozer et al. 2006)	Vegetation Community (Tozer et al. 2006)	Description
DSF p27	Bungonia Slates Woodland	A dry eucalypt woodland with a sparse understorey of shrubs and grasses, A sparse canopy dominated by *Eucalyptus bosistoana* and *E. macrorhyncha*, subcanopy of *Acacia deanei* and *E. cinerea*, shrub layer dominated by *Cassinia uncata* and a very sparse groundcover.
DSF p10	Eastern Tablelands Dry Forest	An open eucalypt forest with an open understorey of sclerophyll shrubs, sedges and forbs. The canopy is dominated by *Eucalyptus sieberi* and the ground cover is sparse and dominated by forbs and grasses such as *Pomax umbellata, Lomandra obliqua* and *Microlaena stipoides.*
DSF p11	Elevated Gorge Forest	A eucalypt forest with an open understorey of sclerophyll shrubs and grasses. *Eucalyptus agglomerata, E. punctata* and *E. sparsifolia* over a patchy shrub layer supporting *Persoonia linearis* and *Phyllanthus hirtellus,* and a sparse groundcover including *Dianella revoluta* and *Lomandra filiformis* subsp. *filiformis*.
GW p24	Tableland Grassy White Box Yellow Box Blakely's Red Gum Woodland	A eucalypt woodland with a sparse shrub layer and grassy groundcover. A canopy of *E. dives, E. macrorhyncha* and *E. melliodora* over a diverse grassy groundcover dominated by *Themeda australis* and *Poa sieberiana.*
GW p23	Tableland Hills Grassy Woodland	An open eucalypt forest or woodland with a sparse shrub layer and grassy groundcover. *Eucalyptus dives* and *E. macrorhyncha* are the dominant tree species and the grassy ground cover is dominated by *Lomandra filiformis* ssp *coriacea, Austrodanthonia racemosa* and *Microlaena stipoides.*

4.2.2 Vegetation validation - Vegetation zones

As detailed in section 4.1, the vegetation of the study area was validated using methods consistent with the BBAM.

Analysis of plot data using PATN (pattern analysis software) was undertaken to determine similarities and differences between plots in species composition and abundance. The dendrogram has been provided in Appendix 3.

Within the study area one native vegetation type and one exotic type were identified. These vegetation communities were aligned to the relevant Plant Community Types (PCTs) required for use with the FBA. Different condition classes were assigned to vegetation where obvious differences in structure and quality occurred, resulting in five vegetation categories:

1. Blakely's Red Gum - Yellow Box - Grassy open woodland (condition A – clumped trees with native forbs and grasses) (SR670)
2. Blakely's Red Gum - Yellow Box - Grassy open woodland (condition B –occasional eucalypts with low diversity) (SR670)
3. Blakely's Red Gum - Yellow Box - Grassy open woodland (condition C – occasional eucalypts with introduced ground cover) (SR670)
4. Blakely's Red Gum - Yellow Box - Grassy open woodland (condition D – grassland) (SR670)
5.
6. The vegetation categories along with equivalent PCT (and reference codes), Keith Class, Keith Formation, Tozer et al (2006) community, and Exotic vegetation.

Alignment to the validated vegetation communities is provided in Table 11.

Descriptions for those communities which occur within the study area are provided in section 4.3. Vegetation community mapping is shown in Figure 9.

Table 11. Vegetation zone

Niche vegetation mapping	Tozer et al. (2006) equivalent/ best fit	Plant Community Type (PCT) best fit	Vegetation formation	Vegetation class	Threatened Ecological Community (TEC)*	Condition identifier input used in BBCC	Total
Blakely's Red Gum - Yellow Box - Grassy open woodland (Condition A – Trees with native forb and grass cover)	P24 Tableland Grassy White Box Yellow Box Blakely's Red Gum Woodland	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	Grassy Woodlands	Southern Tableland Grassy Woodlands	CEEC under the EPBC Act. EEC under the TSC Act.	Moderate/good_high	0.7
Blakely's Red Gum - Yellow Box - Grassy open woodland (Condition B - Trees with predominately native ground cover)	P24 Tableland Grassy White Box Yellow Box Blakely's Red Gum Woodland	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	Grassy Woodlands	Southern Tableland Grassy Woodlands	CEEC under the EPBC Act. EEC under the TSC Act.	Moderate/good	2.3
Blakely's Red Gum - Yellow Box - Grassy open woodland (Condition C – Scattered trees with introduced ground cover)	P24 Tableland Grassy White Box Yellow Box Blakely's Red Gum Woodland	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	Grassy Woodlands	Southern Tableland Grassy Woodlands	EEC TSC Act. Possible CEEC under the EPBC Act - As a precaution this class has been aligned to the EPBC Act definition)	Moderate/good_poor	0.9
Blakely's Red Gum - Yellow Box - Grassy open woodland (Condition D – native grassland)	P24 Tableland Grassy White Box Yellow Box Blakely's Red Gum Woodland	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	Grassy Woodlands	Southern Tableland Grassy Woodlands	EEC TSC Act. Possible CEEC under the EPBC Act - As a precaution this class has been aligned to the TSC Act and EPBC Act definition	Moderate/good_derived grassland	4.2
Exotic pasture/ Infrastructure							4.8
Total							12.9
Total native vegetation							8.1

4.3 Vegetation descriptions

4.3.1 Blakely's Red Gum - Yellow Box - Grassy open woodland (SR670)

Habitat: Blakely's Red Gum – Yellow Box – Grassy open woodland (SR670) occupies the flat terrain and gentle slopes on relatively fertile soils.

Distribution within study area: Occupies most of the southern and eastern portion of the study area. The best condition of this community occurs to the south where grazing intensity is lowest.

Structure/Characteristics: Four different condition classes of the community were recorded in the study area (Table 12). Typically, the best condition of the community consisted of a tree layer ranging in height from 15 - 25 m consisting of *Eucalyptus blakelyi*, and *Eucalyptus melliodora*. A midstorey contained *Acacia parramattensis*, which depending on disturbance was sparse. The shrub layer consisted of *Cassinia aculeata, Lissanthe strigosa* and *Olearia viscidula*. The ground layer consisted of *Einadia hastata Austrodanthonia racemosa, Microlaena stipoides, Bothriochloa macra, Acaena novae-zelandiae, Lomandra filiformis* subsp*. coriacea, Thysanotus patersonii, Anisopogon avenaceus, Poa sieberiana, Austrostipa scabra,* and *Aristida ramosa*.

Conservation Status: This vegetation community in all condition classes aligns to the NSW TSC Act - White Box Yellow Box Blakely's Red Gum Woodland TEC (EEC) due to the following listing criteria (Scientific Committee 2002) being satisfied within the study area:

- Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum
- The understorey in intact sites is characterised by native grasses and a high diversity of herbs
- Shrubs are generally sparse or absent, though they may be locally common
- Characteristic species are present as identified in the Scientific Committee (2012)
- Occurs within the known range of the TEC.

In regards to the EPBC Act listing, an analysis of the Determination and Flow Chart Diagram within the EPBC Act Policy Statement (DoE undated) was undertaken. The three different condition classes occurring in the study area meet the criteria in different ways, with the majority of Condition Class C being included as a precautionary measure. The alignment of each condition class to the CEEC criteria is provided in Table 12.

Resilience and ability to regenerate:

The historic clearing coupled with the existing and historic grazing within the study area has resulted in most of the study area having a significantly low resilience. Of the TEC present within the study area, only Condition Class A consists of patches which are of a high resilience. Such patches only occupy 0.7 ha of the study area (Table 11). It is likely that these patches would continue to naturally regenerate and abundance and cover would increase, however given the small size of the patches, regular weed management would need to be established in order to assist natural regeneration from edge effects.

Condition Class B contains a lower resilience to Condition Class A. It has therefore been given a moderate resilience rating. It is likely that a high level of management, including extensive weed maintenance would be required to assist natural regeneration of the TEC within Condition Class B.

Both Condition Class C and D have low resilience. It is unlikely that these areas would naturally regenerate. Extensive plantings, importation of logs, installation of nest boxes and intensive weed management would

be required to extend these patches and increase overstorey and midstorey cover, native ground cover, native shrub cover and fallen logs towards a benchmark condition.

Table 12. CEEC condition classes

Condition	Description	How it meets the TSC Act Determination	How it meets the EPBC Act Determination
Class a. (aligns to a CEEC under EPBC Act and EEC under TSC Act) (see Photo 1)	▪ The presence of diagnostic mature trees including *Eucalyptus blakelyi, E. melliodora* and *E. eugenioides* in an open woodland formation. ▪ Presence of diagnostic groundcover plant species including some important species (excluding grasses). ▪ Presence of regenerating over-storey species. ▪ Moderate occurrence of exotic plant species. ▪ The patch has a high resilience.	▪ Characterised by the presence or prior occurrence of *Eucalyptus albens, E. melliodora* and/or *E. blakelyi*. ▪ The understorey is characterised by native grasses and a high diversity of herbs. ▪ Shrubs are generally sparse or absent, though they may be locally common. ▪ Characteristic species are present as identified in the Scientific Determination. ▪ Occurs within the known range of the TEC.	▪ Diagnostic species present. ▪ Predominantly native understorey. ▪ Whilst the plots undertaken did not contain greater than 12 native understorey species (excluding grasses), the size of the patch when adjacent grassland areas are included is greater than 2 ha. ▪ Mature trees and natural regeneration of eucalypts is present.
Class b. (aligns to a CEEC under EPBC Act and EEC under TSC Act) (see Photo 2)	▪ Reduced diversity of characteristic canopy dominants in the overstorey stratum with diagnostic tree species confined to *Eucalyptus blakelyi* and *E. melliodora.* ▪ Low to very low diversity of White Box Yellow Box Blakely's Red Gum Woodland CEEC groundcover plant species (excluding grasses). Rare occurrences of important species of which there were 0 to 2 of in floristic plots conducted within the degraded condition class. ▪ Regenerating over storey species ▪ Moderate to high occurrence of exotic plant species ▪ A long history of grazing.	▪ Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum. ▪ The understorey in intact sites is characterised by native grasses and some diversity of herbs. ▪ Shrubs are generally sparse or absent. ▪ Characteristic species are present as identified in the Scientific Determination. ▪ Occurs within the known range of the TEC.	▪ Whilst in a disturbed condition, diagnostic species such as overstorey eucalypts are present. ▪ Whilst the plots undertaken did not contain greater than 12 native understorey species (excluding grasses), the size of the patch when adjacent grassland areas are included is greater than 2 ha. ▪ Mature trees and natural regeneration of eucalypts are present
Class c. (aligns to a TEC under the TSC Act. Possible CEEC under the EPBC Act - As a precaution this class has been aligned to the EPBC Act definition) (see Photo 3)	▪ Isolated line of trees only but spaced within 75 m of each other. ▪ Limited diversity of native plants. ▪ Absence or near absence of important species for the White Box Yellow Box Blakely's Red Gum Woodland CEEC (0 to 1 in floristic plots conducted within the highly degraded condition class) ▪ Moderate to high occurrence of exotic plant species particularly of ground-covering species however areas where native perennial species dominate the ground cover are patchily distributed throughout the area. ▪ In most areas < 50% of the understorey	▪ Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum. ▪ Shrubs are generally sparse or absent, though they may be locally common. ▪ Characteristic species are present as identified in the Scientific Determination; ▪ Occurs within the known range of the TEC.	The following presented issues when aligning to the CEEC criteria: ▪ Lack of overstorey eucalypts however >50% of the understorey cover is native. ▪ Trees were isolated and generally spaced within 75 m of each other. ▪ There is some doubt as to whether the condition class is sufficiently representative of the community or has sufficient resilience to recover from past disturbance. This is apparent due to the highly cleared area comprising predominantly of exotic grasses. It is likely that the agricultural management of the land has depleted the native seed bank such that recruitment is unlikely. However the condition class has been included as part

Condition	Description	How it meets the TSC Act Determination	How it meets the EPBC Act Determination
	cover is native. ▪ A long history of grazing and disturbance and moderate to high modification of the natural soil profile.		of the TEC based on the presence of adjacent patches in slightly better condition classes. As a precaution, this condition class has therefore been aligned to the CEEC.
Class d. (As a precaution this class has been aligned to the TSC Act and EPBC Act definition) (see Photo 4)	▪ General absence of trees. ▪ Limited diversity of native plants. ▪ Absence or near absence of important species for the White Box Yellow Box Blakely's Red Gum Woodland CEEC (0 to 1 in floristic plots conducted within the highly degraded condition class) ▪ Moderate to high occurrence of exotic plant species particularly of ground-covering species however areas where native perennial species dominate the ground cover are patchily distributed throughout the area. ▪ In most areas, greater than 50% of ground cover is native. ▪ A long history of grazing and disturbance and moderate to high modification of the natural soil profile	▪ Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum. ▪ Regenerating eucalypts were occasionally observed in the patch where the patch was close to better condition classes of the TEC. ▪ Characteristic species are present as identified in the Scientific Determination; ▪ Occurs within the known range of the TEC.	The following presented issues when aligning to the CEEC criteria: ▪ Lack of overstorey eucalypts - however >50% of the understorey cover is comprising of native pasture grasses. ▪ The native grassland was adjacent to areas where there were at least 5 diagnostic canopy trees within 75 m of each other. ▪ There is some doubt as to whether the condition class is sufficiently representative of the community or has sufficient resilience to recover from past disturbance. However the condition class has been included as part of the TEC based on the presence of adjacent patches in slightly better condition classes. As a precaution, this condition class has therefore been aligned to the CEEC.

Photo 1. Blakely's Red Gum - Yellow Box - Grassy open woodland (SR670) Condition Class A.

Photo 2. Blakely's Red Gum - Yellow Box - Grassy open woodland (SR670) Condition Class B.

Photo 3. Blakely's Red Gum - Yellow Box - Grassy open woodland (SR670) Condition Class C.

Photo 4. Blakely's Red Gum - Yellow Box - Grassy open woodland (SR670) Condition Class D.

4.3.2 Exotic pasture

This entirely artificial/cultivated community occupies large portions of the study area. All native vegetation has been cleared from the community (see Photo 5).

The exotic pasture consists predominantly of the following species: *Nassella tenuissima, Lolium perenne, Hypericum perforatum, Plantago lanceolata, Hypochaeris radicata, Phalaris aquatica, Sorghum leiocladum, Sonchus oleraceus, Bromus catharticus, Paspalum dilatatum, Centaurium spicatum, Lactuca serriola, Dactylis glomerata, Holcus lanatus, Acetosella vulgaris, Anagallis arvensis, Conyza bonariensis, Medicago arabica, Onopordum acanthium,* and *Verbena bonariensis*.

Photo 5. Grazed exotic pasture grasses

4.4 Threatened Ecological Communities

4.4.1 Result of database searches

The following TECs are known to or could occur within 10 km of the study area:

Endangered Ecological Communities **(TSC Act):**

- Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions
- Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory
- Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions
- Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions
- White Box Yellow Box Blakely's Red Gum Woodland.

Endangered Ecological Communities **(EPBC Act):**

- Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory;
- Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion.

Critically Endangered Ecological Communities **(EPBC Act):**

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

The potential for these TECs to occur within the study area is considered in section 4.4.

4.4.2 Result of field assessment

One TEC: White Box Yellow Box Blakely's Red Gum Woodland was found to occur within the study area during field surveys (described above).

The determination for this TEC differs for the State and Commonwealth listing as discussed in section 4.3.1 and Table 12.

Approximately 8.1 ha of the TEC listed under the TSC Act and EPBC Act would be impacted by the Project.

4.5 Site values

4.5.1 Flora

During the field survey 48 plant species were recorded across 22 families. A list of all flora identified from within the study area is included as Appendix 2.

During the field survey 25 introduced species were recorded. Five of these species are classed as noxious weeds. The noxious weed species are sporadically distributed throughout the study area, particularly where a high level of previous clearing and soil disturbance has occurred. The noxious weeds recorded within the study area that are declared under the *Noxious Weeds Act 1993* for the Goulburn Mulwaree LGA Control Area together with the legal requirements for their control are listed in Table 13.

Table 13. Noxious weeds recorded in the study area

Scientific Name	Common Name	Class	Legal Requirements
Rubus fruticosus species aggregate	*Blackberry*	4	*The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed*
Nassella neesiana	*Chilean needle grass*		
Echium plantagineum	*Paterson's curse*		
Nassella trichotoma	*Serrated tussock*		
Hypericum perforatum	*St. John's wort*		

Note: Class 4 – Locally Controlled Weeds: Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.

Apart from declared noxious species, common environmental weed species recorded within the study area include: *Bromus cartharticus* (Prairie Grass), *Cirsium vulgare* (Spear Thistle), *Conyza bonariensis* (Flaxleaf Fleabane), *Hordeum leporinum* (Barley Grass), *Hypochaeris radicata* (Catsear), *Lactuca serriola* (Prickly Lettuce), *Lantana camara* (Lantana), *Senecio madagascariensis* (Fireweed), *Solanum nigrum* (Black-berry Nightshade), *Sonchus asper* (Prickly Sowthistle), and *Verbena bonariensis* (Purpletop).

All recorded weed species have the potential to spread in response to disturbances of various kinds. Invasion of introduced perennial grasses into native communities is also a key threatening process under the TSC Act.

4.5.2 Plot and transect values

Ten BioBanking plots were undertaken during the survey. The results of the plot data and species list obtained during the field assessment is provided in Appendix 2.

4.5.3 Site Value scores

The Site Value assessment was carried out by entering the data obtained in the transects and plots into the BBCC (Appendix 2). The data provides quantitative measures of 10 site attributes (section 4.1) for each vegetation zone (Table 11).

The BBCC compares the benchmark for the vegetation type or class to provide the Site Value score. This score represents the overall condition of the vegetation compared against the benchmark.

Given the site would be cleared in the future, all the attributes were then assigned a future Site Value score of zero.

The score from these inputs, coupled with other data in the following section of this report, is used to determine the number of Ecosystem Credits that are required to offset the biodiversity impacts associated with the Project.

5. Assessing threatened species and populations

5.1 Threatened flora

5.1.1 Database analysis

Based on the results of the data review, 21 threatened flora species have been recorded within 10 km of the proposed study area (Table 14).

The list includes:

- Two species listed as Critically Endangered under TSC Act and one under the EPBC Act
- Eight species listed as Endangered under the TSC Act and eight under the EPBC Act
- Nine species listed as Vulnerable under the TSC Act and seven under the EPBC Act.

The potential for these species to occur within the study area is discussed in section 5.1.5.

Table 14. Threatened flora database results

Scientific Name	Legal Status		Records		Presence (X)	
	TSC Act	EPBC Act	Earliest / Latest Record (NSW wildlife atlas)	No. of records (NSW wildlife atlas)	EPBC Act Search within 10 km	BioBanking Tool (CMA)
Caladenia tessellata	E	V			X	
Cryptostylis hunteriana	V	V			X	
Eucalyptus aggregata	V	-	2000	1		
Eucalyptus macarthurii	V	-	1920	1		X
Genoplesium baueri	-	E			X	
Genoplesium plumosum	CE	E	1992/2002	7	X	
Grevillea molyneuxii	V	E	1933	1		
Haloragis exalata subsp. *exalata*	V	V			X	
Kunzea cambagei	V	V			X	
Lepidium hyssopifolium	E	E			X	
Leucochrysum albicans var. tricolor	-	E	1933/2008	5	X	X
Pelargonium sp. *Striatellum*	E	E			X	
Phyllota humifusa	V	V			X	
Pimelea axiflora subsp. pubescens	E	-	1978/2007	12		X
Pomaderris cotoneaster	E	E	1976/2007	6	X	X
Pomaderris pallida	V	V	2006	1	X	
Pultenaea pedunculata	E	-				X
Rulingia prostrata	E	E	1898	5		
Solanum celatum	E	-	1969/2007	31		
Thelymitra sp. Kangaloon	CE	CE			X	
Thesium australe	V	V			X	

5.1.2 Endangered flora populations

No endangered populations of terrestrial flora are listed for the locality.

5.1.3 Critical habitat - flora

No Critical Habitat declared under the TSC Act or EPBC Act occurs within the study area.

5.1.4 Threatened flora survey

The walking meanders were used to survey for threatened flora species across the study area, in particular the presence of *Solanum celatum,* given the species has been previously recorded throughout the locality.

In total, approximately 12 hours of threatened flora random meanders were conducted between 19th and the 21st of May 2015.

5.1.5 Threatened flora survey results

During the field survey, one threatened flora listed under the TSC Act was recorded outside of the study area: *Solanum celatum*. Approximately 20 plants were recorded within Dry Sclerophyll Shrubby Forest immediately to the east of the study area. The closest plant was approximately 50 m from the study area. None of these species would be impacted by the Project (Figure 10).

Based on the results of the data review and field survey, no threatened flora are likely to be present within the study area for the following reasons:

- The study area has been highly disturbed. Habitat for threatened flora is only marginally likely to occur within White Box Yellow Box Blakely's Red Gum Woodland Condition A vegetation (approximately 0.7 ha). However, given the field survey involved walking over this area and yielded no threatened flora, it is highly unlikely that any threatened flora would be impacted.
- Many of the species are relatively conspicuous and unlikely to remain undetected during field survey.

5.2 Threatened fauna

5.2.1 Database analysis

Fifty-two threatened fauna species have been recorded or predicted to occur within 10 km of the study area (Table 15). The list includes:

- One species listed as Critically Endangered under TSC Act
- Six species listed as Endangered under the TSC Act and five under the EPBC Act
- Thirty-five species listed as Vulnerable under the TSC Act and 12 under the EPBC Act
- Eleven species listed as Migratory under the EPBC Act.

Of those species listed under the TSC Act, 15 are regarded as 'Species credit Species' which unlike 'Ecosystem credit Species' cannot be assumed present based on habitat surrogates.

The potential for these species to occur within the study area is discussed in section 5.2.10 and in Appendix 2.

Table 15. Threatened fauna previously recorded or predicted to occur

		Legal status				
Scientific Name	**Common Name**	**TSC Act**	**EPBC Act**	**EPBC Act Search within 10 km**	**BioBanking tool predicted threatened species or species requiring survey**	**Species credit or Ecosystem credit Species**
Amphibians						
Heleioporus australiacus	Giant Burrowing Frog	V	V	X		Species
Litoria aurea	Green and Golden Bell Frog	E	V	X		Species
Litoria littlejohni	Littlejohn's Tree Frog	V	V	X		Species
Anthochaera phrygia	Regent Honeyeater	CE	E,M	X	X	Species
Birds						
Ardea alba	Great Egret	-	M	X		N/A
Ardea ibis	Cattle Egret	-	M	X		N/A
Botaurus poiciloptilus	Australasian Bittern	E	E	X		Species
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	-	X	Ecosystem
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	-		Ecosystem
Chthonicola sagittata	Speckled Warbler	V	-	-	X	Ecosystem
Climacteris picumnus victoriae	Brown Treecreeper	V	-	-	X	Ecosystem
Daphoenositta chrysoptera	Varied Sittella	V	-	-	X	Ecosystem
Gallinago hardwickii	Latham's Snipe	-	M	X		N/A
Glossopsitta pusilla	Little Lorikeet	V	-	-		Ecosystem
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	M	X		N/A
Hieraaetus morphnoides	Little Eagle	V	-	-	X	Ecosystem
Hirundapus caudacutus	White-throated Needletail	-	M	X		N/A
Lathamus discolor	Swift Parrot	E	E	-		Ecosystem
Melanodryas cucullata cucullata	Hooded Robin	V	-	-	X	Ecosystem
Melithreptus gularis gularis	Black-chinned Honeyeater	V	-	-	X	Ecosystem
Merops ornatus	Rainbow Bee-eater	-	M	-		N/A
Monarcha melanopsis	Black-faced Monarch	-	M	X		N/A
Myiagra cyanoleuca	Satin Flycatcher	-	M	X		N/A
Neophema pulchella	Turquoise Parrot	V	-	-		Ecosystem

		Legal status				
Scientific Name	**Common Name**	**TSC Act**	**EPBC Act**	**EPBC Act Search within 10 km**	**BioBanking tool predicted threatened species or species requiring survey**	**Species credit or Ecosystem credit Species**
Ninox connivens	Barking Owl	V	-	-	X	Ecosystem
Ninox strenua	Powerful Owl	V	-	-		Ecosystem
Petroica boodang	Scarlet Robin	V	-	-	X	Ecosystem
Petroica phoenicea	Flame Robin	V	-	-	X	Ecosystem
Rhipidura rufifrons	Rufous Fantail	-	M	-		N/A
Rostratula australis	Australian Painted Snipe	E	E, M	X		Ecosystem
Stagonopleura guttata	Diamond Firetail	V	-	-	X	Ecosystem
Tyto novaehollandiae	Masked Owl	V	-	-		Ecosystem
Tyto tenebricosa	Sooty Owl	V	-	-		Ecosystem
Mammals						
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	X		Ecosystem and Species
Dasyurus maculatus	Spotted-tailed Quoll	V	E	X	X	Ecosystem
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	-	X	Ecosystem
Kerivoula papuensis	Golden-tipped Bat	V	-	-		Ecosystem
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	-		Ecosystem and Species
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	-		Ecosystem
Petaurus australis	Yellow-bellied Glider	V	-	-		Ecosystem
Myotis macropus	Southern Myotis	V	-	-		Ecosystem and Species
Petaurus norfolcensis	Squirrel Glider	V	-	-		Species
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	X		Species
Phascolarctos cinereus	Koala	V	V	X	X	Species
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V			Ecosystem
Pseudomys novaehollandiae	New Holland Mouse	-	V	X		Ecosystem
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	X		Ecosystem and Species.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	-		Ecosystem

		Legal status				
Scientific Name	**Common Name**	**TSC Act**	**EPBC Act**	**EPBC Act Search within 10 km**	**BioBanking tool predicted threatened species or species requiring survey**	**Species credit or Ecosystem credit Species**
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	-		Ecosystem
Reptiles						
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	X		Species
Delma impar	Striped Legless Lizard	V	V	X		Species
Hoplocephalus bungaroides	Broad-headed Snake	E	V	X		Species
Varanus rosenbergi	Rosenberg's Goanna	V	-	-	X	Species
Suta flagellum	Little Whip Snake	V	-	-	X	Ecosystem

5.2.2 Endangered fauna populations

No endangered fauna populations have been listed for the study area.

5.2.3 Critical habitat - fauna

No Critical Habitat declared under the TSC Act or EPBC Act occurs within the study area.

5.2.4 Fauna survey effort

The fauna field surveys incorporated both targeted survey using established survey techniques (as described in Table 16) and habitat-based assessment.

Habitat assessment considered the type and condition of habitats for fauna species. Habitat features recorded within the survey area included:

- Topographic features (such as slope, aspect and landscape position)
- Geology/soil type
- Dominant vegetation community composition, structure and condition of strata levels
- Form, quality and location of water sources
- The presence, number, size and condition of unique habitat features (such as tree hollows and crevices, loose tree bark, fallen timber mistletoe and any rock outcropping or scattered surface rock)
- The level of disturbance.

The fauna survey design effort had an emphasis on detection of Species Credit species where available habitat was present for such species. Since Ecosystem Credit species (see Table 15) have a high likelihood of being present on the site (based on the presence of habitat surrogates) specific targeted survey was not always performed for these species. However, the design attempted to detect the range of fauna using the study area in order to assist with evaluating its importance to fauna more generally.

Table 16. Fauna survey details and effort

Method	Effort and Timing	Details
Ultrasonic call recording for bats	2 x nights 19/05/2015 – 21/05/2015	Wildlife Acoustics SM2BAT ultrasonic recorders were deployed overnight at two sites and set to record from dawn to dusk. The detectors were placed on the ground or elevated up to a metre where possible and pointed upwards at approximately a 45 degree angle.
Diurnal bird surveys (2 hectare)	1 hour 20/05/2015 2 hours 21/05/2015	20 minute, 2 hectare bird surveys were extended in time (to 1 hour) and space (3-4 hectares) due to relatively low bird activity in most areas and additional species being recorded after or at the end of the typical standard 20 min period. Incidental bird sightings were made throughout survey activities with species of note being recorded spatially. Birds were identified with the use of 10 X 42 binoculars or from their calls.
Spotlighting	2 hours 19/05/2015 1.5 hours 20/05/2015	Spotlighting surveys targeting ground dwelling and arboreal mammals and nocturnal birds were performed, primarily on foot but also from a slow moving vehicle, throughout the study area.
Call playback and listening	2 x 30 minute surveys 19/05/2015 1 x 30 minute survey 20/05/2015	Target species - Powerful Owl, Masked Owl, Sooty Owl, Koala, Yellow-bellied Glider and Squirrel Glider. Call-playback was performed at three locations within the study area over two nights. After an initial listening period of 15 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.
Frog chorus survey and aquatic habitat surveys.	15 mins 03/02/2015	Frogs were listened for at dams and permanent and ephemeral drainage lines throughout the study area. Active searching for frogs was not conducted due to lack of habitat for threatened species and seasonality.

Method	Effort and Timing	Details
Stag watching	2 x 20 mins:19/05/2015 1 x 20 mins: 20/05/2015	Trees with hollows or cracks were watched immediately prior to sunset in conjunction with call playback.
Koala SAT Koala indirect evidence surveys	1 x survey 20/05/2015 3 hours across trees within the study area.	A SAT (Koala scat) survey was done in the parts of the study area where clumps of trees were present. In addition to the SAT survey tree inspections were carried out during traverses of the study area at selected preferred feed tree species searching for scats and characteristic bark scratches.
Opportunistic survey	During all activities	Opportunistic observations were made of fauna aided with binoculars and photography as appropriate. Opportunistic survey included searches of habitat such as under logs, rocks or waste piles (where limited areas of such habitat existed) or within heaped leaf litter, casual bird or mammal observations or observations of their calls, and observations of indirect evidence for certain species such as scats tracks and other traces.

5.2.5 Weather conditions during survey

Weather conditions for the survey period were obtained from the Bureau of Meteorology (Station 70330 - Table 17). In summary, temperatures generally ranged from 5 degrees Celsius in the early morning to 15 degrees Celsius during the day. Rainfall occurred on Wednesday 20th morning.

Table 17. Weather conditions during field survey

Date	Day	Temperature		Rain	Max wind gust			9:00 AM			3:00 PM		
		Min	Max		Direction	Speed	Time	Temp	Direction	Speed	Temp	Direction	Speed
		°C	°C	mm		km/h	local	°C		km/h	°C		km/h
19	Tu	5.4	13.4	0	NNW	24	20:56	10.5	NNW	7	12.7	NNW	13
20	We	6.9	18	7.8	NW	41	13:55	11.4	Calm		17.5	WNW	26
21	Th	4.5	15.5	0	N	50	7:18	9.8	NW	9	14.8	SSE	9

5.2.6 Limitations

Field survey sites were located within representative areas of the prevailing habitats with a bias towards better condition areas.

5.2.7 Fauna survey results

Available fauna habitat within the study area was relatively limited consisting of:

- Grassy Woodlands (mostly scattered trees with a mix of native and exotic grasses) and
- Farm dams.

Dry sclerophyll woodland (shrub/grass subformation) habitat occurred to the east of the study area leading into the Barbers Creek gorge.

Grassy Woodland

Grassy Woodland habitat within the study area consisted predominantly of sparse scattered trees mainly *Eucalyptus melliodora* and *E. blakelyi* with areas of more consolidated woodland patches occasionally present. Habitat features were degraded due to historic clearing and grazing.

Trees were predominantly mature (30 – 50 cm diameter breast height (Dbh)), however larger trees occasionally occurred reaching a Dbh of 1 m. No tree hollows were observed within the study area despite targeted survey. This is attributed to past clearing practices and a lack of recent fire or other disturbance factors that might cause tree hollows. Logs, including hollow logs, were rare throughout the site, being

confined to isolated occurrences around the base of larger trees. Logs are generally medium sized reflecting the prevalent tree size structure. No large (> 60 cm diameter) hollow logs were recorded with log diameter typically 10 to 30 cm. Logs were typically from fallen branches rather than tree trunks. Rocky outcrops occurred within the eastern and southern margins of the proposed study areas but offered limited reptile habitat due to a general absence of exfoliating rock or scattered surface rock.

Farm dams

Three dams from 0.05 – 0.15 ha in size occurred within the study area. The dams differ in their shape and depth and accordingly the quantity and diversity of aquatic macrophyte and shallow benthic habitat. In general terms the dams were typical of farm dams in the area and included small areas of fringing low diversity aquatic macrophyte assemblages within their shallows. Cattle access had degraded existing macrophyte assemblages and water quality. The dams would play a role in water supply for vertebrate fauna and may act as foraging habitat for bats, birds and common frogs.

5.2.8 Disturbance of habitat

Clearing has occurred throughout the study area which is the major source of disturbance. Numerous sources of disturbance continue to operate throughout the study area. Livestock grazing (cattle) occurs throughout the study area. Rabbits and Brown Hares were moderately common throughout most of the study area as well. Foxes were observed during spotlighting. These introduced predators, coupled with the low abundance of available sheltering habitat (such as hollow logs) would have undoubtedly led to a decreased abundance and diversity of small and medium sized ground dwelling mammals.

Weeds were common throughout the study area in response to levels of grazing or other disturbance factors. There was no evidence of recent bushfire throughout the study area.

5.2.9 Fauna recorded from field surveys

Fauna field surveys using the methods described in section 5.2.4 were undertaken. Opportunistic sightings within the study areas were also recorded.

A total of 49 fauna were recorded during field surveys comprising two reptiles, 16 mammals, 29 birds and two frog species. A complete fauna list is provided in Appendix 4.

The suite of fauna recorded were predominantly locally common species tolerant of at least moderate disturbance and lower condition vegetation or degraded habitats. Frogs recorded consisted of common species able to persist in farm dams with limited shallow habitat and fringing vegetation. Similarly there was low species richness for reptiles and species recorded were common species.

Several species were recorded aurally during survey from adjacent woodland areas but would not be expected to use the study area (e.g. Superb Lyrebird). Some mobile species recorded would primarily be dependent on the adjacent woodland areas to the east but would take advantage of parts of the study area to forage (e.g. common Wallaroo, Large-eared Pied Bat).

5.2.10 Threatened fauna recorded and potential to occur

Six threatened fauna were recorded from the survey area (Diamond Firetail, Scarlet Robin, Varied Sittella, Eastern Bentwing Bat, Greater Broad-nosed Bat and Large-eared Pied Bat) (Figure 10 Table 18). All threatened species recorded are listed as vulnerable threatened species under the TSC Act and one (Large-eared Pied Bat) is listed as vulnerable under the EPBC Act.

A number of additional threatened fauna have the potential to occur within the study area but were not recorded, most likely due to their potential use of the study area or wider locality being limited to sporadic occurrences (e.g. nomadic birds). Such species are tabled in Appendix 2 as species with a moderate or higher chance of occurring and include: Gang-gang Cockatoo, Speckled Warbler, Rainbow Bee-eater, Black-faced Monarch, Flame Robin, Rufous Fantail, Eastern False Pipistrelle, Koala and Grey-headed Flying-fox. Impacts of the Project on these species are considered in section 6.2.4.

Table 18: Threatened fauna recorded in the study area

Common Name	Scientific Name	TSC Act Status	EPBC Act Status	Species credit or Ecosystem Credit species
Diamond Firetail	*Stagonopleura guttata*	V	-	Ecosystem
Scarlet Robin	*Petroica boodang*	V	-	Ecosystem
Varied Sittella	*Daphoenositta chrysoptera*	V	-	Ecosystem
Eastern Bentwing Bat	*Miniopterus schreibersii*	V	-	Ecosystem (no breeding habitat on-site)
Greater Broad-nosed Bat	Scotorepens ruppellii	V		Ecosystem
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	Ecosystem (no breeding habitat on-site)

Key: V = species listed as vulnerable under relevant legislation

5.2.11 Migratory species (EPBC Act)

During the field survey, no migratory species listed under the EPBC Act were recorded. However, a number of listed migratory species have been recorded from the locality and in some cases have the potential to fly over the study area (see Appendix 2). Species include: Cattle Egret, Speckled Warbler, Rainbow Bee-eater, Black-faced Monarch, and Rufous Fantail. Impacts of the Project on these species are considered in section 6.2.4.

6. Impact assessment

The Impact Assessment forms Stage 2 of the Biodiversity Assessment Report as detailed in the FBA.

The following impact assessment has been conducted considering the FBA with particular attention to PCTs, and those species listed as Species credit species under the FBA. Further Assessment of Significance have been carried out for those species listed under the EPBC Act that may potentially be impacted by the Project.

6.1 Potential impacts

The Project would impact biodiversity, including threatened biodiversity through both direct and indirect impacts associated with the development of the southern overburden emplacement. The majority of impacts on biodiversity would occur as a result of direct impacts through clearing of native vegetation and removal of habitat for flora and fauna. Indirect impacts are also considered within the overall assessment of impacts.

Impacts on biodiversity would occur during the development of the southern overburden emplacement. Rehabilitation of this new overburden emplacement will be undertaken progressively and completed as soon as practically possible after the emplacement has reached it's final landform. While rehabilitation of the southern overburden emplacement would be important in mitigating long-term impacts from the Project, for the purpose of conducting this impact assessment, minimal consideration has been given to the likelihood of threatened species re-establishing populations within the rehabilitated emplacement.

6.2 Direct Impacts

6.2.1 Native vegetation

The main impact on biodiversity associated with the Project is clearing of native vegetation and removal of habitat, including threatened species habitat, within the study area.

Details regarding the areas of vegetation to be disturbed are provided in Table 11.

The extent of clearing of native vegetation communities is conservatively estimated at 8.1 ha. A further 4.8 ha of exotic pasture and existing cleared land would be developed as a result of the Project. The total disturbance footprint is 12.9 ha.

6.2.2 Threatened ecological communities

One TEC would be impacted by the Project – White Box Yellow Box Blakely's Red Gum Grassy Woodland, which is listed as an EEC under the TSC Act and a CEEC under the EPBC Act.

As discussed previously (refer to section 4.3.1), the determination for this TEC differs for the State and Commonwealth listing.

In total the Project would result in the disturbance of approximately 8.1 ha of the TEC listed under the TSC Act and EPBC Act.

To satisfy the EPBC Act requirements, a MNES Assessment of Significance has also been conducted and provided in Appendix 5 for White Box Yellow Box Blakely's Red Gum Grassy Woodland. The Assessment concluded that the Project is unlikely to significantly impact the CEEC.

The TEC has been discussed in detail below and has been considered further in the offset strategy for the Project (section 8).

White Box Yellow Box Blakely's Red Gum Woodland

Distribution

White Box Yellow Box Blakely's Red Gum Woodland is located throughout the study area in various condition, with the better condition generally occurring toward the south. Historically, it is likely the community occupied most of the study area prior to clearing and grazing. At present it is highly likely the existing vegetation would further decline should no management actions be implemented.

Historically, the TEC has been drastically reduced in area and highly fragmented throughout its distribution because of clearance for cropping and pasture improvement due to the ecological community's occurrence on fertile soils. Very few high quality remnants remain anywhere across its former range. The EPBC Policy Guidelines (DoE 2014) also state that over 90% of the original extent of this ecological community has been cleared. This is supported by OEH (2014) who regarded the equivalent Biometric Vegetation Type to be 90% cleared, and Thomas et al. (2000) estimate that within South-Eastern NSW 59,468 ha remain from the pre-1750 extent of 1,012,052 ha (approximately 94% cleared).

Thomas et al. (2000) also estimate that in south-eastern NSW the extent of White Box-Yellow Box-Blakely's Red Gum Woodland has been reduced to around 5% of its pre-1750 distribution, existing as remnants that have greater than 20% canopy cover, and are 10 ha in size or larger. Further, it is considered that only 0.05% of Box-Gum Grassy Woodland in NSW remains in near to original condition (Prober and Thiele 2005).

In an attempt to determine the extent of Box-Gum Woodland in the locality, mapping by Tozer et al (2006) was examined as it covered the extent of the study area. A total of 3,304.6 ha of the best equivalent vegetation type (p24, Tableland Grassy Box Gum Woodland) has been mapped within a 10 km radius of the study area. The p24 mapping unit has been described by Tozer as potentially aligning to the CEEC and the state listed EEC, however it would include some areas that do not meet the CEEC. As a conservative approach, it has been assumed in this assessment that half of the total p24 area would be an approximate representation of the remaining CEEC in the locality (i.e. 1,652.3 ha). The potential habitat removed by the Project is therefore estimated to represent <0.5% of the community in the locality.

Conservation reserves

In NSW, White Box Yellow Box Blakely's Red Gum Woodland is poorly represented in conservation reserves. The community is currently known to occur within at least 42 National Parks, Nature Reserves and State Conservation Areas; although in some cases these remnants are quite small. The exact area of the ecological community protected in NSW is currently still to be quantified, however in the South-Western Slopes bioregion, estimates suggest approximately 8000 ha occurs in National Parks and Nature Reserves (Benson 2008).

There are small occurrences of White Box Yellow Box Blakely's Red Gum Woodland in Border Ranges National Park, Goobang National Park, Goulburn River National Park, Manobalai Nature Reserve, Mt Kaputar National Park, Oxley Wild Rivers National Park, Queanbeyan Nature Reserve, Towari National Park, Warrumbungle National Park, Wingen Maid Nature Reserve and Wollemi National Park. The community also occurs in the following State Conservation Areas, Copeton, Lake Glenbawn and Lake Keepit (DECCW). None of these conservation reserves occur within the locality of the Project.

Importance of habitat

The TEC determination states that it is questionable whether it would ever be possible to define and locate habitat that is critical for a widespread ecological community that is considered critically endangered, precisely because it has been cleared, fragmented and degraded to the point where its medium- and long-term survival is threatened. Given the current highly fragmented and degraded state of this ecological community, all areas of Box-Gum Grassy Woodland which meet the minimum condition criteria outlined in Section 3 of the EPBC Act Policy could therefore be considered critical to the survival of this ecological community. Furthermore, DoE (undated) states that degraded woodland areas not considered part of the listed ecological community may also be essential to the long-term conservation of Box-Gum Grassy Woodland, by virtue of their landscape setting (e.g. providing connectivity) or remaining flora/fauna habitat features (e.g. occurrence of rare or threatened species, tree hollows), and should also potentially be considered as habitat critical to the survival of the ecological community. The DoE definitions of critical habitat are encompassing and too broad scale to allow a true depiction of habitat critical to the survival of the TEC. As discussed above, it is estimated that <0.5% of the community in the locality is likely to be impacted by the Project. As discussed in section 4.3.1, the TEC within the study area is highly disturbed, with some areas only considered part of the community on a precautionary basis. Not all the TEC within the locality would be impacted as a result of the Project and as such the Project would not result in a significant loss towards the TEC at a local or regional scale. With this in mind, it is unlikely that the TEC in the study area is habitat critical to the survival of the TEC. Furthermore, given the degraded condition of the TEC (within the study area), its condition is likely to further decline without management, as it is subjected in parts to grazing and lack of weed and pest management. For these reasons, it should be considered that the study area does not contain habitat critical to the survival of the TEC.

Fragmentation

In its current condition, the patches of White Box Yellow Box Blakely's Red Gum Woodland in the study area are already fragmented by historic agricultural practices. This is a common theme for the TEC which is highly fragmented in the locality (Tozer, 2006 mapping of map unit 24). The Project would lead to minor fragmentation of the ecological community from the patches of the TEC to the west, and patches of the TEC to the east. However connectivity to other native vegetation would be retained within contiguous habitat around the periphery of the study area.

Objectives or actions of a recovery plan or threat abatement plan.

A National Recovery Plan has been prepared for White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland (2011). The objectives of the recovery plan and how each is being addressed by the Project are detailed below:

- Achieving no net loss in extent and condition of the ecological community throughout its geographic distribution – The Project would result in a loss of the TEC. Approximately 8.1 ha of the TEC in a degraded condition is to be cleared as part of the Project. However, an offset would be provided which will enhance the viability of the TEC in the long-term through management in perpetuity.
- Increasing protection of sites in good condition – The Project would result in clearing approximately 8.1 ha of TEC in a degraded condition (0.7 ha of which is in a moderately degraded condition). An offset will be provided under the FBA which would be managed in perpetuity for White Box - Yellow Box - Blakely's Red Gum Grassy Woodland on the proposed offset site.
- Increasing landscape functionality of the ecological community through management and restoration of degraded sites – The Project will result in the removal of approximately 8.1 ha of TEC in a degraded condition. However, the offset strategy involving the active management and restoration of degraded

sites of the TEC on Boral owned lands to the north of the Project, is likely to increase landscape functionality of these patches of the TEC.

- Increasing transitional areas around remnants and linkages between remnants – The study area is already fragmented. The Project will result in further fragmentation of the TEC.
- Bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland – The Project will offer an offset as detailed in section 7 of this report in order to enhance and protect areas of the TEC.

6.2.3 Threatened flora

No threatened flora are likely to be impacted by the Project given the lack of habitat and results of the field survey. The population of *Solanum celatum* which was recorded outside of the study area is unlikely to be impacted by the Project.

It is therefore unlikely that the Project will result in a significant impact to any threatened flora.

6.2.4 Threatened fauna

Fifteen threatened and migratory fauna (Table 19Table 19) are considered to be affected by the Project (affected species) after application of the process described in section 2.1 (Diagram 1).

The Koala is the only Species credit species to be potentially affected. The Koala has been assigned a low (marginally moderate) likelihood of occurrence given previous records in the locality, and the study area presenting only marginal habitat given the presence of scattered eucalypts. The Koala, may occasionally move through the study area, however this is unlikely to be occurring on a regular basis given there were no Koala scats or scratches identified on trees within the study area, and the targeted survey involving spotlighting and Koala SAT plots (section 5.2.4) did not yield any results. Given the species was not recorded on-site and the relatively low likelihood of occurrence, an offset for the species is not proposed under the FBA.

The Large-eared Pied Bat and Eastern Bentwing Bat are both Species/Ecosystem credit species, however, the habitat pertaining to the Species credit component of the species would be unaffected by the Project as no breeding habitat for these bat species occurs within the study area. The Large-eared Pied Bat's preferred breeding habitat comprises caves and mine shafts (OEH 2012), neither of which will be impacted by the Project. Similarly caves are the primary roosting habitat for the Eastern Bentwing Bat, but they also use derelict mines, storm-water tunnels, buildings and other man-made structures (OEH 2012). Given none of these features are located within the study area, and impacts to breeding habitat are unlikely, both species have been regarded as Ecosystem Credit species only and therefore no further assessment of impact is required based on the FBA and the offsetting of the associated PCTs provided in section 8.

No Species Credit species will therefore be impacted by the Project.

The remaining affected species are Ecosystem Credit species or Migratory species, not assessed under the FBA. Most of these species are likely to utilise the foraging habitat of the study area on an intermittent basis. No further assessment of impact is required for the Ecosystem Credit Species based on the requirements of the FBA and the offsetting of the associated PCTs provided in section 8.

Those species in Table 19Table 19 which are listed under the EPBC Act include Vulnerable species: Koala, Large-eared Pied Bat and Grey-headed Flying Fox; and Migratory species: Cattle Egret, Rainbow Bee-eater, Rufous Fantail and Black-faced Monarch. An EPBC Act Assessment of Significance for each of these species

has been completed and provided in Appendix 5. Based on the results of the Assessments, a significant impact to any EPBC Act listed threatened fauna is unlikely.

Table 19: Affected threatened and migratory fauna

Scientific Name	Common Name	TSC Act	EPBC Act	Likelihood of Occurrence	Potential for Impacts	Species credit or Ecosystem Species and whether predicted
Ardea ibis	Cattle Egret	-	M	Moderate	Unlikely - Assessment of Significance completed (Appendix 5)	N/A
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Moderate. Recorded on Peppertree Quarry by ERM (2006)	Potential – with negligible impacts.	Ecosystem – involved in Ecosystem Credit calculations
Chthonicola sagittata	Speckled Warbler	V	-	Moderate	Potential – with negligible impacts.	Ecosystem – involved in Ecosystem Credit calculations
Daphoenositta chrysoptera	Varied Sittella	V	-	Known	Likely – non-significant impacts	Ecosystem – involved in Ecosystem Credit calculations
Merops ornatus	Rainbow Bee-eater	-	M	Moderate	Unlikely Assessment of Significance completed (Appendix 5)	N/A
Monarcha melanopsis	Black-faced Monarch	-	M	Moderate	Unlikely Assessment of Significance completed (Appendix 5)	N/A
Petroica boodang	Scarlet Robin	V	-	Known	Likely – non-significant impacts	Ecosystem – involved in Ecosystem Credit calculations
Petroica phoenicea	Flame Robin	V	-	Moderate	Potential – with minimal impacts.	Ecosystem – involved in Ecosystem Credit calculations
Rhipidura rufifrons	Rufous Fantail	-	M	Moderate	Unlikely Assessment of Significance completed (Appendix 5	N/A
Stagonopleura guttata	Diamond Firetail	V	-	Known	Likely – non-significant impacts	Ecosystem – involved in Ecosystem Credit calculations
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Known	Likely – non significant impacts. Assessment of Significance completed (Appendix 5	Species – Species Credits generated. Assessed for impacts under the Commonwealth Assessment of Significance.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Moderate	Potential – with low level impacts.	Ecosystem – involved in Ecosystem Credit calculations
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	Known	Likely – non significant impacts.	Ecosystem and species. Species credit component (breeding habitat) excluded from assessment.

Scientific Name	Common Name	TSC Act	EPBC Act	Likelihood of Occurrence	Potential for Impacts	Species credit or Ecosystem Species and whether predicted
Phascolarctos cinereus	Koala	V	V	Low-moderate	Unlikely. Assessment of Significance completed (Appendix 5	Species – not recorded during survey. No further assessment. Assessed for impacts under the Commonwealth Assessment of Significance.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Moderate	Likely – negligible, Assessment of Significance completed (Appendix 5).	Ecosystem and species. Species credit component (breeding habitat) excluded from further assessment.

V=Vulnerable, M = Migratory

6.3 Avoidance of direct impacts

In accordance with the NSW Biodiversity Offsets Policy for Major Projects and the FBA, proponents must demonstrate the measures employed to avoid, mitigate and offset impacts of a Project on biodiversity values. This section of the report outlines the avoidance, management and mitigation measures that Boral has incorporated into the Project design or will employ during construction, operation or completion of the Project to reduce impacts on biodiversity values. Section 8 of this report describes the offset strategy for the Project to account for residual impacts that cannot be avoided or mitigated.

6.3.1 Site selection and design considerations

Site selection for the Project has been largely dictated by the availability of Boral owned land, within the development consent boundary, that is not required for other quarry operations, is located as far as possible from neighbouring residences and does not impact on land with higher biodiversity values i.e. is located on grazing lands that have been highly modified through historic agricultural practices.

Alternatives locations for the Southern Emplacement Area on Boral owned land were considered and discounted on biodiversity, noise or logistical grounds. These alternatives included:

- A patch of Boral owned land (within the Peppertree Quarry consent boundary) boarded by the Western Overburden Emplacement to the north-east, Boral's private railway line to the north, the agricultural lime manufacturing facility to the west, the agricultural lime manufacturing facility's driveway to the south and Marulan South Road to the east. This site was discounted as it:
    - Is located significantly closer to sensitive receivers than the proposed Southern Overburden Emplacement site, with associated noise implications;
    - Supports a greater area of more intact native vegetation with greater resilience than alternative sites;
    - Requires a longer haulage distance resulting in greater greenhouse gas emissions; and
    - Requires trucks to cross the railway line when hauling loads to and from the pit.
- An area of Boral owned land (within the Peppertree Quarry consent boundary) located immediately north of Tangarang Creek. This site was discounted as it:
    - Is located closer to sensitive receivers than the proposed Southern Overburden Emplacement site, with associated noise implications;
    - Is likely to be of higher Aboriginal heritage significance due to its proximity to a prominent creek – Tangarang Creek;
    - Is logistically more complex as trucks need to drive through the processing plant and cross the Tangarang Dam wall to access the site; and
    - Is the location of an additional approved water supply dam for the Quarry.

The location for the proposed Southern Overburden Emplacement (Figure 4) was therefore selected as the preferred location due to the following reasons:

- It is located the furthest from noise sensitive receivers;
- Trucks do not need to cross the railway line, the Tangarang dam wall or drive along Marulan South Road;
- The site supports limited Aboriginal heritage values;
- The historic clearing coupled with the existing and historic grazing within the study area has resulted in most of the native vegetation within the preferred Southern Overburden Emplacement area having a significantly low resilience. Although the TEC White Box Yellow Box Blakely's Red Gum Grassy Woodland would be impacted by the Southern Overburden Emplacement, only 0.7ha of this vegetation community has high resilience with the remainder having moderate to low resilience, suggesting that it would be unlikely to regenerate naturally without intensive management; and
- A biodiversity offset area has been identified on Boral owned land approximately 1.4 km north of the preferred Southern Overburden Emplacement. This offset area supports a significantly greater extent of White Box Yellow Box Blakely's Red Gum Grassy Woodland, in significantly superior condition to that which is located within the preferred Southern Overburden Emplacement area and would achieve the biodiversity offset liability of the Project.

The proposed southern overburden emplacement has been designed to avoid/minimise impacts to adjacent areas of higher biodiversity value by:

- Maintaining a suitable buffer to the woodland associated with the neighbouring Barbers Creek Gorge.
- Developing a stormwater management system that will attenuate stormwater and trap sediment during emplacement establishment.
- Progressive and final revegetation and rehabilitation to create a stable landform that does not result in the sediment laden runoff, fugitive dust emissions, blends well with the adjacent natural landscapes of the Morton National Park and re-establishes a native bushland dominated by White Box Yellow Box Blakely's Red Gum Grassy Woodland species.

6.4 Construction

Impacts arising from the construction will primarily relate to vegetation clearing. Boral proposes to undertake the following mitigation and management actions during construction.

6.4.2 Fencing and signposting

Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing at the edge of the study area.

Signposting will be used to inform Project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with threatened species - e.g. speed limits along access roads to reduce potential for fauna vehicle strikes.

6.4.1 Employee Education and General Environmental Controls

Employees and contractors would be educated on and required to implement the following controls, to avoid or at least minimise potential environmental impacts associated with the construction of the southern overburden emplacement.

- minimise dust generation by minimising the extent and time that bare soil is exposed and by appropriate dust suppression.
- procedures for the management of hydrocarbon and/or chemical spills throughout the study area including the requirements for vehicles to carry spill kits.

- ensuring vehicles remain on designated roads and tracks and abide by site speed limits, through use of signposting and driver education during the induction process and in on-going Project discussions.
- management and removal of all rubbish from the study area.

6.4.2 Vegetation Clearing

Vegetation Clearance Protocol

The vegetation clearing protocol provided in Boral's Peppertree Quarry Landscape and Rehabilitation Management Plan should be adhered to. This Plan includes the following:

- Prior to clearing of grassland, ecologists are to survey for ground dwelling fauna and to remove any fauna/ fauna habitats to adjacent areas that would not be further disturbed.
- Prior to clearing of remnant hollow-bearing trees, ecologists are to be engaged to supervise felling. All hollow-bearing trees that are accessible safely from the ground are to be checked and identified fauna relocated. Hollows higher up and not accessible from the ground are to be identified and trees felled gently by an excavator or dozer and left overnight to allow fauna to relocate.
- Any fauna displaced during clearing are to be captured where possible and relocated to pre-planned areas (fauna to be captured and handled only by personnel trained to do so).
- In an event that fauna are injured during clearing, the NSW Wildlife Information, Rescue and Education Service (WIRES) will be contacted to handle and collect for appropriate care and rehabilitation.

6.4.3 Rehabilitation

The southern overburden emplacement would be progressively rehabilitated in accordance with the Peppertree Quarry Landscape and Rehabilitation Management Plan, to create a stable landform that does not result in sediment laden runoff or fugitive dust emissions, blends well with the adjacent natural landscapes of the Morton National Park and re-establishes a native bushland dominated by White Box Yellow Box Blakely's Red Gum Grassy Woodland species, which outcompetes invasive weed species.

6.4.4 Update of Peppertree Quarry Landscape and Rehabilitation Management Plan

It is advised that Boral's Peppertree Quarry Landscape and Rehabilitation Management Plan be updated to reflect biodiversity management measures associated with the proposed southern overburden emplacement in order to protect and manage important biodiversity values. Currently, the existing Plan discusses key commitments relating to threatened species management, pest and weed management, fire management and site hygiene practices.

Pest and weed management

The existing Plan would include a section relating to pest and weed management activities of the Project and will include:

- Management protocols for feral animals such as foxes, goats, rabbits and cats within the rehabilitation area.
- Management protocols for the identification of noxious or important environmental weeds within areas to be cleared (in order to avoid transporting the weeds to rehabilitation areas or other parts of the site).

Fire management

Boral currently have a Bushfire Management Plan (Boral 2015) for the South Marulan Operations. Fire prevention and suppression are detailed within the Plan including emergency protocols should a fire occur. This Plan would be updated where required to reflect the Project.

6.5 Indirect impacts

Indirect impacts associated with the Project will largely occur during the construction of the new overburden emplacement resulting in a short term impact (i.e. the construction and rehabilitation phases of the southern overburden emplacement) and will be minimised where possible through management procedures. A range of indirect impacts are likely to, or could, occur as a result of the Project including:

- Increased noise and dust.
- Erosion or sedimentation in the drainage lines downslope.
- Increased spreading of weed propagules.
- Increased edge-effects on the adjacent woodlands of the Barbers Creek Gorge.

The indirect impacts described above are variable in terms of the distance they may extend from the study area, and in many cases, due to mitigation measures, indirect impacts will be completely contained within the study area. Indirect impacts are unlikely to extend into areas of native vegetation due to the following:

- The study area and its surrounds are highly disturbed and currently used for grazing.
- The edges of the study area are already disturbed and contain introduced species.
- A buffer of approximately 30 to 50 m occurs between the study area and the woodland areas adjacent.
- Mitigations measures are proposed to minimise noise and dust emissions, the introduction and spread of weeds and erosion and sedimentation of downstream drainage systems.

Indirect impacts on the biodiversity values of areas surrounding the proposed southern overburden emplacement, along with recommended mitigation measures to minimise identified impacts, are discussed in Table 22.

Table 20. Indirect impacts

Indirect impact	Likely impact from the Project	Mitigation measure
Edge effects	The establishment of the new southern overburden emplacement would result in the creation of new edges adjacent to areas of existing native vegetation, however these edges would be located on disturbed grazing land. The woodland areas which occur approximately 50 metres from the southern overburden emplacement (at its closest point) to the east and south may be exposed to edge effects, however, given the distance from the emplacement, these are likely to be minor. The new edges could facilitate the establishment and spread of introduced plant species, however appropriate monitoring and control measures would be implemented during and after construction, to counter act weed invasion. The overburden emplacement would be progressively rehabilitated and will eventually be entirely revegetated to a native, open woodland community, which will recreate fauna habitat and minimise the edge effect created during construction disturbance.	Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing at the edge of the emplacement. Signposting and education will be also be used to inform Project personnel of no-go areas, especially those of higher conservation value located to the east and south og the emplacement. Weed management and monitoring to be updated in the existing Landscape and Rehabilitation Management Plan (Boral 2012).
Weeds	Weeds have the opportunity to establish themselves in areas of disturbed vegetation. The greatest establishment of weeds are in areas already disturbed or subject to agricultural land use. This is mainly toward the north of the study area and the surrounding land to the north which is currently grazed by livestock. However, it should be noted that weeds were common throughout the entire study area. The Project has the potential to increase or lead to the establishment of weed species where they do not currently exist through the operation of machinery during construction. New weed species can potentially be introduced as a result of the movement of construction vehicles and materials into the study area. Areas more likely to be exposed to weed increases are areas of native vegetation that occur to the east and south of the study area as these areas, unlike the study area, are in better condition and contain less introduced species. However, weeds will be controlled during and after construction in accordance with the Landscape and Rehabilitation Management Plan and thus indirect impacts from weeds is likely to be minor within the adjacent woodland areas.	Weed management and monitoring to be implemented in accordance with the Landscape and Rehabilitation Management Plan.
Erosion and sedimentation	Erosion of soils and associated sedimentation associated with the proposed overburden emplacement may involve the following: • Alteration of soil structure beneath haul roads. • The increase of surface water flow from the study area during rain events into the woodland areas to the east and south may result in erosion. • The deposition of soil particulates in drainage lines and remnant vegetation along the toe of the emplacement.	Sediment basins have been designed to attenuate stormwater runoff and capture sediment from the overburden emplacement. Stormwater management measures will be implemented in accordance with the recommendations in the Peppertree Quarry Modification 4 Surface Water Assessment (Advisian 2015) and in accordance with Peppertree Quarry Water Management Plan.
Dust	Dust will be generated from the construction of the southern overburden emplacement and the extended in-pit operating hours. The Peppertree Quarry Modification 4 Air Quality Impact Assessment (Todoroski Air Sciences 2015) concluded that the Project is unlikely to result in exceedances of the relevant air quality	Dust impacts will be mitigated through the onsite use of water suppression and the progressive rehabilitation of the overburden emplacement. Further, vegetation clearing protocols for the Project will

Indirect impact	Likely impact from the Project	Mitigation measure
	criteria and is therefore unlikely to impact on human health. Through accumulation with existing dust generated from existing Quarry operations, dust generated during construction of the southern overburden emplacement has the potential to impact upon the health of plants and vegetation particularly in those areas of dense native woodland immediately adjacent to the site. Research shows that the impacts of dust on vegetation can have both positive and negative impacts, however the impacts of increased levels of dust on animals are unknown (Farmer 1993). Farmer (1993) anticipated that dust may increase the susceptibility of plants and vegetation to secondary stresses, such as drought, insects and pathogens, or allow penetration of toxic metals or phytotoxic gaseous pollutants.	seek to minimise exposed areas with the potential to generate dust by completing vegetation clearing as close to the commencement of overburden emplacement as practical.
Noise	Noise will be generated from the construction of the southern overburden emplacement and the extended in-pit operating hours. The Peppertree Quarry Modification 4 Noise Impact Assessment (Wilkinson Murray 2015) concluded that the Project is unlikely to result in exceedances of the relevant noise criteria during the day, evening or night time. Although relevant research is limited, studies have found that traffic noise can mask the important contact calls of certain birds such as the budgerigar, canary, and Zebra Finch, (Lohr et al. 2003). Parris and Schneider (2008) found that it was increased volumes of noise and not increased volumes of traffic that were important. Various studies have indicated that changes in bird calls in response to traffic noise are twofold, either the birds change the characteristics of their call to avoid interaction of the sound of the call with the created sounds or they limit calling to periods when the levels of noise are reduced. As the construction of the southern overburden emplacement will be undertaken immediately south of and after the completion of the eastern overburden emplacement, fauna inhabiting the adjacent woodlands of Barbers Creek Gorge will not be exposed to any greater noise than they are currently exposed to. The noise assessment of both the extension of in-pit operating hours and the establishment of the southern overburden emplacement has predicted that the proposed modifications to the approved operations, will not result in any perceptible changes in noise levels in the surrounding area. The Project is therefore unlikely to result in any additional noise impacts on local fauna.	It should be noted that noise emissions from the extension of in-pit operating hours and the establishment of the southern overburden emplacement would be managed and monitored in accordance the Peppertree Quarry Noise and Blast Management Plan, which includes all reasonable and feasible noise mitigation measures.
Increased lighting	The emplacement of overburden in the proposed new southern overburden emplacement area will undertake in accordance with the Project Approval i.e. 7am – 7pm and will therefore be undertaken largely within daylight hours without the need for artificial lighting. Additional night time lighting associated with the Project will therefore be limited to that which is produced from the proposed extension in operating hours of the in-pit works. The light that is currently emitted from the existing operations is from the lighting associated with the out-of-pit works, primarily the processing plant and surrounds, which is the main light source from the Quarry. The light that is likely to be generated by the extended hours of in-pit works, by selected pieces of machinery including the Primary Crusher,	As outlined in the Peppertree Quarry Modification 4 Visual Impact Assessment, prior to and immediately following the commencement of extended in-pit operations, it is recommended that a night-time audit is undertaken to ascertain whether the introduction of night time in-pit works results in any visible lighting or in any change to the 'glow' created above the Quarry. If there was any noticeable direct lighting, or the 'glow' effect was found to noticeably increase by the light from extended in-pit operations, reasonable and feasible measures will be investigated and

Indirect impact	Likely impact from the Project	Mitigation measure
	Excavator, Front End Loader, two trucks and possibly some "daymaker" lighting, will be emitted from a position below ground level and will not result in any direct light spill into surrounding areas including the wooded Barbers Creek Gorge and Morton National Park. The light that is likely to be generated by the extended hours of in-pit works, is therefore unlikely to result in a significant or even noticeable change to the light emitted by the existing night time operations. Lighting from the existing night time operations is far greater in scale, extent and intensity than the proposed in-pit operations proposed.	implemented to mitigate the change in light emissions resulting from the in-pit works. This may involve gradual replacement of lights that may produce obtrusive light.
Fire	Historically, arid zone bushfires tend to be associated with a proficient growth of native grasses following large rain events. During summer, following rain events, dry swards of grasses pose a bushfire hazard when placed near a source of ignition. Vehicles driven through long grass with hot exhausts may cause a fire particularly during the hotter months of the year.	Boral will continue to manage site operations in accordance with the existing Bushfire Management Plan.

7. Thresholds for impacts and offsetting unavoidable impacts

7.1 Threshold impact criteria

The FBA lists threshold impact criteria for landscape features, native vegetation, and threatened species in order to determine when an offset or further consideration by consent authorities is required due to a Project's impacts. The impacts are put into the following criteria:

a. impacts that the assessor is required to identify for further consideration by the consent authority
b. impacts for which the assessor is required to determine an offset
c. impacts for which the assessor is not required to determine an offset
d. impacts that do not require further assessment by the assessor.

This offset strategy quantifies the required offsets for the Project in accordance with both the TSC Act and EPBC Act, through the use of the FBA methodology.

The Project meets criteria b, *impacts for which the assessor is required to determine an offset* due to the following:

- Impacts on approximately 8.1 ha of White Box Yellow Box Blakely's Red Gum Woodland TEC.

7.2 Quantifying offset of impacts

The FBA identifies the BioBanking Credit Calculator (BBCC) as the appropriate tool for quantifying the precise nature of the offsets required in both Ecosystem Credit and Species Credit terms. The major Project function of the BBCC is used under the FBA. Accredited BioBanking assessors can access and "run" the BBCC and in the case of the current assessment, the calculations were undertaken by Luke Baker who is an accredited BioBanking assessor.

A calculation of the nature and extent of offset credits required due to the biodiversity impacts associated with the Project has been undertaken using Version 4.0 of the BBCC.

Details of the BBCC inputs have been discussed in sections 3 to 6. Appendix 6 includes the full output printout of the BBCC for the Project which defines the Ecosystem Credits required to offset the impacts of the Project on biodiversity in accordance with the NSW Biodiversity Offsets Policy for Major Projects. No Species Credits were required to be offset as no Species Credit species were recorded on-site.

7.2.1 Summary of Ecosystem credits required

Offsets required for vegetation disturbance as a result of the Project are shown in Table 21.

Table 21. Ecosystem credits required for the Project

Vegetation formation	Vegetation class	Revised Biometric Vegetation Type (RBVT) best fit	Niche vegetation mapping	study area (ha)	Credits required
Grassy Woodlands	Southern Tableland Grassy Woodlands	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	Blakely's Red Gum - Yellow Box - Grassy open woodland – Condition A	0.7	26
Grassy Woodlands	Southern Tableland Grassy Woodlands	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	Blakely's Red Gum - Yellow Box - Grassy open woodland (degraded) – Condition B	2.3	95
Grassy Woodlands	Southern Tableland Grassy Woodlands	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	Blakely's Red Gum - Yellow Box - Grassy open woodland (degraded) – Condition C	0.9	19
Grassy Woodlands	Southern Tableland Grassy Woodlands	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	Blakely's Red Gum - Yellow Box - Grassy open woodland (degraded) – Condition D	4.2	85
			Grand Total	8.1	**225**

8. Biodiversity offset strategy

The Biodiversity offset strategy forms Stage 3 of the FBA. An offset on Boral Landholdings has been proposed in this chapter. The area has been subject to vegetation validation to the level of detail required in the FBA. Details regarding the survey including the BioBanking Credit calculations and inputs are detailed in section 8.3. Boral are in the formal stages of determining the precise layout of the proposed offset site within the area surveyed. At present the offset area meets 129 percent of the offset liability of the Project. The formal layout would ensure that 100 percent of the offset liability for the Project would be met. The final layout would be formally established as a BioBank site following approval.

8.1 Introduction

The NSW Biodiversity Offsets Policy for Major Projects (OEH 2014) states that biodiversity offsets provide benefits to biodiversity to compensate for the adverse impacts of an action. Biodiversity offsets assist in achieving long-term conservation outcomes while providing development proponents with the ability to undertake actions that have unavoidable impacts on biodiversity.

Unavoidable impacts to biodiversity are those impacts that are residual (i.e. impacts that remain after impact avoidance, management and mitigation measures are employed to reduce the type or magnitude of biodiversity impacts). Section 6.3 of this report outlines the design changes that Boral has implemented through the feasibility and pre-feasibility stages of the Project in order to avoid and reduce impacts to biodiversity values. Section 6.3 and Section 6.4 of this report outline the management and mitigation actions that Boral will employ to further reduce direct and indirect impacts to biodiversity values as a result of this Project.

This section of the report describes the approach to biodiversity offsetting proposed for the Project in accordance with the NSW Biodiversity Offsets Policy for Major Projects.

Based on the results of the MNES Assessments of Significance contained in this report, the Project would not require an offset under the EPBC Act as no MNES are likely to be significantly impacted by the Project.

8.1.1 NSW Biodiversity Offsets Policy for Major Projects

The Project requires an offset for White Box Yellow Box Blakely's Red Gum Woodland (SR670). As such, the proposed offset strategy must account for the NSW Biodiversity Offsets Policy for Major Projects.

The policy:

1. Establishes a set of offsetting principles for Major Projects.
2. Defines key thresholds for when offsetting is required.
3. Adopts an assessment methodology to quantify and describe the offset required.
4. Defines mechanisms required to establish offset sites.
5. Provides a range of flexible options that can be used in lieu of providing offsets, including rehabilitation actions and supplementary measures.

The NSW Biodiversity Offsets Policy for Major Projects contains within it provision for the establishment of an offset fund into which proponents may contribute financially an amount which otherwise would be equal to the cost of establishing independent offset sites. The fund is not yet available and the timing for the development of the fund has not been confirmed. However, if the fund is established within a

timeframe that makes it available to Boral, contributing to the fund will be considered as an option for securing offsets for the Project.

8.2 Proposed offset strategy

This document presents the offset strategy that will guide the finalisation of the offset following planning approval. The approach to the development of the future biodiversity offset package is presented below.

8.2.1 Offset to satisfy the NSW Offset Requirements

The formalisation of the offset proposed in section 8.3 will satisfy the NSW offset requirement. Table 22 outlines the approach that will be taken by Boral to develop a suitable biodiversity offset in accordance with the key offsetting policy principles.

Table 22: Principles for developing biodiversity offsets under NSW legislation

Offsetting principle	How principle will be addressed in the offset package
NSW Biodiversity Offsets Policy for Major Projects	
Principle 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.	Impacts have been avoided where possible during the design of the Project. Management and mitigation measures for biodiversity values have been proposed for the Project. Impact avoidance, management and mitigation measures have been detailed in Section 6.3 to Section 6.5.
Principle 2: Offset requirements should be based on a reliable and transparent assessment of losses and gains.	BioBanking plot data and threatened species surveys within the study area have been undertaken in accordance with the FBA. The methodology utilised in this assessment is detailed in Section 5. The latest version of the BBCC has been used to determine the credits required to offset the impacts of the Project on PCTs. No Species credit species would be impacted by the Project. Accredited BioBanking assessors have conducted the field surveys and offset calculations. The proposed offset has been assessed in accordance with the requirements of the FBA, to determine the suitability and quantum of offsets for the Project.
Principle 3: Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.	The offset to be proposed is a like-for-like offset.
Principle 4: Offsets must be additional to other legal requirements.	The proposed offset will be additional to other legal obligations that the proposed offset site may have.
Principle 5: Offsets must be enduring, enforceable and auditable.	The biodiversity offset site will be formally secured in accordance with the permissible offset mechanisms of the NSW Biodiversity Offsets Policy for Major Projects. Application of this policy will ensure that there is adequate funding available for current and future landowners to manage the offset site and that the offset site will be subject to monitoring and reporting requirements.
Principle 6: Supplementary measures can be used in lieu of offsets.	A like-for-like offset is proposed using the rules under the FBA.

8.3 Proposed offset

Boral proposes to use an area of native vegetation within their existing landholdings which has formally been assessed by Niche as an offset site for the Project (Figure 11). The area has been verified by Niche as containing SR670 Yellow Box - Blakely's Red Gum grassy woodland which is required to offset the Project (section 7.2.1).

At this stage the exact layout of the BioBank site is being internally formalised by Boral, however the layout within the area will be such that it would offset the 225 credits required for SR670 Yellow Box - Blakely's Red Gum grassy woodland. None of the other PCTs surveyed in thee area shown in Figure 11 would be included in the offset package for this Project.

8.3.2 The proposed offset area

The proposed offset area is located approximately 1.4 km to the north of the study area. The offset area consists of native vegetation which is part of an extensive corridor of native vegetation which extends along Barber's Creek into Morton National Park and Bungonia State Conservation Area.

Overall, the condition of vegetation across the offset area (in particular the eastern side) was in relatively good condition – with all stratum layers intact and minimal weeds. Weeds tended to occur to the west of the offset area which was within or immediately adjacent areas currently grazed. Eucalypt regeneration was extensive throughout this area signifying a resilient soil seed bank.

Across the proposed offset area, disturbances include existing tracks, some evidence of feral animals and sporadic occurrences of weeds. Grazing occurs immediately to the west of the proposed offset area.

8.3.3 Landscape Assessment of proposed offset area

The offset area occurs within the South Eastern Highlands IBRA region, and within the Bungonia IBRA subregion (Figure 11). This is the same IRBA region, and IBRA subregion as the Project.

One Mitchell landscape occurs across the study area: Bungonia Tableland and Gorge, which is also the same as the Project (Figure 11).

Native vegetation cover

GIS interrogation was used to determine the vegetation cover percentage as provided in Table 23

Table 23. Native vegetation cover at the proposed offset area

Native vegetation cover class (%)			
Before offset		**After offset**	
1,000 ha	**100 ha**	**1,000 ha**	**100 ha**
31-35%	51-55%	31-35%	51-55%

Connectivity

No riparian buffers, State Biodiversity Links or Regional Biodiversity Links would be impacted by the Project.

The connecting link that occurs to the south of the offset area would not increase with the offset site. The connectivity scores will therefore remain the same before and after the offset. Details of the connectivity scores entered into the BBCC are provided in Table 24.

Table 24. Connectivity values at the offset area

Connectivity class/description in BBCC	Before development	After development
Connectivity Value Class	>500m	>500m
Overstorey Condition	Project foliage cover at Benchmark	Project foliage cover at Benchmark
Midstorey Condition	Project midstorey/ground cover at Benchmark	Project midstorey/ground cover at Benchmark

Landscape score calculation

The information presented in the above section was entered into the BBCC, resulting in a landscape score calculation of 12.0 for the offset area.

8.3.4 Assessing native vegetation at the offset area

The flora survey methodology followed the BBAM, with additional information recorded (abundance, structure etc.) on the basis of current best practice flora survey guidelines for assessment of a large site, particularly OEH's Working Draft *Threatened Biodiversity Survey and Assessment – Guidelines for Developments and Activities* (DEC 2004). The methods used are consistent with those detailed in section 4.1.

The offset site has been subject to surveys by Niche on the following dates:

- 22nd and 23rd March 2016
- 26th October 2013
- 13th December 2013.

Flora survey effort consisted of the following:

- A total of 15 BioBanking plots/transects within the offset area.
- A total of 33 RDPs.

The survey effort is shown in Figure 12.

The species list obtained during the field assessment is provided in Appendix 7.

The plots undertaken along with the corresponding effort as specified in the FBA is provided in Table 25.

Table 25. Flora survey effort plot requirement

Niche vegetation mapping	Plant Community Type (PCT) best fit	Condition	Total (ha)	Plot required	Plots conducted
Blakely's Red Gum - Yellow Box - Grassy open woodland	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	Moderate/ Good_High	29.48	4	5
Blakely's Red Gum - Yellow Box - Grassy open woodland	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	Moderate/ Good_other	8.74	3	3
Ribbon Gum floodplain forest	SR547 Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands (no best fit)	Moderate/ Good_High	10.91	3	3

Niche vegetation mapping	Plant Community Type (PCT) best fit	Condition	Total (ha)	Plot required	Plots conducted
Stringybark - Blakely's Red Gum shrubby open forest	SR547 Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands	Moderate/ Good_High	26.41	4	4
Total			75.54	14	15

Native vegetation of the offset area

Vegetation within the offset area has been mapped previously as part of the Native vegetation of South Eastern NSW (Tozer et al. 2006). Vegetation mapping with parts of the offset area have been mapped by Tozer (2006) as aligning to White Box Yellow Box Blakely's Red Gum Grassy Woodland TEC. The descriptions for each vegetation community mapped within or in the vicinity of the study area, based on Tozer et al. (2006), are provided in Table 10, section 4.2.

As discussed above, the vegetation of the offset area was validated using methods consistent with the BBAM.

Analysis of plot data using PATN (pattern analysis software) was undertaken to determine similarities and differences between plots in species composition and abundance. The dendrogram has been provided in Appendix 7.

Within the offset area four native vegetation types were identified, however only the SR670 PCT would be used as an offset for the Project. These vegetation communities were aligned to the relevant PCTs required for use with the FBA. Different condition classes were assigned to vegetation where obvious differences in structure and quality occurred, resulting in four vegetation categories:

1. Blakely's Red Gum - Yellow Box - Grassy open woodland (moderate/good_high condition) (SR670)
2. Blakely's Red Gum - Yellow Box - Grassy open woodland (moderate/good_other condition) (SR670)
3. Ribbon Gum floodplain forest (SR547)
4. Stringybark - Blakely's Red Gum shrubby open forest (SR547).

The vegetation categories along with equivalent PCT (and reference codes), Keith Class, Keith Formation, Tozer et al (2006) community, and alignment to the validated vegetation communities is provided in Table 26.

Descriptions for the Blakely's Red Gum – Yellow Box – Grassy Open Woodland (SR670) is provided below. The other vegetation communities have not been described in this report as these PCTs would not form part of the offset for the Project.

Vegetation community mapping is shown in Figure 12.

Table 26. Vegetation zones mapped in the offset area

Niche vegetation mapping	Tozer et al. (2006) equivalent/ best fit	Plant Community Type (PCT) best fit	Condition	Vegetation formation	Vegetation class	Threatened Ecological Community (TEC)	Total (ha)
Blakely's Red Gum - Yellow Box - Grassy open woodland	P24 Tableland Grassy White Box Yellow Box Blakely's Red Gum Woodland	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	Moderate/ Good_High	Grassy Woodlands	Southern Tableland Grassy Woodlands	CEEC under the EPBC Act. EEC under the TSC Act.	29.48
Blakely's Red Gum - Yellow Box - Grassy open woodland	P24 Tableland Grassy White Box Yellow Box Blakely's Red Gum Woodland	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	Moderate/ Good_other	Grassy Woodlands	Southern Tableland Grassy Woodlands	CEEC under the EPBC Act. EEC under the TSC Act.	8.74
Ribbon Gum floodplain forest	P9. Tableland Low Woodland (no best fit)	SR547 Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands (no best fit)	Moderate/ Good_High	Dry Sclerophyll Forests (Shrub/grass subformation)	Central Gorge Dry Sclerophyll Forests	Not listed	10.91
Stringybark - Blakely's Red Gum shrubby open forest	P9. Tableland Low Woodland (no best fit)	SR547 Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands	Moderate/ Good_High	Dry Sclerophyll Forests (Shrub/grass subformation)	Central Gorge Dry Sclerophyll Forests	Not listed	26.41
Total							75.54

Vegetation description - Blakely's Red Gum - Yellow Box - Grassy open woodland (SR670)

Approximately 38.22 ha of Blakely's Red Gum – Yellow Box – Grassy open woodland (SR670) occur within the proposed offset area. The community tended to occur on the flats and the gentle slopes.

Two condition classes were recorded in the offset area:

1. Moderate/good_high – occurred toward the east of the offset area and comprised of a community with stratum layers intact, with minimal weed disturbance (Photo 4).

2. Moderate/good_other - attributed to areas of the PCT which was in more of a regenerating state ie. Lack of overstorey cover and midstorey, low coverage of shrubs, lack of fallen logs, and greater occurrence of weeds. This condition class occurred to the west adjacent to areas that are currently grazed (Photo 5).

Typically, the best condition of the community consisted of a tree layer ranging in height from 15 - 25 m and dominated by *Eucalyptus blakelyi, Eucalyptus melliodora,* and *Eucalyptus eugenioides*. Some areas of the community exhibited a localised dominance of *Eucalyptus eugenioides* with *E. blakelyi* and *E. melliodora* occurring less frequently however the vegetation structure and floristic were similar compared to the rest of the zone. A midstorey contained *Acacia parramattensis*. The shrub layer consisted *of Cassinia aculeata, Lissanthe strigosa* and *Olearia viscidula.* The ground layer consisted of *Einadia hastata Austrodanthonia racemosa, Microlaena stipoides, Bothriochloa macra, Acaena novae-zelandiae, Lomandra filiformis subsp. coriacea, Thysanotus patersonii, Anisopogon avenaceus, Poa sieberiana, Austrostipa scabra,* and *Aristida ramosa*.

The mix of the species listed above was similar for the Moderate/Good_other vegetation zone, however the abundances of native ground cover values were generally lower than the Moderate/Good_high zone, and *E. blakelyi* tended to be a dominant. Eucalypt regeneration was high across the zone as evident in Photo 5. Weed occurrence, in particular *Nassella* spp. was higher in this zone. The zone was impacted by grazing in areas. This vegetation community in all condition classes aligns to the NSW TSC Act White Box Yellow Box Blakely's Red Gum Woodland TEC (EEC) due to the following listing criteria (Scientific Committee 2002) being present within the disturbance area:

- Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum
- The understorey in intact sites is characterised by native grasses and a high diversity of herbs
- Shrubs are generally sparse or absent, though they may be locally common
- Characteristic species are present as identified in the Scientific Determination
- Occurs within the known range of the TEC.

In regards to the EPBC Act listing, an analysis of the Determination and Flow Chart Diagram within the EPBC Act Policy Statement (DoE undated) was undertaken and concluded that the site meets the EPBC definition due to the following:

- Diagnostic species present.
- Predominantly native understorey.
- Whilst some plots undertaken did not contain greater than 12 native understorey species (excluding grasses), the size of the patch is greater than 2 ha.
- Mature trees and natural regeneration of eucalypts is present.

Photo 6. Blakely's Red Gum - Yellow Box - Grassy open woodland (SR670) Moderate/Good_High.

Photo 7. Blakely's Red Gum - Yellow Box - Grassy open woodland (SR670) Moderate/Good_Other – note the regenerating Eucalyptus blakelyi.

Ten BioBanking plots were undertaken during the survey. The results of the plot data and species list obtained during the field assessment is provided in Appendix 2.

8.3.5 Site Value scores of the offset area

The Site Value assessment was carried out by entering the data obtained in the transects and plots into the BBCC (Appendix 7). The data provides quantitative measures of 10 site attributes (section 4.1) for each vegetation zone (Table 26).

The BBCC compares the benchmark for the vegetation type or class to provide the Site Value score. This score represents the overall condition of the vegetation compared against the benchmark.

Given the site would be managed in the future, all the attributes were then assigned the default future Site Management Value.

The score from these inputs, coupled with other data in the following section of this report, is used to determine the number of Ecosystem Credits that may be generated by the site.

8.3.6 Credit generated at the offset area

A calculation of the nature and extent of offset credits generated from the offset area has been undertaken using Version 4.0 of the BBCC.

Details of the BBCC inputs have been discussed above. Appendix 8 includes the full output printout of the BBCC for the offset area which defines the Ecosystem Credits that may be generated from the site.

Offsets generated at the offset site are shown in Table 27.

Table 27. Ecosystem Credits generated at the offset area

Niche vegetation mapping	Plant Community Type (PCT) best fit	Condition	Total (ha)	Credits generated
Blakely's Red Gum - Yellow Box - Grassy open woodland	SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	Moderate/ Good_High	29.48	225
		Moderate/ Good_other	8.74	66
Ribbon Gum floodplain forest	SR547 Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands (no best fit)	Moderate/ Good_High	10.91	89
Stringybark - Blakely's Red Gum shrubby open forest	SR547 Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands	Moderate/ Good_High	26.41	222
Total			75.54	602

8.4 Targeting ecological gains in the offsets package

Based on the credit calculations, Boral's proposed offset area meets 129 percent of the offset liability of the Project (Table 28) (additional 66 credits). As noted previously, Boral are in the formal stages of determining the precise layout of the offset area, however the layout would ensure that 100 percent of the offset liability for the Project would be met.

The final Offset would be secured following approval of this modification.

Table 28. Ecosystem credit requirements for the Project and quantities generated by the offset site

Plant Community Type	Credits required	Credits earned - Offset Area	Excess credits
SR670 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands	225	291	66

8.5 Finalising the Biodiversity Offset Package

The current investigation demonstrates the Ecosystem Credit availability within Boral's landholding would be sufficient to offset the Project. The formalisation of the site to a BioBank site is proposed to occur following modification approval.

The following works will need to be completed following approval:

1. Final layout of offset area defined by Boral and formally established as a BioBank site.
2. Preparation of Management Plans for the agreed BioBank site.
3. Consultation with OEH regarding the BioBank site, application and management actions.
4. Submission of all required reports and applications.

9. Conclusion

This report provides a biodiversity assessment to address the potential impacts associated with the Project.

The Project will result in the disturbance of 12.9 ha of vegetation comprising approximately 8.1 ha of native vegetation and 4.8 ha of exotic pasture. Indirect impacts may include dust, noise, erosion and sedimentation which will be mitigated by measures provided in section 6.5 of this report.

During the field survey one TEC - White Box Yellow Box Blakely's Red Gum Woodland was found to occur within the study area. Four condition classes were attributed to the TEC to assist with offsetting the impacts. The Project will result in disturbance to approximately 8.1 ha of the TEC listed under the TSC Act and EPBC Act. This TEC would be offset according to the requirements of the FBA.

No threatened flora are likely to be impacted by the Project given the lack of habitat and absence of threatened flora during the field survey.

Fifteen threatened and migratory fauna species are considered to be affected by the Project. Most of these species are likely to utilise the foraging habitat of the study area on an intermittent basis. No further assessment of impact is required for the Ecosystem Credit Species based on the requirements of the FBA and the offsetting of the associated PCTs Ecosystem Credit Species under the FBA which do not require further assessment of impact as they would be offset with their associated PCTs.

The Koala is the only listed Species Credit Species which has a low to moderate likelihood of occurring within the study area. However, given the species was not recorded on-site, and the relatively low likelihood of occurrence, an offset for the species is not proposed under the FBA.

No Species Credit Species will therefore be impacted by the Project.

Those threatened fauna species which are listed under the EPBC Act include Vulnerable species: Koala, Large-eared Pied Bat and Grey-headed Flying Fox; and Migratory species: Cattle Egret, Rainbow Bee-eater, Rufous Fantail and Black-faced Monarch. An EPBC Act Assessment of Significance for each of these species has been completed and concluded that a significant impact to any EPBC Act listed threatened fauna is unlikely.

The Project has maximised use of areas of exotic pasture and low condition White Box Yellow Box Blakely's Red Gum Grassy Woodland within the Project footprint where possible.

Mitigation measures associated with indirect impacts have been proposed through the revision and implementation of existing management plans.

A total of 225 Ecosystem Credits are required to offset PCT impacts and associated threatened fauna habitat surrogates.

Boral proposes an offset area which currently meets 129 percent of the offset liability of the Project. Boral are in the formal stages of determining the precise layout of the offset area, however the layout would ensure that 100 percent of the offset liability for the Project would be met. The final layout would be formally established as a BioBank site following approval.

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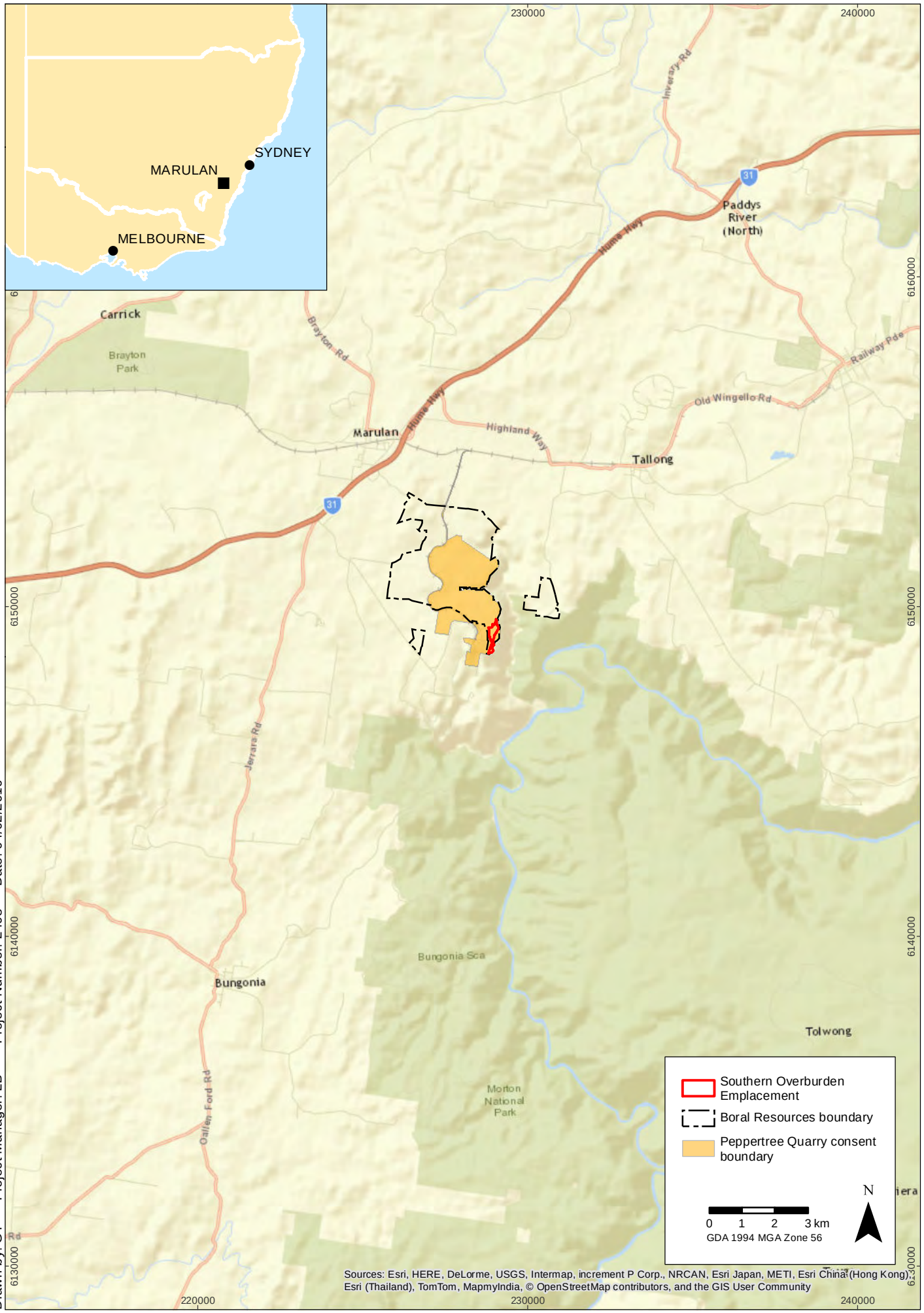
Figures



Drawn by: GT Project Manager: LB Project Number: 2498 Date: 04/02/2016

Locality overview

Peppertree Modification 4 Biodiversity Assessment

FIGURE 1

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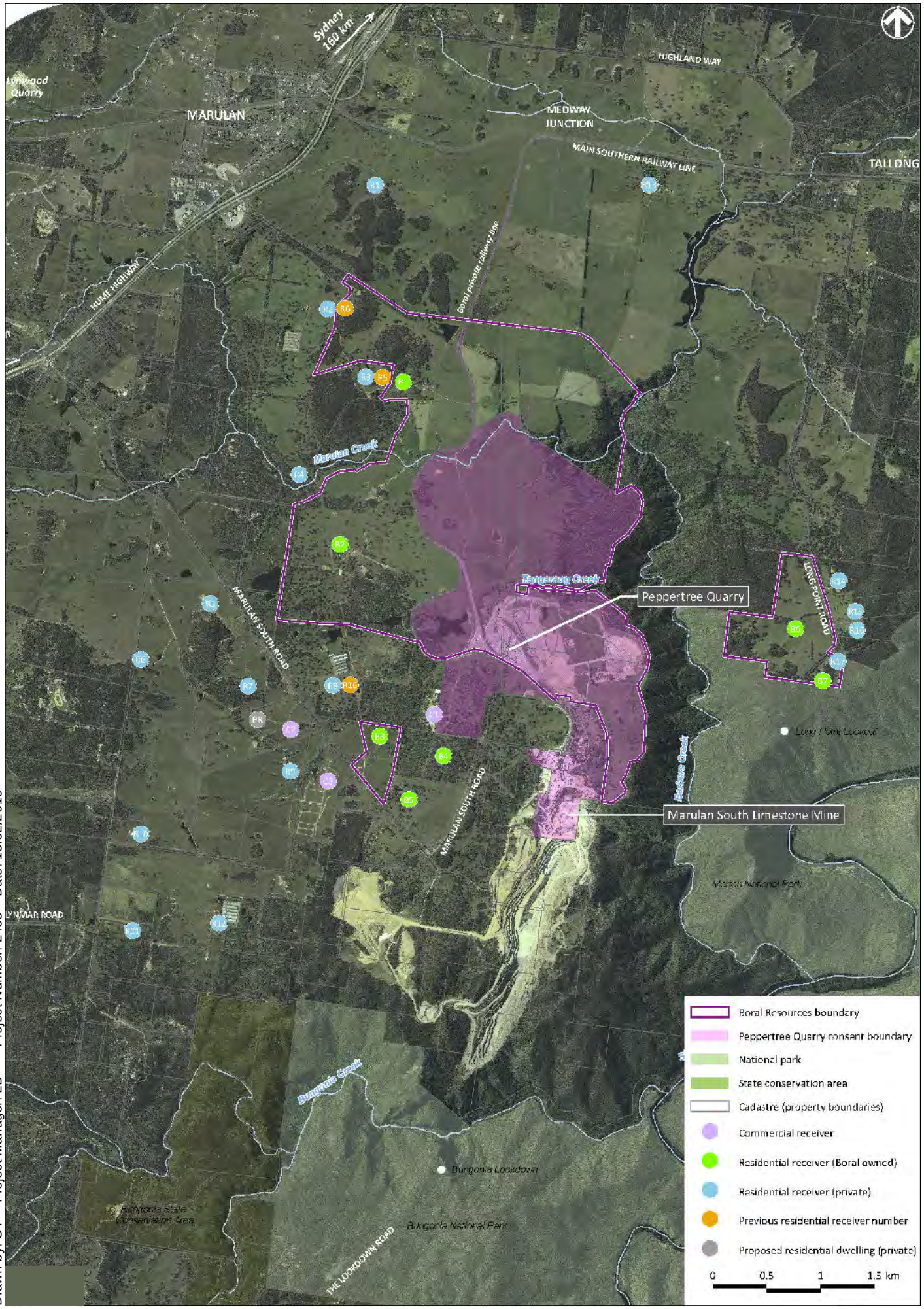

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Local Context

Peppertree Modification 4 Biodiversity Assessment

FIGURE 2

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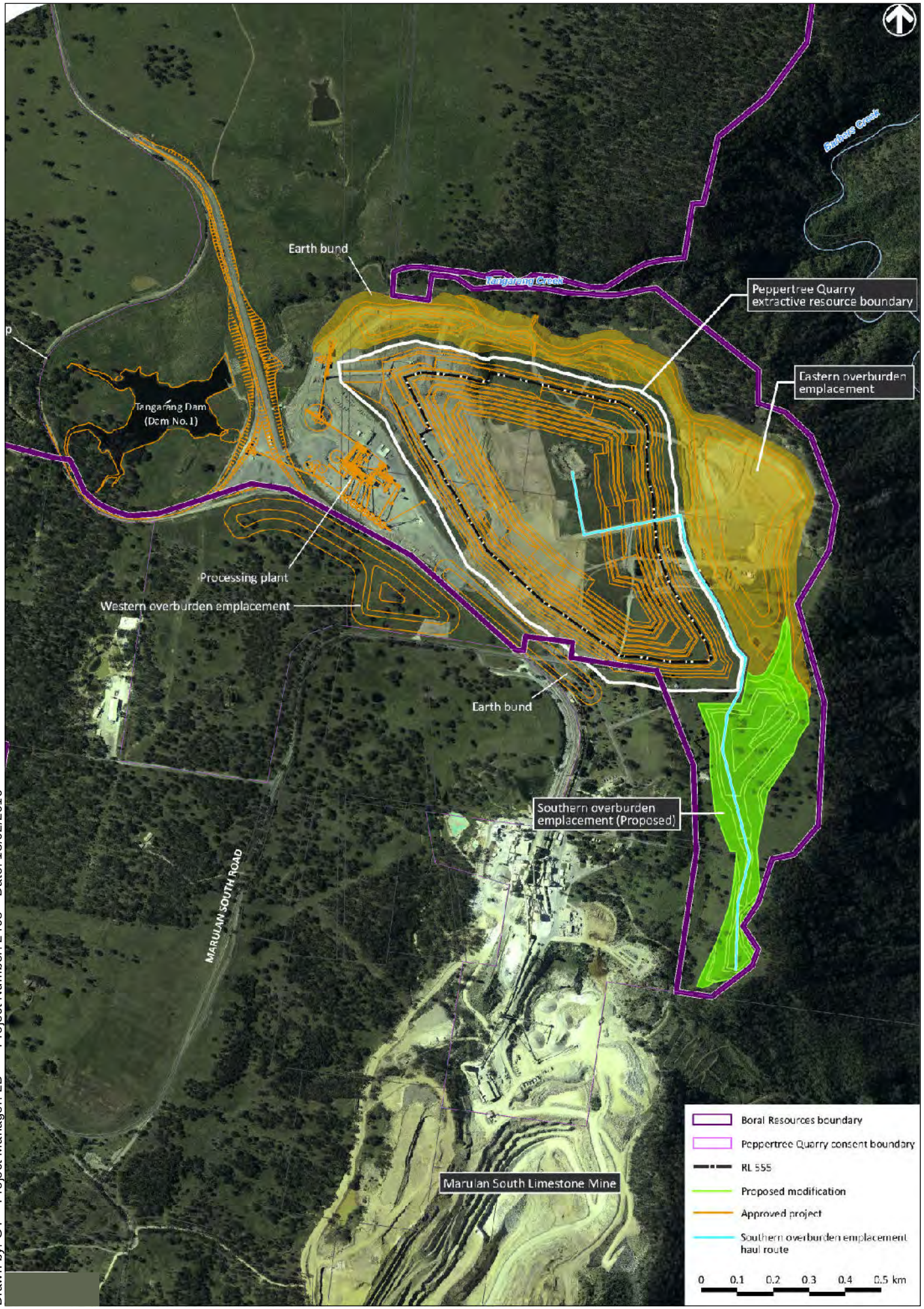

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The Project

Peppertree Modification 4 Biodiversity Assessment

FIGURE 3

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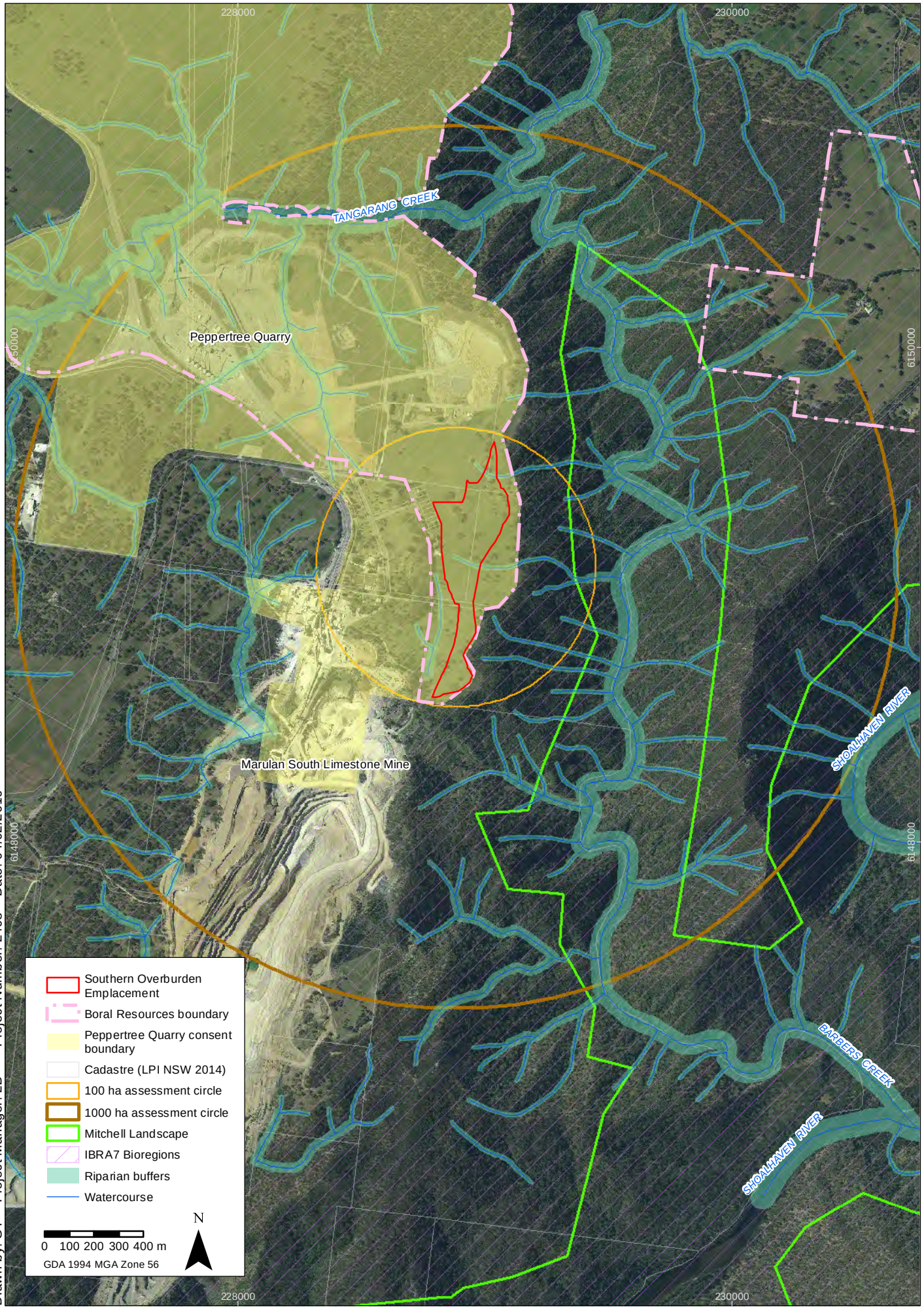

Location Map of Proposed Southern Overburden Emplacement

Peppertree Modification 4 Biodiversity Assessment

FIGURE 4

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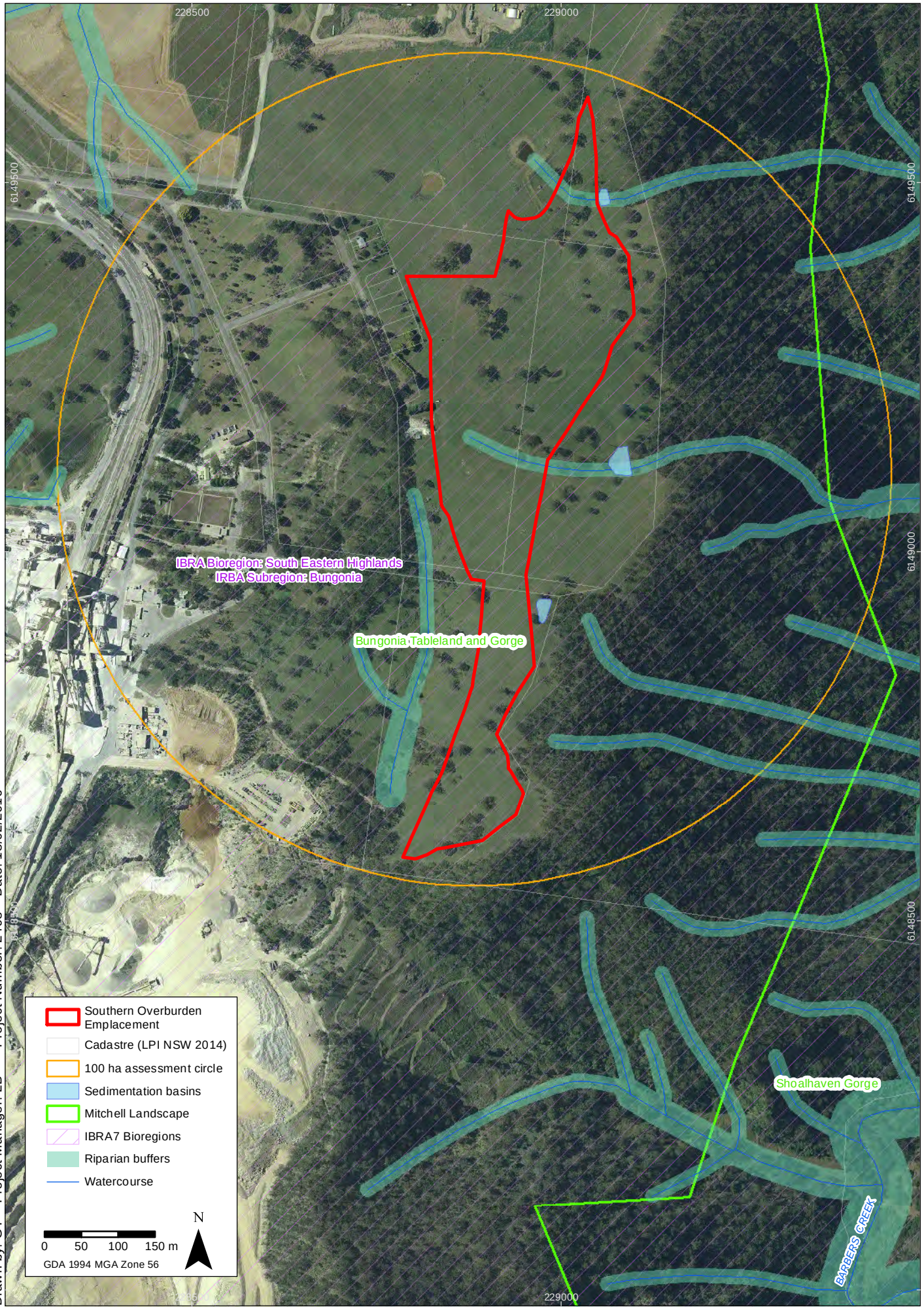

Site Map

Peppertree Modification 4 Biodiversity Assessment

FIGURE 5

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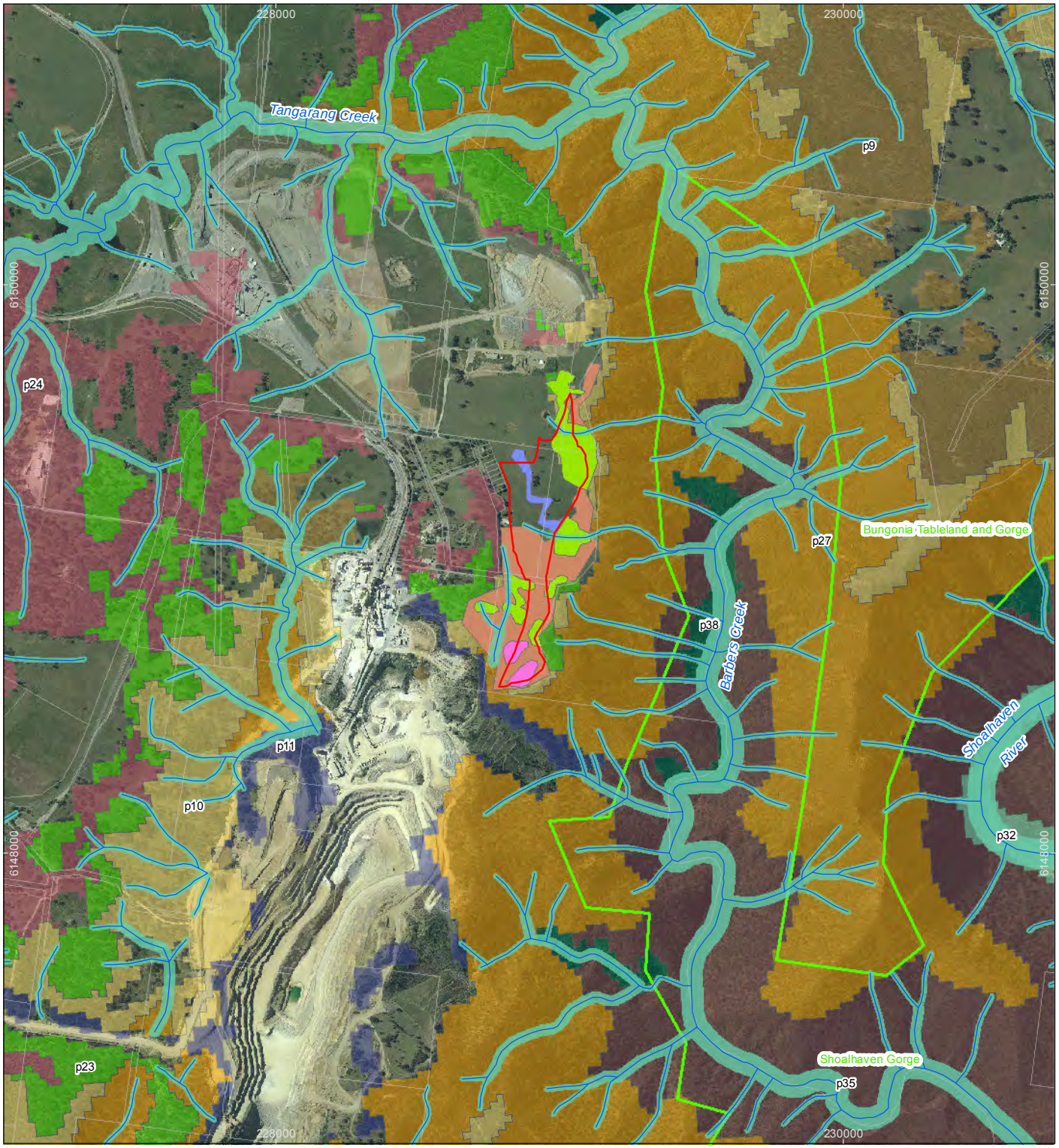

Project Number: 2498 Date: 04/02/2016

Project Manager: LB

Drawn by: GT

Southern Overburden Emplacement
Cadastre (LPI NSW 2014)
Mitchell Landscape
Riparian buffers
Watercourse

Vegetation (Niche 2015)

White Box Yellow Box Blakely's Red Gum Woodland (Degraded condition A. Trees with native forb and grass cover)

White Box Yellow Box Blakely's Red Gum Woodland (Degraded condition B. Trees with predominately native grass cover)

White Box Yellow Box Blakely's Red Gum Woodland (Degraded condition C. Scattered trees with predominately introduced grass cover)

White Box Yellow Box Blakely's Red Gum Woodland (Degraded condition D. native grassland)

Vegetation (South Coast SCIVI)

p10, Eastern Tablelands Dry Forest
p11, Elevated Gorge Forest
p23, Tableland Hills Grassy Woodland
p24, Tableland Grassy Box-Gum Woodland
p27, Bungonia Slates Woodland
p32, Riverbank Forest
p35, Wollondilly-Cox-Shoalhaven Gorge Woodland
p38, Grey Myrtle Dry Rainforest
p9, Tableland Low Woodland

N

0 100 200 300 400 m

GDA 1994 MGA Zone 56

Landscape assessment

Peppertree Modification 4 Biodiversity Assessment

FIGURE 6

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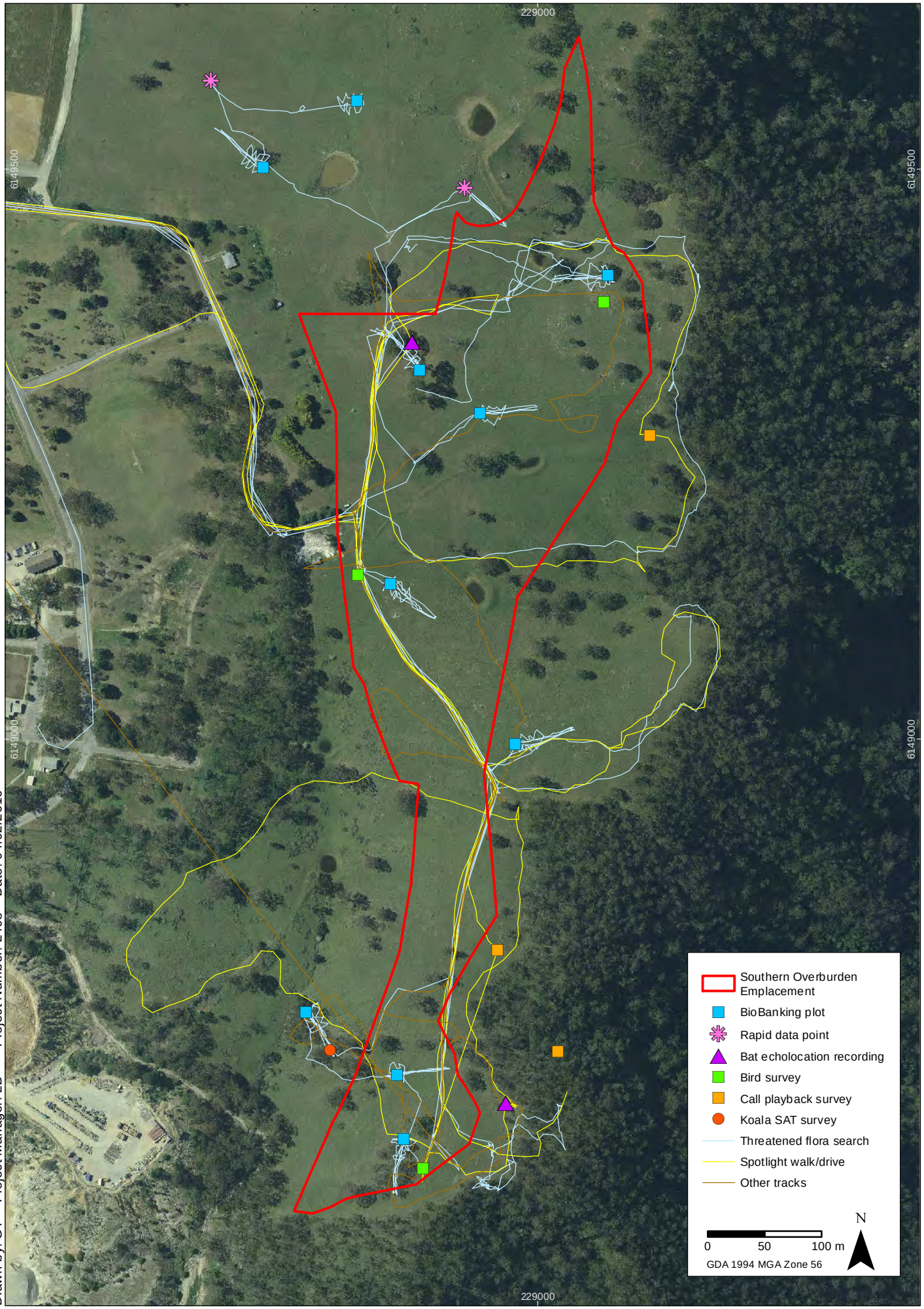

Survey effort

Peppertree Modification 4 Biodiversity Assessment

FIGURE 7

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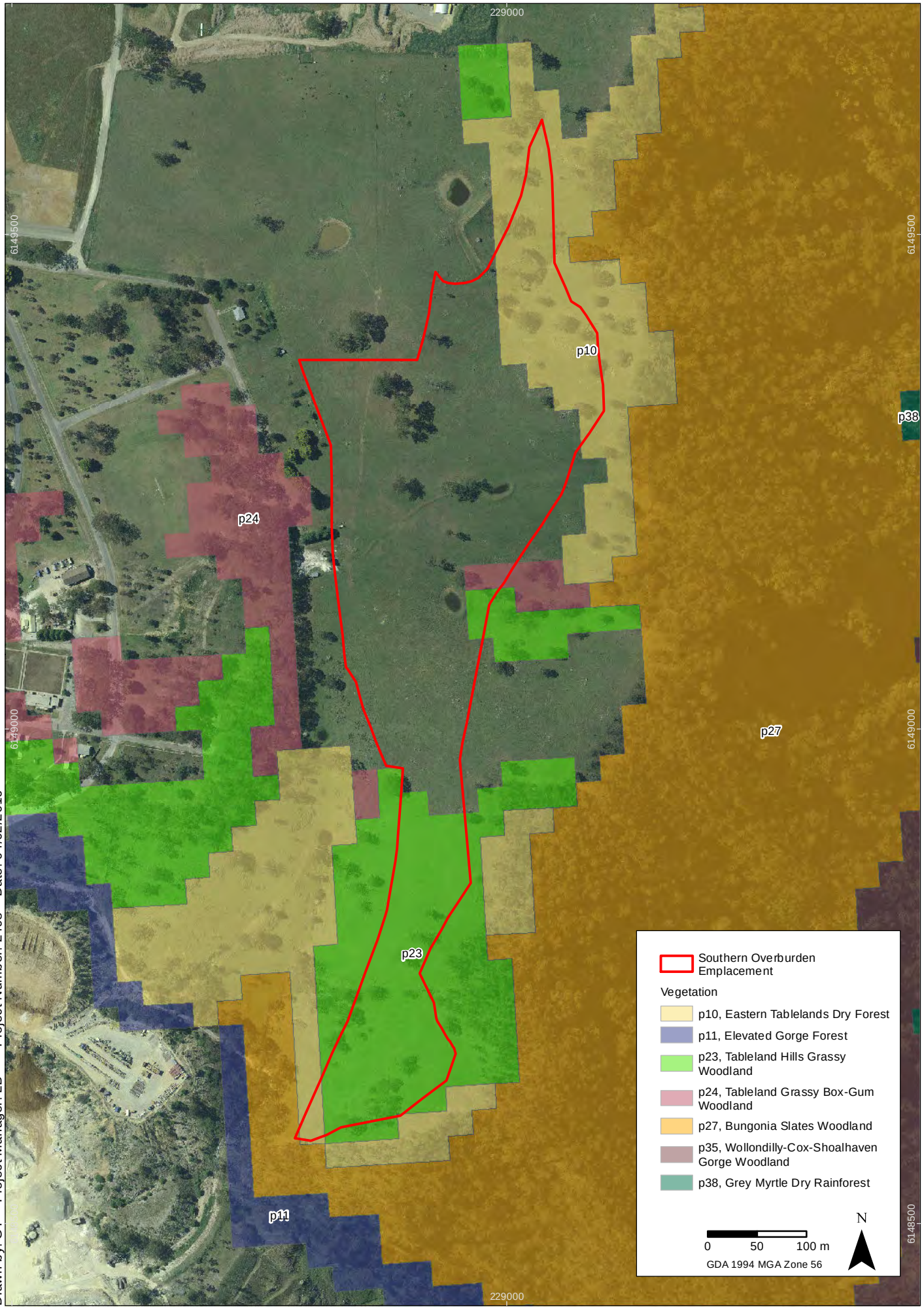

Vegetation mapping (Tozer et al. 2006)

Peppertree Modification 4 Biodiversity Assessment

FIGURE 8

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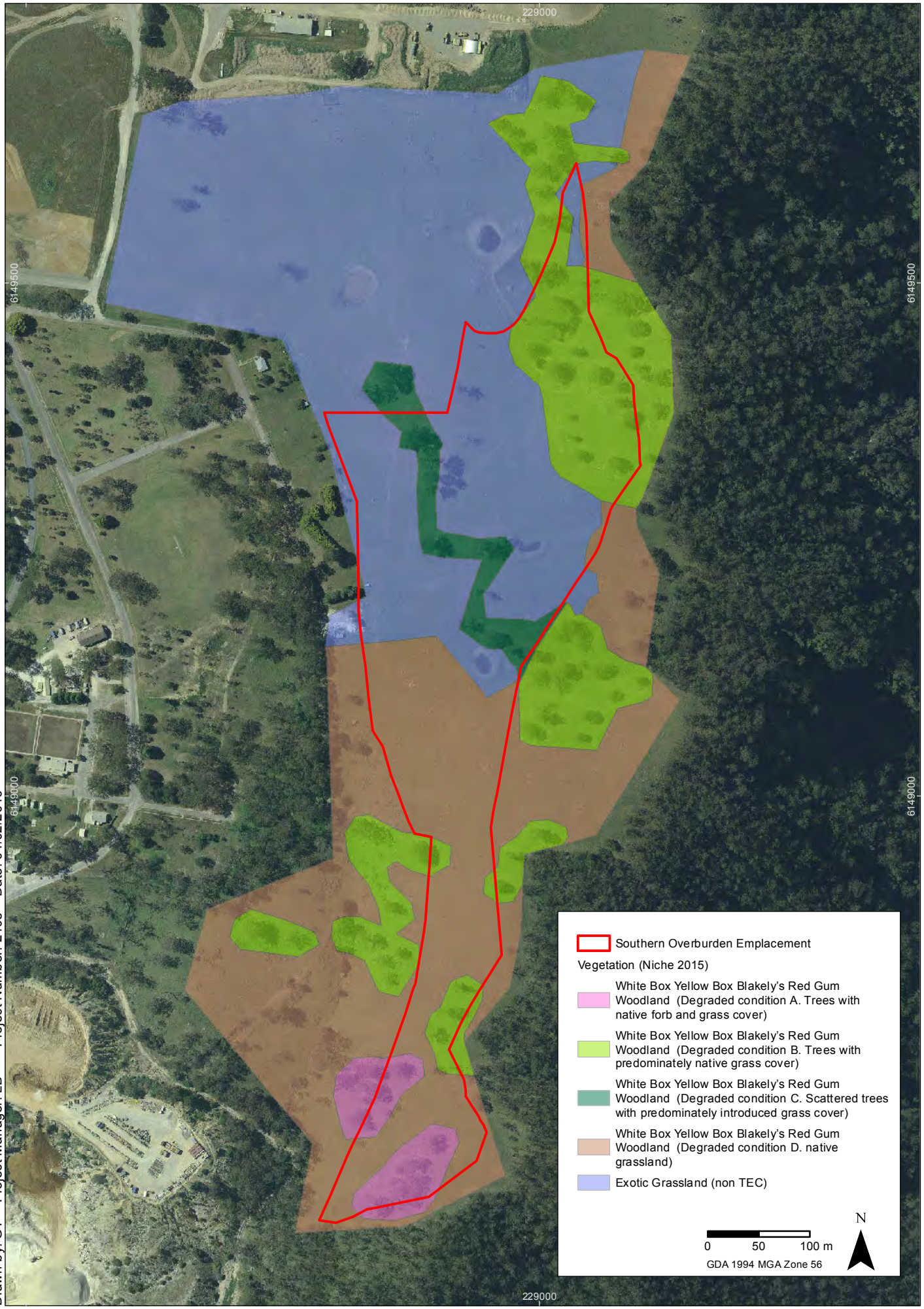

Niche vegetation mapping (Plant Community Types PCTs) with survey effort

Peppertree Modification 4 Biodiversity Assessment

FIGURE 9

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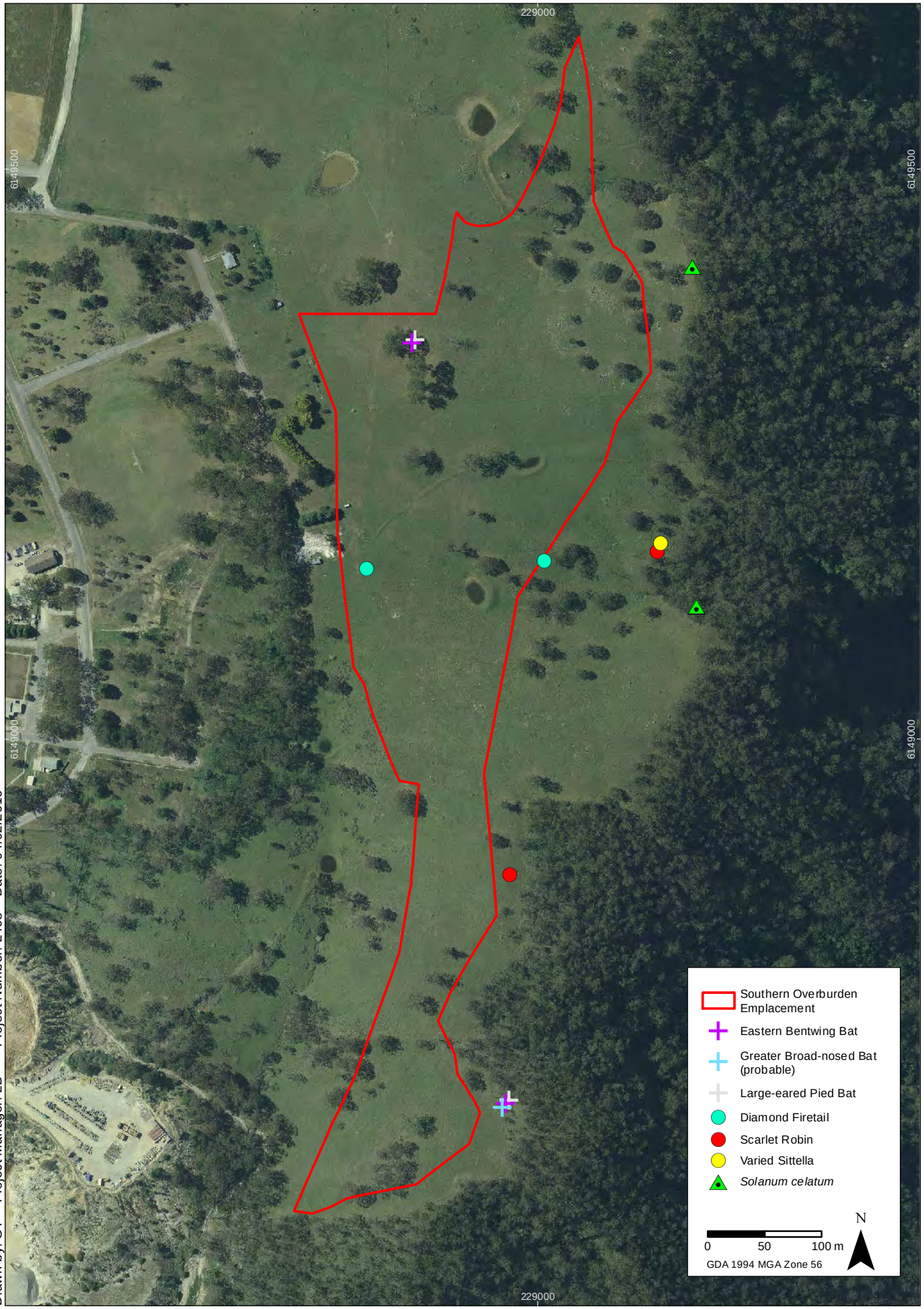

Threatened biodiversity recorded during field survey (Niche 2015)

Peppertree Modification 4 Biodiversity Assessment

FIGURE 10

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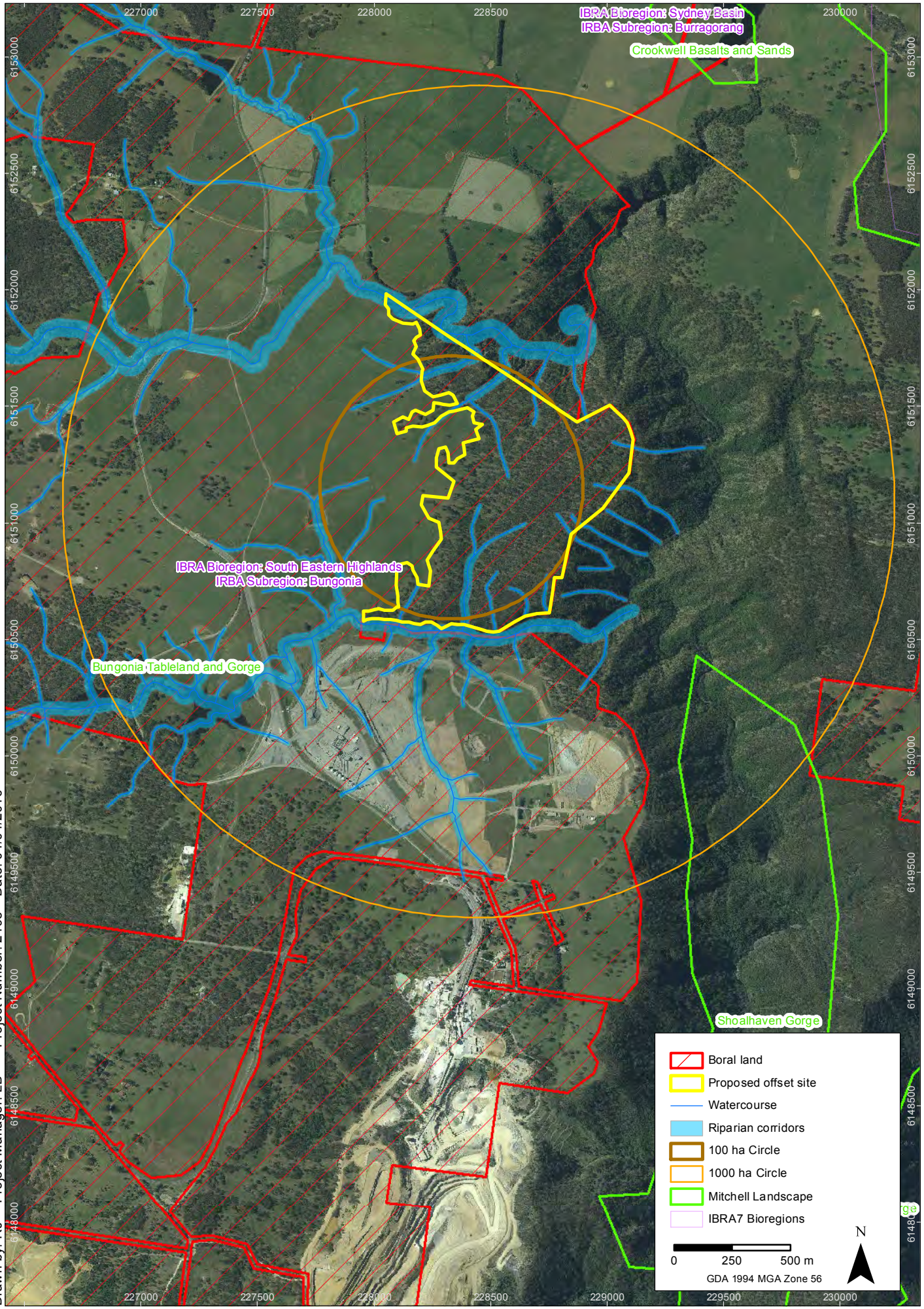


Drawn by: RJ Project Manager: LB Project Number: 2498 Date: 01/04/2016

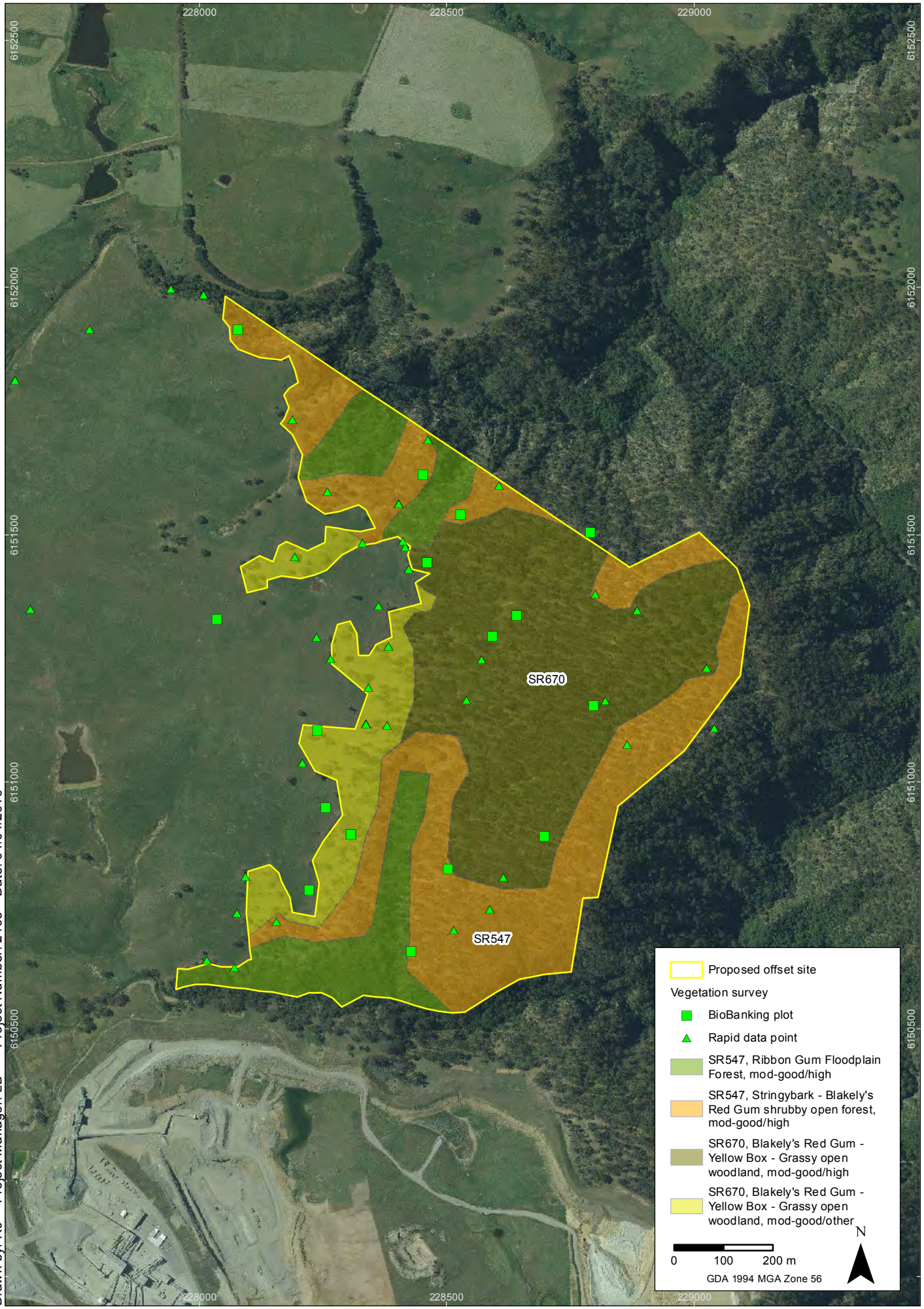
Proposed offset area – Landscape

Peppertree Modification 4 Biodiversity Assessment

FIGURE 11

Path: T:\spatial\projects\a2400\a2498_Peppertree_Quarry_M4\Maps\report\2498_Figure_11_EasternOffset.mxd

Imagery: (c) Boral 2014



Proposed offset area – Survey and vegetation mapping

Peppertree Modification 4 Biodiversity Assessment

FIGURE 12

Path: T:\spatial\projects\a2200\a2255_Balranald_Weed_Survey\Maps\report\201601\2498_Figure_12_EasternOffsetSurvey.mxd

Imagery: (c) Boral 2014

Appendix 1. Threatened species likelihood tables

Threatened flora likelihood of occurrence

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Caladenia tessellata	Thick-lipped Spider-orchid	E	V	The Thick-lipped Spider-orchid is found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. is known to favour low, dry sclerophyll woodland (for example open Kunzea woodland) with a heathy or sometimes grassy understorey on clay loams or sandy soils. The population at Braidwood occurs in dry, low Brittle Gum (*Eucalyptus mannifera*), Inland Scribbly Gum (*E. rossii*) and *Allocasuarina* spp. woodland with a sparse understorey and stony soil.	Low – no records within 10km. Habitat within study area is not suitable.
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	Grows in swamp-heath on sandy soils, chiefly in coastal districts, south from the Gibraltar Range. The Leafless Tongue-orchid has been reported to occur in a wide variety of habitats including heathlands, heathy woodlands, sedgelands, *Xanthorrheoa* spp. plains, dry sclerophyll forests (shrub/grass sub-formation and shrubby sub-formation), forested wetlands, freshwater wetlands, grasslands, grassy woodlands, rainforests and wet sclerophyll forests (grassy sub-formation). Soils are generally considered to be moist and sandy, however, this species is also known to grow in dry or peaty soils	Low – no records within 10km. Habitat within study area is not suitable.
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 in the lowest parts of the landscape, on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers. Also occurs as isolated paddock trees in modified native or exotic pastures. Often grows with other cold-adapted eucalypts, such as Snow Gum or White Sallee (*Eucalyptus pauciflora*), Manna or Ribbon Gum (*E. viminalis*), Candlebark (*E. rubida*), Black Sallee (*E. stellulata*) and Swamp Gum (*E. ovata*). Black Gum usually occurs in an open woodland formation with a grassy groundlayer dominated either by River Tussock (*Poa labillardierei*) or Kangaroo Grass (*Themeda australis*), but with few shrubs.	Low - Recorded over 2 km to the north-east of the study area within Conservation Area. Relatively conspicuous species and unlikely to remain undetected during field survey.
Eucalyptus macarthurii	Paddys RiverBox	V	-	A moderately restricted distribution, recorded from the Moss Vale District to Kanangra Boyd National Park. In the Southern Highlands it occurs mainly on private land, often as isolated individuals in, or on the edges of paddocks. Isolated stands occur in the north west part of the range on the Boyd Plateau. The only known record in the conservation estate is within Kanangra Boyd National Park. Occurs on grassy woodland on relatively fertile soils on broad cold flats.	Low – recorded over 5 km to the west. Relatively conspicuous species which is unlikely to remain undetected during survey.
Genoplesium baueri	Yellow Gnat-orchid	-	E	The species has been recorded from locations between Ulladulla and Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. Currently the species is known from just over 200 plants across 13 sites. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Grows in dry sclerophyll forest and moss gardens over sandstone.	None – no suitable habitat. No records. Not detected during field survey.
Genoplesium plumosum	Tallong Midge Orchid	CE	E	Occurs exclusively in heathland, generally dominated by violet kunzea, common fringe-mytre and parrot-peas. Grows on very shallow soils or within mosses on sandstone conglomerate shelves. Plants exist only as a dormant tuber for much of the year, with leaves or fruiting stems dying back in winter. Reproduces by seed and has no mechanism for vegetative reproduction.	Low – the disturbed area is not along sandstone shelves.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Grevillea molyneuxii	Wingello Grevillea	V	E	This species has only been recorded in low heathland on sandstone, where it grows in skeletal soil on flat, wet sandstone shelves above dissected valleys.	Low – no suitable habitat.
Haloragis exalata subsp. *exalata*	Square Raspwart	V	V	Occurs in 4 widely scattered localities in eastern NSW. It is disjunctly distributed in the central coast, south coast and north-western slopes botanical subdivisions of NSW. The species appears to require protected and shaded damp situations in riparian habitats.	Low – not detected during field survey. Habitat marginal within study area.
Kunzea cambagei	Cambage Kunzea	V	V	Restricted to damp, sandy soils in wet heath or mallee open scrub at higher altitudes on sandstone outcrops or Silurian group sediments.	Low – no potential habitat.
Lepidium hyssopifolium	Aromatic Peppercress	E	E	Currently, the species is known from near Bathurst and Bungendore, in the South Eastern Highlands Bioregion (Tumino 2010). Historically, the Basalt Pepper-cress has been recorded from the Northern and Central Tablelands, with an atypical specimen from Cooma on the Southern Tablelands (Harden 2000). The Central Tablelands records are from the Bathurst area; the Northern Tablelands collections are from Gostwyck, near Armidale, and there was an 1884 record from 'near Maryland', though this record may have been from either NSW or Queensland, as the Maryland Station once extended over the border. Most other records have been found to be misidentifications (Scarlett & Parsons 2000 pers. comm.). Generally, the Aromatic Peppercress is known to establish on open, bare ground with limited competition from other plants. The Aromatic Peppercress was previously recorded from Eucalypt woodland with a grassy ground cover, low open Casuarina woodland with a grassy ground cover and tussock grassland. Recently recorded localities have predominantly been in weed-infested areas of heavy modification, high degradation and high soil disturbance such as road and rail verges, on the fringes of developed agricultural land or within small reserves in agricultural land. Many populations are now generally found amongst exotic pasture grasses and beneath exotic trees such as the Radiata Pine (*Pinus radiata*) and Monterey Cypress (*Cupressus macrocarpus*), often associated with other species of Lepidium. The lack of competition from other shade-tolerant species allows the Aromatic Peppercress to persist (Tumino 2010).	Low – despite having marginal habitat present, there are no records within 10 km. Unlikely to be present.
Leucochrysum albicans var. *tricolor*	Hoary Sunray	-	E	Occurs in a wide variety of grassland, woodland and forest habitats, generally on relatively heavy soils. The Hoary Sunray occurs at relatively high elevations in woodland and open forest communities, in an area roughly bounded by Goulburn, Albury and Bega. The species has been recorded in the Yass Valley, Tumut, Upper Lachlan, Snowy River and Galong The species is known from the South Eastern Highlands, Australian Alps and Sydney Basin bioregions (Sinclair 2010). Herbarium records indicate that the taxa once occurred more widely in inland NSW, near Cobar, Dubbo, Lithgow, Moss Vale and Delegate (Sinclair 2010).	Low – grassland areas are highly disturbed. No records within 10 km of site.
Pelargonium sp. *Striatellum*	Omeo's Stork's-bill	E	E	Flowering occurs from October to March. Occurs in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds. The species is known to form clonal colonies by rhizomatous propagation. Known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. A population at a fourth known site on the Monaro has not been seen in recent years. The only other known population is at Lake Omeo, Victoria. It occurs at altitudes between 680 to 1030 m. It is known to occur in the local government areas of Goulburn-Mulwaree, Cooma-Monaro, and Snowy River, but may occur in other areas with suitable habitat; these may include Bombala, Eurobodalla, Palerang, Tumbarumba, Tumut, Upper Lachlan, and Yass Valley local government areas.	Low – no known records. No habitat present.
Phyllota humifusa		V	V	The species occurs in dry sclerophyll forest, sometimes near swamps, in deep sandy soils or gravely loams over a sandstone substrate. Accompanying trees are often Brittle Gum *Eucalyptus mannifera*, Narrow-leafed Peppermint *E. radiata* or Sydney Peppermint *E. piperita*.	Low – closest record over 6 km to the north-east.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
					Lack of sandstone present. Habitat very marginal.
Pimelea axiflora subsp. *pubescens*	Bungonia Rice-flower	E	-	Occurs on limestone cliff edges and outcrops	None – Habitat within study area is not suitable.
Pomaderris cotoneaster	Cotoneaster Pomaderris	E	E	Cotoneaster Pomaderris has been recorded in a range of habitats in predominantly forested country. The habitats include forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs. Habitat notes from specimens include: 'base of cliff, tall open forest (*E. fastigata*)'; 'alluvial terrace with tall open forest (*E. cypellocarpa*)'; 'alluvial terrace with tall open forest (*E. muelleriana*)'; 'rocky riparian site amongst tall open eucalypt forest (*E. viminalis*)'; 'rocky river bed'; 'Growing on dry south-westerly facing slope above river. Associated with *Westringia* sp. aff. *longifolia*, *Grevillea lanigera, Prostanthera* sp. *nov., Eucalyptus radiata, Olearia* sp., *Kunzea ericoides* and *Acacia pravissima'*; 'Growing in shrubby woodland of *Eucalyptus maidenii* & *E. elata*. south-facing slope with loamy soil on metasiltstone'	Low – Habitat within study area is not suitable.
Pomaderris pallida	Pale Pomaderris	V	V	This species usually grows in shrub communities surrounded by Brittle Gum (*Eucalyptus mannifera*) and Red Stringybark (*E. macrorhyncha*) or *Callitris* spp. woodland.	Low – Habitat within study area is not suitable.
Pultenaea pedunculata	Matted Bush-pea	E	-	The Matted Bush-pea occurs in a range of habitats. NSW populations are generally among woodland vegetation but plants have also been found on road batters and coastal cliffs. It is largely confined to loamy soils in dry gullies in populations in the Windellama area. The ability of stems to creep and root from the nodes has made this species a very good coloniser of bare ground in many parts of its range. Matted Bush-pea is widespread in Victoria, Tasmania, and south-eastern South Australia. In NSW however, it is represented by just three disjunct populations, in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn (where it is locally abundant). The Cumberland Plain occurrences were more widespread (Yennora, Canley Vale and Cabramatta were lost to development) and is now found at Villawood and Prestons, and north-west of Appin between the Nepean River and Devines Tunnel number 2 (Upper Sydney Water Supply Canal).	Low – out of known range. Unlikely to be present.
Rulingia prostrata	Dwarf Kerrawang	E	E	Occurs on sandy, sometimes peaty soils in a wide variety of habitats: snow gum woodland at Rose Lagoon; blue leaved stringybark open forest at Tallong; and in brittle gum low open woodland at Penrose; scribbly gum - swamp mahogany ecotonal forest at Tomago.	Low – habitat not suitable within study area and unlikely to remain undetected during survey if present.
Solanum celatum		E	-	Grows on hills and slopes in eucalypt woodland; commonly found after fire or disturbance. Restricted to an area from Wollongong to a little south of Nowra and west to Bungonia Nature Reserve.	Low – Habitat within study area is not suitable. The species was recorded during the field survey in areas of woodland outside of the Project footprint which were in a far better condition than that of the study area. Furthermore, the species is relatively conspicuous and unlikely to remain undetected

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
					during the field survey.
Thelymitra sp. Kangaloon	Kangaloon Sun Orchid	CE	CE	*Thelymitra* sp. Kangaloon is only known to occur on the southern tablelands of NSW in the Moss Vale - Kangaloon - Fitzroy Falls area at 550-700 m above sea level. It is known to occur at three swamps that are above the Kangaloon Aquifer. It is found in swamps in sedgelands over grey silty grey loam soils	None – no habitat present.
Thesium australe	Austral Toadflax	V	V	Grows in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland. Grows on kangaroo grass tussocks but has also been recorded within the exotic coolatai grass.	None. No records within 10 km. Habitat not suitable.

Threatened fauna likelihood of occurrence

Scientific Name	Common Name	TSC Act	EPBC Act	Preferred habitat/previous records and habitat within impact area	Likelihood of Occurrence	Potential for Impacts	BioBanking tool predicted threatened species or species requiring survey	Species credit or Ecosystem Species and whether considered further
Amphibians								
Heleioporus australiacus	Giant Burrowing Frog	V	V	The Giant Burrowing Frog has been recorded breeding in a range of water bodies associated with more sandy environments of the coast and adjacent ranges from the Sydney Basin south the eastern Victoria. It breeds in hanging swamps, perennial non-flooding creeks and occasionally permanent pools, but permanent water must be present to allow its large tadpoles time to reach metamorphosis. No potential habitat is present within the area to be cleared. Some marginal habitat is present within the gullies to the east of the study area, however it was not recorded during field surveys for the Marulan South Limestone Mine Project (Niche 2015). It has not been recorded from the locality and there are no records in the region.	None	None	Survey not required	Species - excluded from further assessment
Litoria littlejohni	Littlejohn's Tree Frog	V	V	Occurs in wet and dry sclerophyll forests and heathland associated with sandstone outcrops between 280 and 1000 m on the eastern slopes of the Great Dividing Range from the Central Coast down into Victoria. Individuals have been collected from a wide range of water bodies that includes semi-permanent dams, permanent ponds, temporary pools and permanent streams, with calling occurring from fringing vegetation or on the banks. Individuals have been observed sheltering under rocks on high exposed ridges during summer and within deep leaf litter adjacent to the breeding site. Calling occurs in all months of the year, often in association with heavy rains. The tadpoles are distinctive, being large and very dark in colouration. No potential habitat is present within the area to be cleared. Some marginal habitat is present within the gullies to the east of the study area, however it was not recorded during field surveys for the Marulan South Limestone Mine Project (Niche 2015). It has not been recorded from the locality and there are no records in the region.	None	None	Survey not required	Species - excluded from further assessment
Birds								
Anthochaera phrygia	Regent Honeyeater	CE	E,M	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. This species has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding	Low – transient visitor only.	Unlikely – negligible impacts.	Survey required	Species - excluded from further assessment – not detected during survey.

Scientific Name	Common Name	TSC Act	EPBC Act	Preferred habitat/previous records and habitat within impact area	Likelihood of Occurrence	Potential for Impacts	BioBanking tool predicted threatened species or species requiring survey	Species credit or Ecosystem Species and whether considered further
				fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests. Three records from the locality centred around the Bungonia National Park area to the south. As the species is migratory it may occur as a transient visitor to the site, including to forage, but would use the site rarely. No breeding habitat present. Not recorded during targeted bird survey.				
Ardea alba	Great Egret	-	M	Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands.	Low	Unlikely – negligible impacts.	N/A	N/A
Ardea ibis	Cattle Egret	-	M	The Cattle Egret is found in grasslands, woodlands and wetlands, and is not common in arid areas. It also uses pastures and croplands, especially where drainage is poor. May occur intermittently within the study area – species is common and widespread.	Moderate	Low	N/A	Not considered further - no real chance of impacts.
Botaurus poiciloptilus	Australasian Bittern	E	E	The Australasian Bittern is widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes and spikerushes. Single record from Bungonia Conservation Area. Potential habitat is very limited within the proposed study areas with permanent wetlands very limited in extent.	None	None	Survey not required	Species - excluded from further assessment
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine snow gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed. The species has been recorded to the south and north of the study area and has the potential to use the site on occasion to forage. There is no particularly important breeding or foraging habitat to be impacted.	Moderate Recorded on Peppertree Quarry by ERM (2006)	Potential – with negligible impacts.	Predicted	Ecosystem – involved in Ecosystem Credit calculations
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Inhabits forest with low nutrients, characteristically with key *Allocasuarina* spp. Tends to prefer drier forest types with a middle stratum of Allocasuarina below Eucalyptus or Angophora. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead. Endangered population in the Riverina. The species has been recorded to the south and north of the study area. Preferred foraging habitat	Low	Unlikely	Not predicted	Ecosystem - excluded from further assessment

Scientific Name	Common Name	TSC Act	EPBC Act	Preferred habitat/previous records and habitat within impact area	Likelihood of Occurrence	Potential for Impacts	BioBanking tool predicted threatened species or species requiring survey	Species credit or Ecosystem Species and whether considered further
				is not present in areas to be impacted. The species was not detected during survey.				
Chthonicola sagittata	Speckled Warbler	V	-	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. This species has been recorded from the locality within grassy woodland areas to the west of the study area. While the species was not recorded during field survey there is potential habitat that may be used on occasion or by migrating individuals. Three records exist for Speckled Warbler from the locality west of the study area. The species was not recorded during field survey.	Moderate	Potential – with negligible impacts.	Predicted	Ecosystem – involved in Ecosystem Credit calculations
Climacteris picumnus victoriae	Brown Treecreeper	V	-	Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (*Eucalyptus camaldulensis*) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Whilst this species has been recorded within the locality, there is limited potential habitat within the study area as mature trees with hollows and large logs are rare. Conspicuous species not recorded during field survey.	Low	Unlikely	Predicted	Ecosystem – involved in Ecosystem Credit calculations
Daphoenositta chrysoptera	Varied Sittella	V	-	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature Eucalypts with hollows. Four records exist from the locality to the west of the study area. A single observation of this species was made adjacent to the impact area during field survey.	Known	Likely – non-significant impacts	Predicted	Ecosystem – involved in Ecosystem Credit calculations
Gallinago hardwickii	Latham's Snipe	-	M	Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. Seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. No records from locality and not recorded during field survey.	Low	Unlikely	N/A	N/A

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Glossopsitta pusilla	Little Lorikeet	V	-	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes. Most records from the region are from lower elevation near coastal areas. Not recorded during survey.	Low	Unlikely	Not predicted	Ecosystem – excluded from further assessment
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	M	Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna. Some potential habitat within the study area, though it would be infrequently used and for foraging only.	Low	Unlikely	N/A	N/A
Hieraaetus morphnoides	Little Eagle	V	-	Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. May nest in farmland, woodland and forest in tall trees. Wide ranging species, not recorded during field surveys. One record exists from the north of the locality. Two records from Marulan area. No individuals or breeding nests were observed during field surveys. May use impacted area to forage but rarely.	Low	Unlikely	Predicted	Ecosystem – involved in Ecosystem Credit calculations
Hirundapus caudacutus	White-throated Needletail	-	M	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Potential overfly habitat only.	Low	Unlikely	N/A	N/A
Lathamus discolor	Swift Parrot	E	E	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability. No records within the locality and not recorded from surveys. Closest record is approximately 50 km east and most records in the region are coastal. As the species is migratory it may occur as a transient visitor to the site, including to forage, but would use the site rarely given the lack of records from the region.	Low	Unlikely	Not predicted	Ecosystem – excluded from further assessment

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Melanodryas cucullata cucullata	Hooded Robin	V	-	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. One recent and one dated record from locality to west of study area. Conspicuous bird that is primarily sedentary and was not recorded during survey.	Low	Unlikely	Predicted	Ecosystem – involved in Ecosystem Credit calculations
Melithreptus gularis gularis	Black-chinned Honeyeater	V	-	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*). Two records from 30 years ago exist for this species from near Marulan and towards Goulburn. No other records occur from the region and the species was not recorded during field survey.	Low	Unlikely	Predicted	Ecosystem – involved in Ecosystem Credit calculations
Merops ornatus	Rainbow Bee-eater	-	M	Found throughout mainland Australia most often in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels. Widespread migratory species that may move through study area occasionally.	Moderate	Unlikely	N/A	N/A
Monarcha melanopsis	Black-faced Monarch	-	M	Found along the coast of eastern Australia, becoming less common further south. Inhabits rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Predominant habitat within study area is in lower areas away from proposed cleared areas. May move through other parts of the study area.	Moderate	Unlikely	N/A	N/A
Myiagra cyanoleuca	Satin Flycatcher	-	M	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. Found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.	Low	Unlikely	N/A	N/A
Ninox strenua	Powerful Owl	V	-	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within red turpentine in tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows	Low	Potential – with negligible impacts.	Not predicted	Ecosystem – predicted associated within the PCTs of the study area.

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				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. Single record from locality. No individuals or breeding habitat was observed during field surveys. May use impacted area to forage but rarely.				
Pandion cristatus	Eastern Osprey		M	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging. They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes. They exhibit a preference for coastal cliffs and elevated islands in some parts of their range, but may also occur on low sandy, muddy or rocky shores and over coral cays. They may occur over atypical habitats such as heath, woodland or forest when travelling to and from foraging sites.	None	None	N/A	N/A
Petroica boodang	Scarlet Robin	V	-	The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. Recorded at two sites during field survey, adjacent to impact area.	Known	Likely – non-significant impacts	Predicted	Ecosystem – involved in Ecosystem Credit calculations
Petroica phoenicea	Flame Robin	V	-	Flame Robins are found in a broad coastal band from southern Queensland to just west of the South Australian border. The species is also found in Tasmania. The preferred habitat in summer includes eucalyptus forests and woodland, whilst in winter prefers open woodlands and farmlands. It is considered migratory. The Flame Robin breeds from about August to January. Two records from the locality around Marulan, however not recorded during survey. As the species is somewhat migratory it may visit the site, particularly grassy woodlands during winter.	Moderate	Potential – with minimal impacts.	Predicted	Ecosystem – involved in Ecosystem Credit calculations
Rhipidura rufifrons	Rufous Fantail	-	M	Mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (*Eucalyptus microcorys*), Mountain Grey Gum (*E. cypellocarpa*), Narrow-leaved Peppermint (*E. radiata*), Mountain Ash (*E. regnans*), Alpine Ash (*E. delegatensis*), Blackbutt (*E. pilularis*) or Red Mahogany (*E. resinifera*); usually with a dense shrubby understorey often including ferns.	Moderate	Likely – non-significant impacts	N/A	N/A
Rostratula	Australian	E	E, M	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes	Low	Unlikely	Not	Ecosystem –

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australis	Painted Snipe			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.			predicted	excluded from further assessment
Stagonopleura guttata	Diamond Firetail	V	-	Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Found in grassy eucalypt woodlands, including box-gum woodlands and snow gum woodlands. Also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities. Recorded at two sites during field survey on several occasions within impact area. Local population regularly uses parts of impact area to forage.	Known	Likely – non-significant impacts	Predicted	Ecosystem – involved in Ecosystem Credit calculations
Tyto novaehollandiae	Masked Owl	V	-	Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. Nest hollows are usually located within dense forests or woodlands. Masked owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet. Three records south of study area 4 – 6 km away. No individuals or breeding habitat was observed during field surveys. May use impacted area to forage but rarely.	Low	Potential – with negligible impacts	Not predicted	Ecosystem – excluded from further assessment
Tyto tenebricosa	Sooty Owl	V	-	Often found in tall old-growth forests, including temperate and subtropical rainforests. In NSW mostly found on escarpments with a mean altitude less than 500 metres. Nests and roosts in hollows of tall emergent trees, mainly eucalypts often located in gullies. Nests have been located in trees 125 to 161 centimetres in diameter. Single record from Shoalhaven Gorge (Niche 2015). No individuals or breeding habitat was observed during field surveys. May use impacted area to forage but rarely.	Low	Potential – with negligible impacts	Not predicted	Ecosystem – excluded from further assessment
Fish								
Macquaria australasica	Macquarie Perch	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 catchments. The conservation status of the different populations is not well known, but there have been long-term declines in their abundance.	None	None	N/A	N/A

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				Macquarie Perch are found in both river and lake habitats; especially the upper reaches of rivers and their tributaries. They are quiet, furtive fish that feed on aquatic insects, crustaceans and molluscs. Sexual maturity occurs at two years for males and three years for females. Macquarie perch spawn in spring or summer in shallow upland streams or flowing parts of rivers and females produce around 50,000-100,000 eggs which settle among stones and gravel of the stream or river bed. Populations from the eastward-flowing Shoalhaven and Hawkesbury rivers are genetically distinct and may represent an undescribed species. Potential habitat exists in the upper reaches and tributaries of Shoalhaven River where one specimen has been recorded in 2007 (3km upstream of Bungonia confluence. However such habitat is not present within Bungonia or Barbers Creek.				
Prototroctes maraena	Australian Grayling	-	V	Historically, this species occurred in coastal streams from the Grose River Valley, southwards through NSW, Vic. and Tas, With occurences in the Shoalhaven catchment below Tallowa Dam. It also occasionally occurred high upstream in the Snowy R. A single juvenile specimen was collected from Lake Macquarie in 1974. This species spends only part of its lifecycle in freshwater. The Tambo River population inhabits a clear, gravel-bottomed stream with alternating pools and riffles, and granite outcrops. It has also been associated with clear, gravel-bottomed habitats in the Mitchell & Wonnangatta Rivers but was present in a muddy-bottomed, heavily silted habitat in the Tarwin River.	None	None	N/A	N/A
Mammals								
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals. Recorded at two out of two locations where bat recorders were placed within the study area including within the proposed study area. No breeding habitat.	Known	Likely – non significant impacts.	Survey not required	Assessed for impacts under the Commonwealth Assessment of Significance.
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Spotted-tailed Quoll are found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. One regional record only. Not recorded during field survey. Low abundance of preferred prey items	Low	Unlikely	Predicted	Ecosystem – involved in Ecosystem Credit calculations

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				(ground dwelling fauna), no denning habitat and widespread presence of foxes which is likely to prevent establishment of a population in the area. Quolls may occur on the site (more likely dispersing males) given proximity of conservation areas but are unlikely to use site with any frequency and there is limited value in regard to prey density.				
Falsistrellus tasmaniensis	Eastern False Pipistrelle	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. Three records from locality to the west of the study area near Marulan. Not recorded during survey but one single possible record from recent surveys at Marulan South Limestone Mine (Niche 2015).	Moderate	Potential – with low level impacts.	Predicted	Ecosystem – involved in Ecosystem Credit calculations
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	Eastern Bent-wing Bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Known maternity caves within Bungonia Gorge. Recorded at one harp trap location and from all sites where echolocation recording was performed.	Known	Likely – non significant impacts.	Not predicted Survey not required	Ecosystem and Species. Species credit component (breeding habitat) excluded from assessment.
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits. One record from locality from Hume Highway near Marulan. Not recorded during field survey. Hollows/required breeding habitat is rare within the areas to be impacted by clearing. Single record just outside locality near Marulan. Not recorded during the current survey or recent surveys.	Low	Unlikely	Not predicted	Ecosystem – predicted associated within the PCTs of the study area.
Petaurus australis	Yellow-bellied Glider	V	-	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Recorded from Bungonia Gorge during Marulan South Limestone Mine surveys (Niche 2015). Not recorded during surveys of the study areas and no obvious glider incisions found. Habitat poor due	Low	Unlikely	Not predicted	Ecosystem – predicted associated within the PCTs of the study area.

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				to typical distance between trees and open paddock areas.				
Myotis macropus	Southern Myotis	V	-	The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Has been recorded from locality near Bungonia gorge on three occasions. Limited water resources and roost habitat (e.g. hollow trees, bridges and culverts) within study areas.	Low	Unlikely	Not predicted Survey not required	Ecosystem and Species. Species credit component (breeding habitat) excluded from assessment
Petaurus norfolcensis	Squirrel Glider	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. Not recorded during survey. No records from locality or region (one Atlas record from Marulan area with accuracy of 100 km).	Low	Unlikely	Not predicted	Species – Excluded from further assessment
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves and crevices. No potential habitat within the study area and no habitat to be impacted indirectly. Not recorded during field survey.	Low	Unlikely	Not predicted	Species – excluded from further assessment
Phascolarctos cinereus	Koala	V	V	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall. There are preferred feed trees present on the site but these are predominantly scattered paddock trees. The majority of records from the locality are from the Bungonia National Park to the south. The species was not recorded during the current survey of the study area nor during previous surveys of the rest of the Peppertree Quarry nor surveys (spotlighting and aural surveys only) within the Barbers Creek gully for the Marulan South Limestone Mine Project (Niche 2015).	Low-moderate	Unlikely	Predicted	Species – not recorded during survey. No further assessment. Assessed for impacts under the Commonwealth Assessment of Significance.

Scientific Name	Common Name	TSC Act	EPBC Act	Preferred habitat/previous records and habitat within impact area	Likelihood of Occurrence	Potential for Impacts	BioBanking tool predicted threatened species or species requiring survey	Species credit or Ecosystem Species and whether considered further
Pseudomys novaehollandiae	New Holland Mouse	-	V	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. No local records. Single record regionally. Habitat on site is not preferred habitat.	None	None	N/A	Ecosystem – however not predicted to occur
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km. Recorded from Bungonia Gorge and Barbers Creek during recent field survey for Marulan South Limestone Mine (Niche 2015) and expected to occur throughout area. Very limited foraging resources in impact area and would rarely occur within the study area. May fly over study area with some regularity, however such movements are unlikely to be impacted.	Moderate	Likely – negligible, non significant impacts.	Not predicted	Ecosystem and species. Species credit component (breeding habitat). excluded from further assessment.
Reptiles								
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by kangaroo grass. Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. No records locally or regionally. Preferred habitat not present.	Low	Unlikely	Not predicted	Species - excluded from further assessment
Delma impar	Striped Legless Lizard	V	V	Found mainly in natural temperate grassland but has also been captured in grasslands that have a high exotic component. Also found in secondary grassland near natural temperate grassland and occasionally in open box-gum woodland. Sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter. No records locally, single record from Goulburn area regionally. Not recorded during survey and preferred sheltering habitat not present.	Low	Unlikely	Not predicted	Species – excluded from further assessment
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Occurs almost exclusively in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they spend most of the year sheltering in and under rock crevices and exfoliating rock. However, some individuals will migrate to tree hollows to find shelter during hotter parts of summer. No records locally or regionally. Required habitat not present.	Low	Unlikely	Not predicted	Species – excluded from further assessment
Varanus rosenbergi	Rosenberg's Goanna	V	-	This species is a Hawkesbury-Narrabeen sandstone outcrop specialist. Occurs in coastal heaths,	Low	Unlikely	Not predicted	Species – excluded from

Scientific Name	Common Name	TSC Act	EPBC Act	Preferred habitat/previous records and habitat within impact area	Likelihood of Occurrence	Potential for Impacts	BioBanking tool predicted threatened species or species requiring survey	Species credit or Ecosystem Species and whether considered further
				humid woodlands and both wet and dry sclerophyll forests. No local records. No termite mounds in study area, not recorded during survey and preferred habitat not present in areas to be impacted.				further assessment

Appendix 2. Flora species list and plot data

Family	Species	Introduced*	Listed species#	Important species#	lb1730	lb1731	lb1732	lb1733	lb1734	lb1735	lb1736	lb1738	lb1739	lb1741
Apiaceae	*Centella asiatica*			X		2								
Asteraceae	*Conyza bonariensis*	*				2				3	2	2	3	3
Asteraceae	*Cotula australis*		X			1								
Asteraceae	*Hypochaeris radicata*	*							3	3	2	3	2	3
Asteraceae	*Onopordum acanthium*	*					2	2				2	2	
Asteraceae	*Silybum marianum*	*			1				1	1				2
Asteraceae	*Taraxacum officinale*	*					2	3						
Bignoniaceae	*Pandorea pandorana*											1		
Boraginaceae	*Echium plantagineum*	*			2						1			
Campanulaceae	*Wahlenbergia gracilis*		X									2		
Chenopodiaceae	*Einadia hastata*		X								1			
Convolvulaceae	*Dichondra repens*		X			3		2				3		
Cyperaceae	*Cyperus gracilis*					1								
Ericaceae	*Lissanthe strigosa*		X			1						2		
Fabaceae (Faboideae)	*Glycine tabacina*			X		2						2		
Fabaceae (Faboideae)	*Medicago arabica*	*			2									
Fabaceae (Faboideae)	*Trifolium repens*	*			3	2	3		3	3		3	3	
Geraniaceae	*Geranium solanderi*		X				2	3	2	3		3		
Malvaceae	*Sida rhombifolia*	*			2			3						
Myrsinaceae	*Anagallis arvensis*	*					3	3						
Myrtaceae	*Eucalyptus blakelyi*		X									2		
Myrtaceae	*Eucalyptus melliodora*		X			5		3			2			2
Oxalidaceae	*Oxalis perennans*		X					3			2			
Plantaginaceae	*Plantago lanceolata*	*			3	3	4	3	4	3	3	4	3	3
Poaceae	*Austrodanthonia racemosa*		X									2		

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Family	Species	Introduced*	Listed species#	Important species#	lb1730	lb1731	lb1732	lb1733	lb1734	lb1735	lb1736	lb1738	lb1739	lb1741
Poaceae	*Bothriochloa macra*		X		4	3	4	4	5	3	3	3	3	3
Poaceae	*Briza subaristata*	*			4			3	5			4	5	5
Poaceae	*Bromus cartharticus*	*				3					3		3	3
Poaceae	*Chloris gayana*	*							3					
Poaceae	*Echinochloa crusgalli*	*											3	
Poaceae	*Eragrostis leptostachya*									2				
Poaceae	*Lolium perenne*	*							2					2
Poaceae	*Nassella tenuissima*	*			3	3	3	3	3	3	4		4	
Poaceae	*Panicum effusum*		X			3	4		3			3	2	
Poaceae	*Paspalum dilatatum*	*				3	3	3	3	3	3	3	5	
Poaceae	*Pennisetum clandestinum*	*			3	3	4		3	3	3		3	4
Poaceae	*Setaria gracilis*	*			3		3		3	3			5	5
Poaceae	*Sporobolus creber*				4	3	3	3	4	3		4	2	3
Poaceae	*Themeda australis*			X			2	3				3		
Polygonaceae	*Rumex crispus*	*			2				2				1	2
Polygonaceae	*Rumex spp.*	*					2					2		
Rosaceae	*Acaena novae-zelandiae*		X								3	2		
Rosaceae	*Rubus fruticosus*	*					2	2				1		
Rubiaceae	*Asperula conferta*			X								2		
Rubiaceae	*Galium glaudichaudii*			X				2						
Rubiaceae	*Richardia stellaris*	*									3			
Solanaceae	*Solanum nigrum*	*						2			3			

#As per the EPBC Act Policy Guidelines for White Box Yellow Box Grassy Woodland and Derived Grasslands

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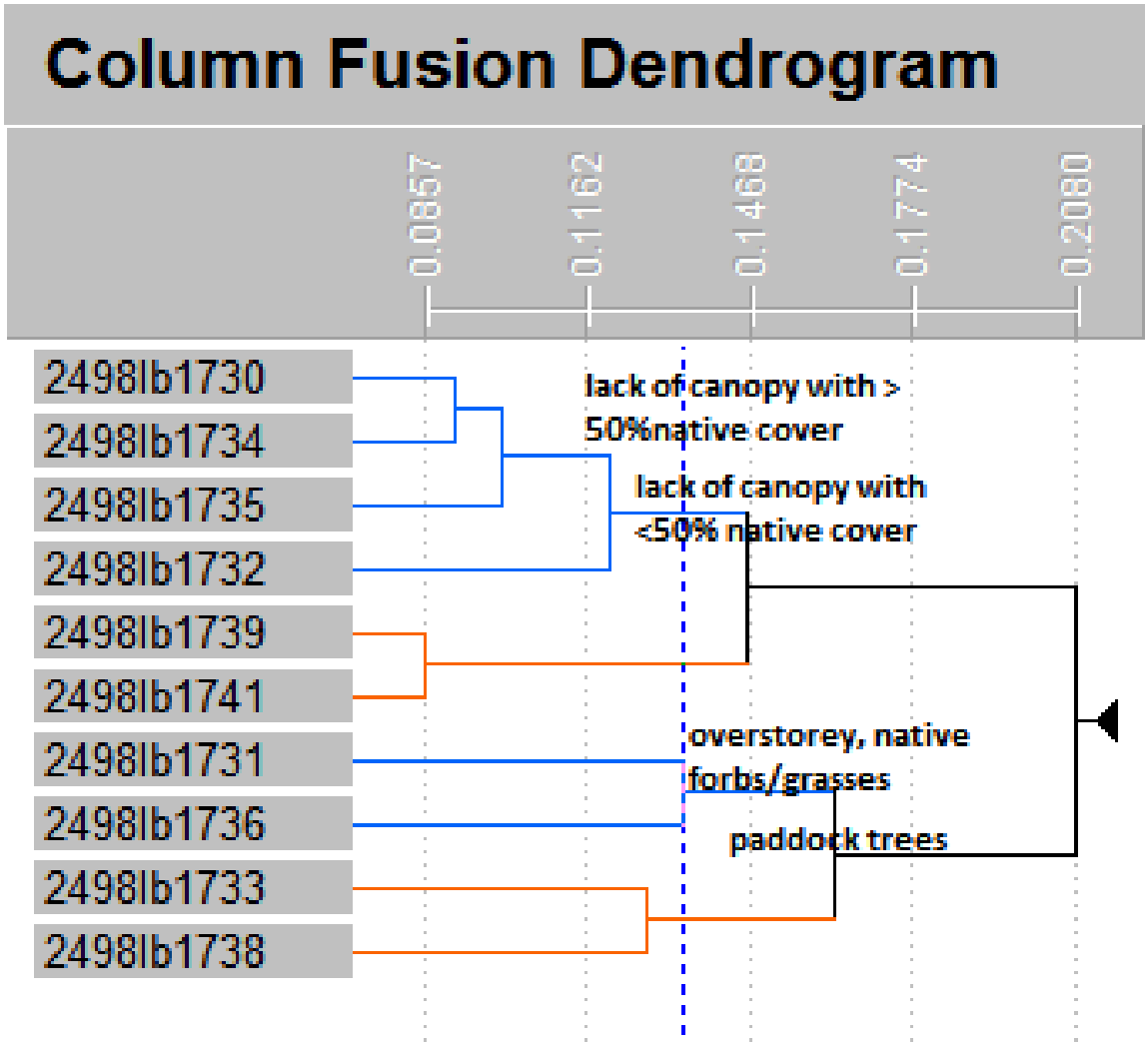
Plot data recorded during field survey.

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
2498lb1730	2	0	0	58	0	0	86	0	0	0	228870	6149136	56
2498lb1731	10	12.5	0	20	0	16	74	0	1	5	228882	6148649	56
2498lb1732	5	0	0	60	0	2	78	0	0	0	228876	6148706	56
2498lb1733	8	8	0	26	0	22	72	0	1	6.5	228796	6148761	56
2498lb1734	4	0	0	60	0	0	72	0	0	0	228980	6148996	56
2498lb1735	4	0	0	42	0	0	96	0	0	0	228949	6149286	56
2498lb1736	5	13.5	0	12	0	0	84	0	1	0	228895	6149332	56
2498lb1738	14	4	0	70	0	48	53	0	1	0	229061	6149407	56
2498lb1739	3	0	0	22	0	0	100	0	0	0	228841	6149561	56
2498lb1741	3	1	0	12	0	0	100	0	0	0	228759	6149502	56

Appendix 3. Dendrogram

Dendrogram of vegetation plots conducted during field survey.



Appendix 4. Fauna species list

	Common Name	Scientific Name	Status (NSW)	Status (National)
Amphibia	Clicking Froglet	*Crinia signifera*	P	-
	Whistling Tree Frog	*Litoria verreauxii*	P	-
Aves	Australasian Pipit	*Anthus novaeseelandiae*	P	-
	Australian Magpie	*Cracticus tibicen*	P	-
	Australian Raven	*Corvus coronoides*	P	-
	Australian Wood Duck	*Chenonetta jubata*	P	-
	Brown Quail	*Coturnix ypsilophora*	P	-
	Crimson Rosella	*Platycercus elegans*	P	-
	Diamond Firetail	***Stagonopleura guttata***	**V**	**-**
	Double-barred Finch	*Taeniopygia bichenovii*	P	-
	European Goldfinch*	*Carduelis carduelis*	U	-
	Grey Fantail	*Rhipidura albiscapa*	P	-
	Grey Shrike-thrush	*Colluricincla harmonica*	P	-
	Jacky Winter	*Microeca fascinans*	P	-
	Laughing Kookaburra	*Dacelo novaeguineae*	P	-
	Long-billed Corella	*Cacatua tenuirostris*	P	-
	Noisy Friarbird	*Philemon corniculatus*	P	-
	Pacific Black Duck	*Anas superciliosa*	P	-
	Pied Currawong	*Strepera graculina*	P	-
	Scarlet Robin	***Petroica boodang***	**V**	**-**
	Spotted Pardalote	*Pardalotus punctatus*	P	-
	Striated Thornbill	*Acanthiza lineata*	P	-
	Superb Fairy-wren	*Malurus cyaneus*	P	-
	Superb Lyrebird	*Menura novaehollandiae*	P	-
	Varied Sittella	***Daphoenositta chrysoptera***	**V**	**-**
	Welcome Swallow	*Hirundo neoxena*	P	-
	White-throated Treecreeper	*Cormobates leucophaea*	P	-
	Willie Wagtail	*Rhipidura leucophrys*	P	-
	Yellow Thornbill	*Acanthiza nana*	P	-
	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	P	-
	Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	P	-
Mammalia	**Large-eared Pied Bat**	***Chalinolobus dwyeri***	**V**	**V**
	Gould's Wattled Bat	*Chalinolobus gouldii*	P	-
	Common Wallaroo	*Macropus robustus*	P	-
	Common Wombat	*Vombatus ursinus*	P	-
	Eastern Grey Kangaroo	*Macropus giganteus*	P	-
	Fox*	*Vulpes vulpes*	U	-
	Eastern Bentwing Bat	***Miniopterus schreibersii***	**V**	**-**
	Eastern Freetail Bat	*Mormopterus ridei*	P	-

	Common Name	Scientific Name	Status (NSW)	Status (National)
	Nyctophilus sp.	*Nyctophilus sp.*	P	-
	Rabbit*	*Oryctolagus cuniculus*	U	
	Greater Broad-nosed Bat	***Scotorepens ruppellii***	V	
	Swamp Wallaby	*Wallabia bicolor*	P	
	White-striped Freetail-bat	*Tadarida australis*	P	
	Large Forest Bat	*Vespadelus darlingtoni*	P	
	Southern Forest Bat	*Vespadelus regulus*	P	
	Little Forest Bat	*Vespadelus vulturnus*	P	
Reptilia	Delicate Skink	*Lampropholis delicata*	P	
	Weasel Skink	*Saproscincus mustelina*	P	

V= Vulnerable, P = Protected, U = Introduced

Appendix 5. MNES Assessments of Significance

Matters for Assessment

Assessments of Significance and supplementary information (where relevant) are presented for the following MNES in relation to the Project:

- Threatened Ecological Communities
  - White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland
- Threatened Fauna
  - Large-eared Pied Bat
  - Koala
  - Grey-headed Flying Fox
  - Migratory species: Cattle Egret, Rainbow Bee-eater, Black-faced Monarch and Rufous Fantail

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Likelihood
An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will: 1. **reduce the extent of an ecological community**	
A total maximum area of 8.1 hectares of White Box Yellow Box Blakely's Red Gum Woodland and Derived Native Grassland (hereafter referred to as Box-Gum Woodland) will be removed by the Project. The total area is made up of four condition classes as detailed in section 4 of this report: 1. Blakely's Red Gum - Yellow Box - Grassy open woodland (condition a – clumped trees with native forbs and grasses) (SR670) 2. Blakely's Red Gum - Yellow Box - Grassy open woodland (condition b –occasional eucalypts with low diversity) (SR670) 3. Blakely's Red Gum - Yellow Box - Grassy open woodland (condition c – occasional eucalypts with introduced ground cover) (SR670) 4. Blakely's Red Gum - Yellow Box - Grassy open woodland (condition d – grassland) (SR670) The Box-Gum Woodland CEEC has been heavily cleared across its range, with the remaining extent of the ecological community being highly fragmented, occurring in small isolated patches within a cleared environment, or within a landscape of other disturbed woodlands (DoE 2014). This is evident throughout the study area and within the wider study area. The EPBC Policy Guidelines (DoE 2014) also state that over 90% of the original extent of this ecological community has been cleared. This is supported by OEH (2014) who regarded the equivalent Biometric Vegetation Type to be 90% cleared, and Thomas et al. 2000 estimate that within South-Eastern NSW 59,468 ha remain from the pre-1750 extent of 1,012,052 ha (approximately 94% cleared). In an attempt to determine the extent of Box-Gum Woodland in the locality, mapping by Tozer et al 2006 was examined as it covered the locality extent. A total of 3,304.6 ha of the best equivalent vegetation type (p24, Tableland Grassy Box Gum Woodland) has been mapped within a 10 km radius of the study area. The p24 mapping unit has been described by Tozer as potentially aligning to the CEEC and the state listed EEC, however it would include some areas that do not meet the CEEC. It has been assumed in this assessment that half of the total p24 area would be an approximate representation of the remaining CEEC in the locality (i.e. 1,652.3 ha). The potential habitat removed by the Project is therefore estimated to represent less than 0.5% of the community in the locality. It is unclear what the condition and security of the remaining CEEC is within the locality. It is likely that much of the extent is on private land and that it is in a similar condition as the study area.	Known.
2. fragment or increase fragmentation of an ecological community	

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Likelihood
All of the CEEC within the study area has experienced weed invasion, grazing pressures and clearing which has resulted in a predominantly degraded condition across the study area. The CEEC within the study area is currently fragmented by agricultural land, offering very little connectivity to the patch of CEEC near the Marulan South administration buildings, and to patches of the CEEC approximately 1km to the east of the study area. However, the Project would not result in the CEEC being fragmented from other patches of native vegetation.	Marginal increase in fragmentation.
3. adversely affect habitat critical to the survival of an ecological community	
The CEEC to be disturbed by the Project consists of four condition classes. None of the condition classes contained a diverse range and cover of native flora species. In particular, none of the sites contained more than 12 important indicator species identified in the EPBC Act Policy guidelines. The Box-Gum Woodland Recovery Plan regards all areas of Box-Gum Woodland which meet the minimum condition criteria to be considered critical to the survival of the ecological community. Based on this statement, it would mean that all patches of the CEEC within the study area, regardless of condition or size, are critical to the survival of the community and similarly, this would extend to all areas of the community within the locality. However in the case of this assessment, consideration should be given to the highly degraded study area, which is currently grazed, with much of the seedbank (particularly in the northern portion of the study area) depleted, which is likely to further decline with the current grazing pressure. It is unlikely that the clearing of 8.1 ha of which 0.7ha contains canopy trees with native grasses and forbs whilst the remainder is highly degraded (approximately less than 1% of the TEC within the locality) is likely to adversely affect habitat critical to the survival of the ecological community.	Unlikely
4. modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.	
The clearing of the CEEC will result and the emplacement of overburden, will also result in the destruction of abiotic factors within the study area. The impacts associated with the Project are not likely to significantly exacerbate currently operating edge-effects that occur adjacent to the disturbance footprint, once rehabilitation has occurred. The main impact from the proposal would be the clearing of the CEEC.	Unlikely to be a factor – impacts restricted to clearing of the CEEC within the study area
5. cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	
The Project will result in the loss of the CEEC within the disturbance footprint. Within the immediate surrounds, patches of CEEC may experience an increase in introduced species via increased edge effects. The closest patch would be to the immediate east of the study area which consists of canopy trees with a degraded understorey (Figure 9). However, despite the potential for edge effects, the risk would be decreased through the implementation of weed control measures which would be updated in in the existing Landscape and Rehabilitation Management Plan (Boral 2012). As such, it is unlikely that a substantial change to species composition would occur in the CEEC immediately adjacent to the study area as a result of the Project. The Project has some minor potential to alter the fire frequency of the area via use of vehicles within the grassy paddocks within the study area and immediate surrounds. However, given Boral's commitments to fire safety and fire response, it is unlikely that this potential indirect impact would result in a significant threat to the CEEC.	Unlikely
6. cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: assisting invasive species, that are harmful to the listed ecological community, to become established, or	
The Project will likely present some potential edge effects for remaining areas of the CEEC that are located immediately to the east of the disturbance footprint (	Some potential

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Likelihood
Figure 9).. However, these areas are already subject to weed invasion, clearing and grazing pressures. It is likely that weed invasion may be exacerbated within adjacent patches however establishment of new weed species is unlikely to occur particularly given control measures for weeds implemented through the Landscape and Rehabilitation Management Plan.	
7. causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or	
The Project will not involve any spraying of fertilizers, herbicides or other chemicals or pollutants which will kill or inhibit the growth of other areas of the CEEC. Herbicides may be required for bushland restoration purposes to reduce the spread of weeds, however these will only be used in accordance within bushland restoration principles and best practise and will not result in any significant impacts to other areas of the CEEC.	Unlikely
8 interfere with the recovery of an ecological community.	
The National Recovery Plan for White Box–Yellow Box–Blakely's Red Gum Grassy Woodland and Derived Native Grassland has been prepared under the provisions of the EPBC Act. The overall aim of the recovery plan is to promote the recovery and prevent the extinction of the CEEC. The specific objectives of the recovery plan is to minimise the risk of extinction of the ecological community through: • achieving no net loss in extent and condition of the ecological community throughout its geographic distribution • increasing protection of sites in good condition • increasing landscape function of the community through management and restoration of degraded sites • increasing transitional areas around remnants and linkages between remnants and • bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland. The Project will interfere with the recovery of the CEEC given that 8.1 ha of the community will be cleared, of which only 0.7 ha contains a native canopy with native forbs and grasses, whilst the remainder is highly degraded. Whilst an offset under the EPBC Act is not proposed, given the PCT will be offset under the FBA the CEEC, it would subsequently result in a no net loss (otherwise known as improve or maintain) outcome for the community at a regional level, by securing patches of the CEEC and managing these in perpetuity. In the long-term the offset is expected to benefit the recovery of the community, given the CEEC to be impacted is predominantly in poor condition, is likely to decline into the future and is on private land facing development and ongoing grazing pressures.	Likely however greater recovery benefits will be achieved through an offset.
Conclusion: The Project is unlikely to result in a significant impact on Box-Gum Grassy Woodland due to the following: • relatively minor amount of highly degraded TEC that would be impacted by the Project which is not critical to the survival of the community in the locality. • Less than 0.5% of the TEC within the locality is likely to be impacted. • Fragmentation is likely to be minor. • Indirect impacts are likely to be managed through proposed mitigation measures.	

Large-eared Pied Bat (Vulnerable)	
Preamble The Large-eared Pied Bat has been recorded from a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. The species can also be found on the edges of rainforests and in wet sclerophyll forests. The Large-eared Pied Bat roosts in caves and mines in groups of between 3 and 37 individuals. During field survey the Large-eared Pied Bat was recorded at all locations (2) where bat recorders were placed within the study area.	
Criteria (Vulnerable Species)	**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:	
1. lead to a long-term decrease in the size of an important population of a species;	
It is not expected that any impacts on breeding habitat for the Large-eared Pied Bat would result from the Project as preferred breeding habitat comprises caves and mine shafts, neither of which will be impacted. Impacts from the Project constitute impacts to foraging habitat (areas of canopy trees with buffer into grassland area) of which approximately 7.5 hectares would be cleared. The foraging habitat is considered to be of moderate to poor quality for the species being degraded woodland (but on fertile soils). Foraging habitat to be removed occurs on fertile soils that are connected to likely breeding areas within Bungonia Gorge via vegetated links, and such habitat has previously been recognised as being important for the species (e.g. Pennay 2008). Given the occurrence of the Large-eared Pied Bat at all sites where bat recording devices were placed within the local area as part of surveys for the Marulan South Limestone Mine Project (Niche 2015), it is assumed that the species forages over a wide range of habitats within the study area and wider locality. An analysis of records undertaken from surveys performed during this Project and for the Marulan South Limestone Mine Project did not appear to highlight a pattern of increased bat abundance from sites on more fertile soils within the locality, rather numbers decreased with distance from potential roost areas. It is noted however that survey concentrated on identification of presence/absence of target species rather than attempts to investigate habitat preferences within the study area and data capture was not sufficient to confidently explain patterns of distribution. Over time, foraging habitat would be at least partially restored through rehabilitation works. Regardless of rehabilitation works, potential foraging habitat would remain abundant within the locality and the currently proposed removal of approximately 7.5 ha of potential foraging habitat is not expected to cause a long-term decrease to any population of the species.	Unlikely
2. reduce the area of occupancy of an important population;	
The Project would not impact the area of occupancy of the Large-eared Pied Bat for the following reasons: • The areas to be cleared are not sufficient in extent to impact the area of occupancy of the Large-eared Pied Bat at a 2km grid square scale (which is the standard unit for measuring area of occupancy according to the IUCN). • Large-eared Pied Bats would still be expected to forage within the vicinity of the study area given that it was recorded at all sites during this survey and previous surveys for Marulan South Limestone Mine (Niche 2015) including close to current Quarry and limestone mining areas. • Once completed (approximately 12 month construction timeframe), the southern overburden emplacement will be revegetated to a native vegetation community dominated by species typical of those native species that currently occur within the study area.	Unlikely
3. fragment an existing important population into two or more populations;	
The Project is unlikely to increase fragmentation for any population of the species. The Large-eared Pied Bat is a mobile species and the Project would not impact on areas where the species is known to breed and roost.	None
4. adversely affect habitat critical to the survival of a species;	

Habitat critical to the survival of the species has not been listed within guidelines or a recovery plan for the species. Such habitat is considered to include breeding caves and roost habitat. Such habitat would not be impacted by the Project. Foraging habitat of the type to be removed as part of the Project has been considered important for the species, however such habitat is considered locally common and the habitat to be removed is not considered critical to the species survival.	Unlikely
5. disrupt the breeding cycle of an important population	
The proposal is unlikely to disrupt the breeding cycle of the species as breeding events for this species primarily take place within caves or other suitable roost habitats, none of which are expected to be adversely impacted by the Project.	None
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	
The extent of foraging habitat to be removed is not considered sufficient to result in the decline of the species given the local abundance of similar habitat. The Project would not isolate areas of foraging habitat.	Unlikely
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	
The Project is unlikely to increase the likelihood of weeds being established in areas adjacent to the study area that constitute potential foraging habitat for the species. The Project will include measures to control weeds becoming established in such areas through the implementation of weed management measures outlined in the Landscape and Rehabilitation Management Plan. Potential invasive predators such as the fox are already present within the study area and the Project is not expected to increase the level of predation threat for the Large-eared Pied Bat.	Unlikely
8. **introduce disease that may cause the species to decline, or**	
There are no known documented diseases that are currently contributing to the decline of the species. The Project in not expected to cause an increased risk of any bat diseases.	Unlikely
9. interfere substantially with the recovery of the species.	
The list of recovery actions for this species on its DoE profile page (DoE 2015) includes: "Management of the species should focus on the protection and enhancement of higher fertility soils". Whilst areas with higher fertility soils will be cleared under the Project, such areas are not in close proximity to breeding or maternity caves and constitute a very small proportion of similar habitat in the locality. As such, the Project is unlikely to interfere with the recovery of this species. Cleared areas will be rehabilitated.	Unlikely
Conclusion: Impacts from the Project relate to the removal of approximately 7.5 ha of potential foraging habitat for the Large-eared Pied Bat. Whilst foraging habitat on fertile soils (or within fertile valleys) is considered an important overall requirement for this species, impacts from the Project are not considered to be significant for the following reasons: • the area to be removed is very small; • the habitat to be removed is not in close proximity to maternity caves; • similar habitat is common throughout the area; and • rehabilitation of areas to be cleared will occur.	

Koala

In assessing the significance of the impact from the Project on the Koala the '*EPBC Act referral guidelines for the vulnerable koala*' (DoE 2015) were applied to the assessment. The following information is presented prior to the Assessment of Significance for the Koala to demonstrate application of the

guidelines and to assist with understanding the assessment and its conclusion. Table 30 presents habitat critical to Koala survival.

Table 29. Koala Habitat Assessment Scoring (DoE 2014):

Attribute	Score	Habitat Appraisal
Koala occurrence	+1	Koalas have not been sighted within or adjacent to the study area by any staff associated with the Quarry or limestone mine. Koalas have been sighted infrequently south-west of the study area over the past decade, with a Koala observed every 2- 3 years around the Marulan South Limestone Mine (pers. comm. with site personnel). On ground surveys did not detect Koalas or their scats within the proposed study area or surrounding areas. A number of Koala records exist from habitat approximately 2-4 km south of the study area from the Bungonia National Park and Bungonia State Conservation Area.
Vegetation Structure and composition	+2	Most of the study area is degraded with scattered native trees and isolated patches of woodland remaining, with a mix of native and exotic grasses. Two secondary food tree species were recorded, *Eucalyptus melliodora* and *Eucalyptus blakelyi* however no primary food tree species occur on the study area. While there is very low canopy cover across the site, the cover is predominantly from the above mentioned species and therefore these species account for >50% of the tree canopy cover.
Habitat connectivity	+2	The study area is part of a contiguous landscape of > than 1,000 hectares, however the existing quarry, limestone mine and perimeter roads form a significant barrier to accessing the study area from the north and west, and extensive vegetated areas with steep gorges occur to the east and south (the most of which are within the Morton and Bungonia National Parks). It is unlikely the study area would facilitate the movement of Koalas given the conditions of the boundaries of the study area.
Key existing threats	+2	There is no known documented or anecdotal evidence of Koala mortality from dog attack or vehicle collision within the study area or surrounds. Dogs, trucks, and train movements are all present within the surrounding area however wild dogs are not common (not detected on infrared cameras or seen during survey).
Recovery value	0	Habitat is unlikely to be important for achieving the interim recovery objectives. The development area is small and largely degraded habitat with sparse native vegetation amongst exotic grasses. The area is therefore not considered important as a habitat refuge. Connectivity to the nearby Bungonia State Conservation Area, a known refuge, is limited due to the adjacent limestone mine and gorge habitat. Given the extensive reserve network surrounding the existing refuge areas, the importance of the study area for Koalas is lessened.
Total	7/10	

Koala (vulnerable)

Preamble

There are 137 Koala records from the NSW Atlas of Wildlife within a 10 km radius of the study area, all but three of which are post 1980 records. The majority of these records (105) are from the Bungonia National Park (NP) and Bungonia State Conservation Area (SCA) which occur approximately 3 - 4 km south of the study area and collectively are considered one of the primary known active sites for a Koala population centred along the Shoalhaven Gorge and extending approximately 30 km to the south of the study area (e.g Allen 2002) encompassing large areas of Morton National Park. The Bungonia NP/SCA active Koala area includes popular walking areas and a camping site and therefore observations of Koalas from this area are relatively frequent. Other unknown active Koala areas may exist within the locality where access is limited.

The Bungonia NP/SCA areas are separated from the study area by the Bungonia Gorge, a limestone gorge approximately 350 m deep. The steepness of the gorge would undoubtedly limit connectivity between the main known breeding area of Koalas in the locality (Bungonia NP/SCA) and the study area, however there are records of the Koala from both sides of the gorge (albeit very limited from the northern side) and connectivity to the study area exists indirectly, west of the main gorge area.

North and west of the protected areas around the Bungonia and Shoalhaven gorges Koala records within the NSW Atlas of Wildlife are very limited with sporadic observations from private land and along roadsides, one being from the Marulan South Limestone Mine and two additional records (including road-kill) each from around the townships of Marulan and Tallong. These areas are more disturbed predominantly private tenure. They generally consist of more fertile areas that have been developed traditionally for agriculture. It is clear that Koalas are able to travel through such areas and feed trees, including primary feed trees, are available to them throughout such areas. Targeted Koala survey in these areas (private land on the tablelands) is likely to have been minimal and therefore actual Koala distribution and abundance within such areas is poorly known. Despite the limits regarding Koala distribution and abundance, given previous disturbance resulting in fragmented vegetation and the lack of Koala records within the higher elevation areas away from the protected areas around the Bungonia and Shoalhaven gorges, it is considered unlikely that active Koala areas (with permanent and moderate to high densities of Koalas) such as those within the Bungonia NP/SCA would occur in the study area.

Surveys and collection of anecdotal evidence of Koala sightings conducted within the study area as part of this assessment revealed no records of Koalas, with infrequent observations south of the study area around the Marulan South Limestone Mine. Scat surveys, spotlighting, call-playback and tree surveys did not identify repeated or on-going use of trees within the study area. Therefore, whilst it is known that Koalas occur in surrounding areas (primarily Bungonia State Conservation Area), the location of the existing quarry, infrastructure nearby and gorge habitat surrounding the study area are likely presenting a barrier to Koala movement in this area.

Criteria (Vulnerable Species)	**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:	
1. lead to a long-term decrease in the size of an important population of a species;	
It is considered unlikely that the Project would lead to a long-term decrease in the size of an important population of the Koala. It is considered that the population of Koalas occurring around the Shoalhaven and Bungonia gorges (as described in Allen - 2002) is an important population, however it has not been listed specifically as such within a recovery plan. The identified active Koala area within the Bungonia NP/SCA, which acts as a known breeding and regular feeding habitat is one of several active areas for this population which inhabits a vast area. The Project would not impact on the population such that it will lead to a long-term decline of an important population, as records away from protected areas within the locality of the study area are very sparse and infrequent, and no records exist on the study area.	Very unlikely
2. **reduce the area of occupancy of an important population;**	
The area to be cleared is not sufficient in extent to impact the area of occupancy of the Koala at a 2km grid square scale (which is the standard unit for measuring area of occupancy according to the IUCN). Koalas would still be expected to occur within the vicinity of the study area (e.g. to the south and east of the proposed emplacement area within bushland).	Unlikely

3. fragment an existing important population into two or more populations;	
The Project is unlikely to fragment the existing population into two or more populations, mostly due to the study area being on the edge of areas inhabited by the known population. There may be some minor impacts on potential connectivity with marginal habitat to the west of the study area, however given the lack of records of Koalas on the study area and the position of the site, it is unlikely the main active population areas would be impacted. Current quarrying and mining or approved overburden emplacements areas to the north and south of the study area (associated with the Marulan South Limestone Mine and Peppertree Quarry) have limited the utility of the study area to act as an east-west corridor for Koala movement. Undeveloped areas to the north and south of the study area would facilitate such movements.	Unlikely
4. adversely affect habitat critical to the survival of a species;	
Habitat within the study area to be impacted constitutes habitat critical to Koala survival as determined through application of the Koala habitat assessment tool (DoE 2014), which is illustrated in the Koala Habitat Scoring Table. The habitat within the study area scores a 7/10. However the area to be impacted is small and while feed trees are present, they are sparse. There have also never been any sightings of Koala within the study area and there is no evidence of Koalas utilising the study area based on results of the field survey.	Likely
5. disrupt the breeding cycle of an important population	
Habitat within the study area is not thought to be a key breeding area due to the absence of records and the lack of evidence of Koalas using the site. Therefore removal of the habitat is unlikely to disrupt the breeding cycle of the population. The area constitutes a very small proportion of the overall habitat for the population, (considered to be the population centred on the Shoalhaven gorge (Allen 2002)), with active population areas, including the Bungonia NP/SCA site, being the prime candidate sites for breeding activity.	Unlikely
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	
The area to be removed is an extremely small proportion of Koala habitat for the population and the species. Its removal is unlikely to have an impact on patterns of Koala movement and no isolation between populations would occur as a result of the Project.	Unlikely
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	
Invasive species such as foxes that may impact on the Koala are already established within the study area. The Project is unlikely to further encourage these threats from occurring.	Unlikely
8. **introduce disease that may cause the species to decline, or**	
The main diseases affecting Koalas are chlamydial infections - the Project would not increase exposure to such infections as Koalas from the local population would not have increased contact with other Koala populations, including infected populations.	Unlikely
9. interfere substantially with the recovery of the species.	
The following aspects are considered in relation to the possibility of the Project interfering with the recovery of the Koala (from DoE 2014): • *Increasing koala fatalities in habitat critical to the survival of the koala due to dog attacks to a level that is likely to result in multiple, ongoing mortalities.* There is no reason to suspect that dogs would become more prevalent within the study area or surrounds as a result of the Project. • *Increasing koala fatalities in habitat critical to the survival of the koala due to vehicle-strikes to a level that is likely to result in multiple, ongoing mortalities.* There have been no reported Koala fatalities due to vehicle strike within the area surrounding the study area or along access roads. Construction vehicle movements will occur during the construction of the southern overburden emplacement (approximately 12 month period) . There are strict speed controls on the vehicles operating within the Quarry (20 and 40 km/hr). Given the very low number of Koala sightings from the area and the absence of recorded fatalities it is considered that the risk of increased fatalities such that multiple ongoing fatalities occur is very low. • *Facilitating the introduction or spread of disease or pathogens for example Chlamydia or*	Unlikely

Phytophthora cinnamomi, to habitat critical to the survival of the koala, that are likely to significantly reduce the reproductive output of koalas or reduce the carrying capacity of the habitat.
This is considered unlikely as there would be no new sources of contamination as a result of the Project. The Project would not lead to Koalas being transported to the site from other areas. If vehicles coming to and from the site are considered to be a potential agent of *Phytophthora cinnamomi,* the Project would not lead to a change in the source areas where vehicles travel from, to arrive at the site and therefore it is not considered that the Project increases the risk of *Phytophthora cinnamomi* spread.

- *Creating a barrier to movement to, between or within habitat critical to the survival of the koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the koala.*
  The area to be impacted by the Project is an extremely small proportion of Koala habitat for the population and the species. Its removal is unlikely to impact on patterns of Koala movement and no isolation between populations would occur from the Project.

- *Changing hydrology which degrades habitat critical to the survival of the koala to the extent that the carrying capacity of the habitat is reduced in the long-term.*
  The Project is unlikely to result in changes to the hydrology of the downstream environments of the Barbers Creek Gorge and Shoalhaven River, which includes habitat accessible to Koala populations.

Conclusion: Impacts from the Project largely relate to the removal of habitat that has been defined as being critical to the survival of the Koala. Such habitat is recognised as critical habitat due to past impacts on similar habitat limiting the Koalas ability to persist throughout its former distribution. The Project includes the removal of approximately 7.5 hectares of critical habitat (made up of areas of canopy trees and a buffer into adjacent grassland) with a score of 7. Through application of the guidelines (DoE 2014) and consideration of the context of the study area this is not considered a significant impact. i.e. "*a significant impact would not be expected if 5 hectares of habitat scoring 9 or 10, or 10 hectares scoring 7 or 8, was selectively cleared*."

Given the absence of records of Koala on the study area and limited observations surrounding the study area, it is not considered that removal of this habitat alone would significantly adversely impact the Koala population (centred around the Shoalhaven gorge) such that a decline would occur. Active sites for this population are concentrated within protected areas and the study area is not thought to provide a link between active areas within the population's distribution or to any other Koala population.

Over time, foraging/refuge habitat would be at least partially restored through rehabilitation works. Regardless of rehabilitation works, the proposed removal of habitat is not expected to cause a significant impact for the species.

Grey-headed Flying-fox (Vulnerable)	
Preamble 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. The species was not recorded during the current survey but may occasionally fly through or forage within the study area.	
Criteria (Vulnerable Species)	**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:	
1. lead to a long-term decrease in the size of an important population of a species;	
Impacts from the Project constitute impacts to marginal foraging habitat of which approximately 7.5 hectares (made up of area of canopy trees with buffer) would be cleared. This is an overestimate as the species will not forage within the open grassland areas, and may only forage within the scattered trees within the study area. The foraging habitat is considered to be of poor quality for the species being a degraded woodland. Eucalypt species in the study area include *Eucalyptus blakelyi* and *Eucalyptus melliodora*. These species may offer some potential foraging habitat. Potential foraging habitat is abundant within the locality, in particular Morton National Park and Bungonia State Conservation Area which occur within close proximity to the study area. The proposed removal of foraging habitat is not expected to cause a long-term decrease to any population of the species.	Unlikely
2. reduce the area of occupancy of an important population;	
The Project would not impact the area of occupancy of the Grey-headed Flying-fox for the following reasons: • The areas to be cleared are not sufficient in extent to impact the area of occupancy of the species at a 2km grid square scale (which is the standard unit for measuring area of occupancy according to the IUCN). • Grey-headed Flying-fox would continue to forage within the vicinity of the study area given that potential habitat is widespread throughout the locality and habitat to be impacted is of no particular importance.	Unlikely
3. fragment an existing important population into two or more populations;	
The Project is unlikely to increase fragmentation for any population of the species. The Grey-headed Flying-fox is a mobile species and the Project would not impact on areas where the species is known to breed and roost.	None
4. adversely affect habitat critical to the survival of a species;	
Habitat critical to the survival of the species has not been determined in the National Recovery Plan for this species (DECC 2009) guidelines or a recovery plan for the species. “Productive” areas are acknowledged as potentially being foraging habitat critical to the survival of the species. However no measure of productivity is given. There are no recognised ‘prolific flowering or fruiting trees within the study area. In addition, whilst the timing of productivity is considered to be important in determining whether habitat is critical to the survival of the species, the timing given as being important covers the entirety of the year (see DECC 2009). Foraging habitat of the type to be removed as a result of the Project is unlikely to be important for the species, given the highly cleared nature of the study area and degraded condition of the woodland present. Better condition habitat occurs to the east of the study area, and habitat is well represented within adjacent conservation reserves. Winter flowering pulses are not considered to be particularly high within the habitat to be cleared. The habitat to be removed is not considered critical to the species survival.	Unlikely
5. disrupt the breeding cycle of an important population	
The Project is unlikely to disrupt the breeding cycle of the species as breeding events for this species primarily take place within camps, none of which would be adversely impacted as a result of the Project.	None
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	
The extent of foraging habitat to be removed is not considered sufficient to result in the decline of the species given the local abundance of similar habitat. The Project would not isolate areas of foraging	Unlikely

habitat.	
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	
The Project is unlikely to increase the likelihood of weeds being established in areas adjacent to study areas that constitute potential foraging habitat for the species with the implementation of measures to control weeds from becoming established in such areas as outlined in the Landscape and Rehabilitation Management Plan. Potential invasive predators such as the fox are already present within the study area and the Project is not expected to increase the level of predation threat for the Grey-headed Flying-fox.	Unlikely
8. **introduce disease that may cause the species to decline, or**	
There are no known documented diseases that are currently contributing to the decline of the species. The Project is not expected to cause an increased risk of any bat diseases.	Unlikely
9. interfere substantially with the recovery of the species.	
The Project does not directly or substantially interfere with any of the specific recovery objectives under the National Recovery Plan (DECC 2009). A general objective is to lessen the currently operating threats for the species which includes the removal of foraging habitat. The Project is therefore not consistent with this general objective. However the area and type of foraging habitat to be removed is not considered to constitute substantial interference with the recovery of the species.	Unlikely
Conclusion: Impacts from the Project relate to the removal of foraging habitat for the Grey-headed Flying-fox within the study area. Whilst protection of foraging habitat is considered important for this species, potential impacts from the Project are not considered to be significant for the following reasons: • the habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution or size; • similarly important foraging habitat occurs throughout the locality including within protected areas; and • rehabilitation of areas to be cleared will occur, with a greater density of trees being planted than what currently exists, which should mitigate the loss of foraging habitat to some extent.	

Migratory Species (Cattle Egret, Rainbow Bee-eater, Black-faced Monarch and Rufous Fantail)	
Preamble: The above species all have potential habitat within the study area that would be impacted from the Project. All of the species subject to this assessment are considered to occur within the study area on an irregular basis and the habitat within the study area is similar to widespread and common habitat within the locality for these species.	
Criteria (Migratory Species)	**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:	
1. substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	
No important habitat for any of the potentially occurring migratory species is considered to occur within the study area.	Unlikely
2. result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	
No invasive species of particular significance to the identified migratory species are expected to be established as a result of the Project. The study area is already affected by invasive plants including some noxious weeds and introduced fauna such as the Fox which has some potential to adversely impact most fauna occurring within the study area and surrounds. New invasive species are unlikely to become established due to the Project.	Unlikely
3. seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	
None of the potentially occurring migratory species would have a significant proportion of their population occurring within the study area.	Unlikely
Conclusion: The Project would remove 8.1 hectares of native vegetation. None of the above species occur in significant numbers within the study area and the study area does not support significant breeding habitat such that it may be used by a significant number of individuals to conduct any aspect of their lifecycle including foraging, breeding, overwintering or sheltering.	

Appendix 6. Credit profile for development

Biodiversity credit report

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 1/04/2016 Time: 4:12:44PM Calculator version: v4.0

Major Project details

Proposal ID: 0112/2015/2048MP

Proposal name: 2498 Peppertree EIS

Proposal address:

Proponent name: Boral

Proponent address:

Proponent phone:

Assessor name:

Assessor address:

Assessor phone:

Assessor accreditation: 0112

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Yellow Box grassy woodland of the northern Monaro and Upper Shoalhaven area, South Eastern Highlands Bioregion	8.10	225.33
Total	8.10	225

Credit profiles

1. Yellow Box grassy woodland of the northern Monaro and Upper Shoalhaven area, South Eastern Highlands Bioregion, (SR670)

Number of ecosystem credits created 225

IBRA sub-region Bungonia - Southern Rivers

Offset options - Plant Community types	Offset options - IBRA sub-regions
Yellow Box grassy woodland of the northern Monaro and Upper Shoalhaven area, South Eastern Highlands Bioregion, (SR670)	Bungonia - Southern Rivers and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

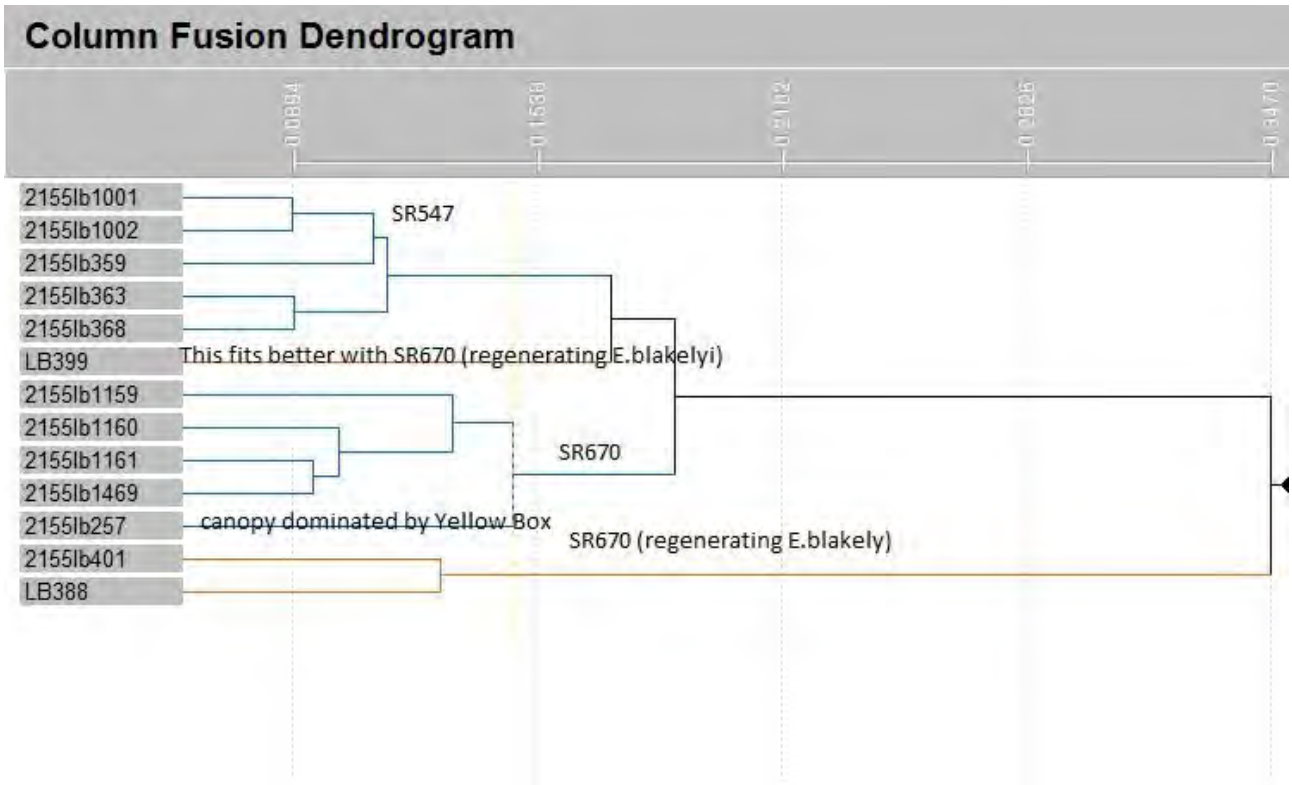
None required

Appendix 7. Flora and dendrogram for offset site

Family	Species	Naturalized
Adiantaceae	*Cheilanthes sieberi*	
Anthericaceae	*Thysanotus spp.*	
Anthericaceae	*Tricoryne elatior*	
Apiaceae	*Centella asiatica*	
Apiaceae	*Hydrocotyle laxiflora*	
Asteraceae	*Calotis lappulacea*	
Asteraceae	*Cassinia aculeata*	
Asteraceae	*Cassinia spp.*	
Asteraceae	*Chrysocephalum apiculatum*	
Asteraceae	*Conyza bonariensis*	*
Asteraceae	*Euchiton spp.*	
Asteraceae	*Helichrysum scorpioides*	
Asteraceae	*Hypochaeris radicata*	*
Asteraceae	*Lagenifera spp.*	
Asteraceae	*Olearia viscidula*	
Asteraceae	*Ozothamnus diosmifolius*	
Asteraceae	*Senecio linearifolius*	
Asteraceae	*Senecio madagascariensis*	*
Asteraceae	*Sigesbeckia orientalis*	
Asteraceae	*Vittadinia cuneata*	
Campanulaceae	*Wahlenbergia gracilis*	
Campanulaceae	*Wahlenbergia stricta*	
Chenopodiaceae	*Einadia nutans*	
Clusiaceae	*Hypericum gramineum*	
Convolvulaceae	*Dichondra repens*	
Cyperaceae	*Fimbristylis tristachya*	
Ericaceae	*Lissanthe strigosa*	
Ericaceae	*Melichrus urceolatus*	
Fabaceae (Faboideae)	*Bossiaea prostrata*	
Fabaceae (Faboideae)	*Glycine clandestina*	
Fabaceae (Faboideae)	*Glycine microphylla*	
Fabaceae (Faboideae)	*Glycine tabacina*	
Fabaceae (Faboideae)	*Hardenbergia violacea*	
Fabaceae (Mimosoideae)	*Acacia genistifolia*	
Fabaceae (Mimosoideae)	*Acacia parramattensis*	
Geraniaceae	*Geranium solanderi*	
Goodeniaceae	*Goodenia bellidifolia*	
Haloragaceae	*Gonocarpus tetragynus*	
Lamiaceae	*Mentha spp.*	*

Family	Species	Naturalized
Lomandraceae	*Lomandra filiformis*	
Lomandraceae	*Lomandra longifolia*	
Lomandraceae	*Lomandra multiflora*	
Myoporaceae	*Myoporum montanum*	
Myrtaceae	*Eucalyptus blakelyi*	
Myrtaceae	*Eucalyptus eugenioides*	
Myrtaceae	*Eucalyptus melliodora*	
Myrtaceae	*Eucalyptus viminalis*	
Oxalidaceae	*Oxalis perennans*	
Phormiaceae	*Dianella caerulea*	
Phyllanthaceae	*Phyllanthus hirtellus*	
Plantaginaceae	*Plantago debilis*	
Plantaginaceae	*Plantago lanceolata*	*
Plantaginaceae	*Veronica plebeia*	
Poaceae	*Aristida ramosa*	
Poaceae	*Aristida vagans*	
Poaceae	*Austrodanthonia racemosa*	
Poaceae	*Bothriochloa macra*	
Poaceae	*Chloris gayana*	*
Poaceae	*Chloris spp.*	*
Poaceae	*Chloris ventricosa*	
Poaceae	*Cynodon dactylon*	
Poaceae	*Dichelachne micrantha*	
Poaceae	*Echinopogon caespitosus*	
Poaceae	*Ehrharta erecta*	*
Poaceae	*Eragrostis brownii*	
Poaceae	*Eragrostis leptocarpa*	
Poaceae	*Eragrostis leptostachya*	
Poaceae	*Microlaena stipoides*	
Poaceae	*Nassella tenuissima*	*
Poaceae	*Panicum effusum*	
Poaceae	*Pennisetum clandestinum*	*
Poaceae	*Poa annua*	*
Poaceae	*Poa sieberiana*	
Poaceae	*Sporobolus creber*	
Poaceae	*Themeda australis*	
Ranunculaceae	*Clematis aristata*	
Rosaceae	*Acaena novae-zelandiae*	
Rosaceae	*Rubus fruticosus*	*
Rubiaceae	*Asperula conferta*	
Rubiaceae	*Opercularia diphylla*	
Solanaceae	*Solanum nigrum*	*

Family	Species	Naturalized
Solanaceae	*Solanum prinophyllum*	



Appendix 8. Credit profile for offset site

BioBanking credit report

This report identifies the number and type of credits required at a BIOBANK SITE

Date of report: 1/04/2016 Time: 3:34:44PM Calculator version: v4.0

Biobank details

Proposal ID: 0112/2016/2554B

Proposal name: 2498 Peppertree Eastern Offset Site

Proposal address:

Proponent name:

Proponent address:

Proponent phone:

Assessor name:

Assessor address:

Assessor phone:

Assessor accreditation: 0112

Additional information required for approval:

- [ ] Use of local benchmark
- [ ] Expert report...
- [ ] Request for additional gain in site value

Ecosystem credits summary

Plant Community type	Area (ha)	Credits created
Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin Bioregion and South Eastern Highlands Bioregion	37.32	311.00
Yellow Box grassy woodland of the northern Monaro and Upper Shoalhaven area, South Eastern Highlands Bioregion	38.22	291.00
Total	75.54	602

Credit profiles

1. Yellow Box grassy woodland of the northern Monaro and Upper Shoalhaven area, South Eastern Highlands Bioregion, (SR670)

Number of ecosystem credits created	291
IBRA sub-region	Bungonia - Southern Rivers

2. Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin Bioregion and South Eastern Highlands Bioregion, (SR547)

Number of ecosystem credits created	311
IBRA sub-region	Bungonia - Southern Rivers

Species credits summary

Additional management actions

Additional management actions are required for:

Vegetation type or threatened species	Management action details
Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin Bioregion and South Eastern Highlands Bioregion	Exclude commercial apiaries
Yellow Box grassy woodland of the northern Monaro and Upper Shoalhaven area, South Eastern Highlands Bioregion	Exclude commercial apiaries
Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin Bioregion and South Eastern Highlands Bioregion	Exclude miscellaneous feral species
Yellow Box grassy woodland of the northern Monaro and Upper Shoalhaven area, South Eastern Highlands Bioregion	Exclude miscellaneous feral species
Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin Bioregion and South Eastern Highlands Bioregion	Feral and/or over-abundant native herbivore control
Yellow Box grassy woodland of the northern Monaro and Upper Shoalhaven area, South Eastern Highlands Bioregion	Feral and/or over-abundant native herbivore control
Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin Bioregion and South Eastern Highlands Bioregion	Fox control
Yellow Box grassy woodland of the northern Monaro and Upper Shoalhaven area, South Eastern Highlands Bioregion	Fox control

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APPENDIX E

ABORIGINAL AND HISTORIC HERITAGE IMPACT ASSESSMENT

APPENDIX E

Aboriginal and historic heritage impact assessment

Peppertree Quarry Modification 4

Prepared for Boral Resources (NSW) Pty Ltd (NSW) Pty Ltd | 31 March 2016

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Aboriginal and historic heritage impact assessment

Final

Report J15057RP1 | Prepared for Boral Resources (NSW) Pty Ltd (NSW) Pty Ltd | 31 March 2016

Prepared by	**Rebecca Newell**	Approved by	**Pamela Kottaras**
Position	Senior Archaeologist	Position	Heritage Services Manager
Signature		Signature	
Date	31 March 2016	Date	31 March 2016

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Document Control

Version	Date	Prepared by	Reviewed by
V01	16 September 2015	Rebecca Newell	Pamela Kottaras
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V02	5 February 2016	Pamela Kottaras	Rod Wallace
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Executive Summary

Boral Resources (NSW) Pty Ltd (Boral) owns and operates the Peppertree Quarry (the Quarry), a hard rock quarry located in Marulan South, New South Wales.

Boral is seeking to modify the current Project Approval (PA 06_0074) under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act), to provide for the following (hereafter referred to as the Project):

- extend daily in-pit operating hours at the Quarry by 6 hours; and
- develop a new overburden emplacement area.

The modification proposed above will constitute Modification 4 to the current Project Approval.

This report has considered the available environmental and archaeological information for the study area including previous reports as well as the nature of the proposed activities.

The desktop and field survey did not identify any historic heritage items in the study area. No impacts to historic heritage are predicted and as such, the only management measure is an unexpected finds protocol.

A review of previous Aboriginal cultural heritage investigations in the vicinity of the study area indicates that sites have been found in the region, usually on moderate slopes adjacent to reliable watercourses. Aboriginal sites are usually open artefact scatters, isolated finds or culturally modified trees. Most stone tools are made of silcrete and quartz.

As part of the investigation for the project, desktop research identified one record, MQ25, within the disturbance footprint. MQ25 has been destroyed, through collection, therefore does not pose a constraint to the project. Field survey identified a culturally modified tree (MQ120), which is outside the project boundary and will not be impacted by the development.

An area of moderate archaeological potential was also recorded during the survey. The area of moderate archaeological potential is located on a ridgeline overlooking the Barbers Creek Gorge. A portion of the identified area of moderate archaeological sensitivity will be subject to impact as a result of the new overburden emplacement area. Further, this ridgeline type of landscape has been previously investigated in excavations for Peppertree Quarry, Marulan South Limestone Mine and throughout the wider Southern Tablelands region. These results have found that areas of ridgelines generally contain artefact densities of less than five artefacts per square meter and a low background scatter of artefacts. These areas have been adequately tested and the information from previous excavations can be extrapolated to the study area where it is highly likely that similar low density scatters may be present. The study area would not be able to provide information additional to what has been uncovered in the region, particularly the main Peppertree Quarry project area, which has been subject to detailed archaeological investigation and which has provided a comprehensive picture of the Aboriginal archaeological landscape. The following management recommendations have been made based on the analysis of results and the research completed for this report. The following management recommendations are designed to be consistent with the existing recommendations as contained in the approved Aboriginal heritage management plan.

Recommendation 1

That MQ 120 is fenced and avoided during development of the southern overburden emplacement area.

Recommendation 2

Update the Aboriginal Heritage Management Plan to include the results of this survey and the management recommendations.

Recommendation 3

If unexpected historical archaeology is discovered during construction, work in the immediate area must cease and an archaeologist must be contacted to make an assessment of the find. If it is determined to be a relic under the Heritage Act, further investigation may be required. Examples of unexpected finds may include consolidated bricks, sandstone blocks and artefact deposits.

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1 Introduction

1.1 Project description

Boral Resources (NSW) Pty Ltd (Boral) owns and operates the Peppertree Quarry (the Quarry), a hard rock quarry located in Marulan South, New South Wales.

Boral is seeking to modify the current Project Approval (PA 06_0074) under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act), to provide for the following (hereafter referred to as the Project):

- extend daily in-pit operating hours at the Quarry by 6 hours; and
- develop a new overburden emplacement area.

The modification proposed above will constitute Modification 4 to the current Project Approval.

1.1.1 New southern overburden emplacement

Overburden emplacement at the Quarry is currently approved within noise bunds located along the northern and eastern boundaries of the site, an emplacement area to the east of the approved quarry pit and a western emplacement area and noise bund to the west of the Quarry across Boral's private railway line. Remaining overburden was proposed to be emplaced within the south pit of Boral's adjoining Limestone Mine.

The noise bunds were completed during construction of the Quarry, and the eastern overburden emplacement area will reach capacity in early 2016. Mine planning for the Limestone Mine has ruled out emplacement within the south pit. The Limestone Mine, under its forthcoming development application, is seeking to hold 5 million m^3 (approximately 13 Mt) of overburden for the Quarry, however, this will not be approved until late 2016. As an interim measure, Boral is seeking to place approximately 1 million m^3 of overburden within a new overburden emplacement, to the south of the approved 30 year quarry pit (Figure 1.1). Overburden stripped from the pit will be transported by trucks along the most direct haul route possible. This new overburden emplacement area will be needed in early 2016 and will take approximately 12 months to establish.

The proposed new overburden emplacement will be located within the south-eastern extent of the future hard rock (granodiorite) resource, which extends south from the existing Quarry pit, to the northern end of the Limestone Mine's north pit. A significant granodiorite resource also exists on Boral's lands to the north of the existing Quarry pit, extending northwards from Tangarang Creek. The proposed southern overburden emplacement will not sterilise resource as Boral will relocate this southern emplacement in the future if the southern granodiorite resource needs to be accessed. Although the southern overburden emplacement may be relocated in the future, this is unlikely to be required for at least the next 25 years. The proposed emplacement will therefore be landscaped and rehabilitated in accordance with the existing Peppertree Quarry Landscape and Rehabilitation Management Plan.

1.2 Site description and existing environment

The Quarry is located in Marulan South, 10 kilometres (km) southeast of Marulan, 35 km east of Goulburn and approximately 175 km south-west of Sydney, within the Goulburn Mulwaree Local Government Area (LGA) in the Southern Tablelands of NSW (Figure 1.1). Access is via Marulan South Road, which connects the Quarry and Boral's Marulan South Limestone Mine with the Hume Highway approximately 9 km to the northwest. Boral's private rail line connects the Quarry and Limestone Mine with the Main Southern Railway approximately 6 km to the north.

The Quarry is located on Boral owned land approximately 650 hectares (ha) in size, which includes the Quarry site, approximately 70ha in size, additional granodiorite resources to the south and surrounding land. The site is zoned RU1 - Primary Production zone under the Goulburn Mulwaree Local Environmental Plan (LEP) 2009. Mining and extractive industries are permissible in this zone with consent.

The Quarry is bordered to the south by the Limestone Mine, to the east by Morton National Park and by rural properties to the north and west. Surrounding land uses include mining, grazing, rural properties including an agricultural lime manufacturing facility, fireworks storage facility, turkey farm and rural residential. The main access for these properties is via Marulan South Road. Rural residential properties are also located to the northeast of the Quarry along Long Point Road. These properties are separated from the Quarry by the deep Barbers Creek gorge.

The site of the former village of Marulan South is located between the Quarry and the Limestone Mine on Boral owned land. The village was established principally to service the Limestone Mine but has been uninhabited since the late 1990s. The majority of the village's infrastructure has been removed and only a village hall and former bowling club remains. The bowling club has been converted into administration offices for the Limestone Mine. The study area for this assessment is the disturbance footprint of the modification. This includes the new overburden emplacement area. The study area and proposed modification are shown in Figure 1.2.

1.3 Approved project

1.3.1 Quarry activities and infrastructure

The approved quarrying activities are for extraction of 105 million tonnes of granodiorite over 30 years at an initial rate of 1–2 million tonnes per annum (Mtpa) and a maximum rate of 3.5 Mtpa. Granodiorite is an intrusive igneous rock suitable for use as a construction and building material. The hard rock aggregates produced at the site are a range of different shapes and sizes for different purposes. Primary production is of concrete and asphalt aggregates (10 mm) and railway ballast (28–50 mm) with capacity to produce larger aggregates (>100 mm) for rock armour and gabion baskets. Fines (generally <5 mm) produced during crushing of product are blended with limestone sand from Boral's adjacent Limestone Mine or Penrose Quarry to produce a marketable manufactured sand.

Infrastructure at the Quarry includes a processing plant, rail loop and loading facilities, two water storage dams, an in-pit mobile crushing plant, overburden emplacement areas, noise and visual bunding, product stockpiles, and staff facilities.

Work to establish the Quarry commenced in July 2011. Production commenced early in 2014 following a lengthy commissioning and proving phase. The Quarry has approval to operate until the end of 2038.

1.3.2 Transport of product

Product from the Quarry is transported entirely by rail except in an emergency where it would be transported by road with the written approval of the Secretary of DP&E. The Quarry has approval to transport up to 3.5 Mtpa of product from the site. At full production the Quarry will operate up to four trains per day which will transport product north to the Sydney market and other customers. In addition, the Limestone Mine currently operates up to six trains per day transporting product north to Berrima and Maldon and east to Port Kembla.

Trains to the Quarry and the Limestone Mine access Boral's private rail line from the Main Southern Railway at the Medway Junction. The rail line is mostly single track with a 1 km length of triple line track used for shunting and train loading. A rail loop has been constructed at the Quarry for separation of rail movements on the rail line between the two Boral sites. Rail loading facilities were also established on the rail loop adjacent to the Quarry's processing plant.

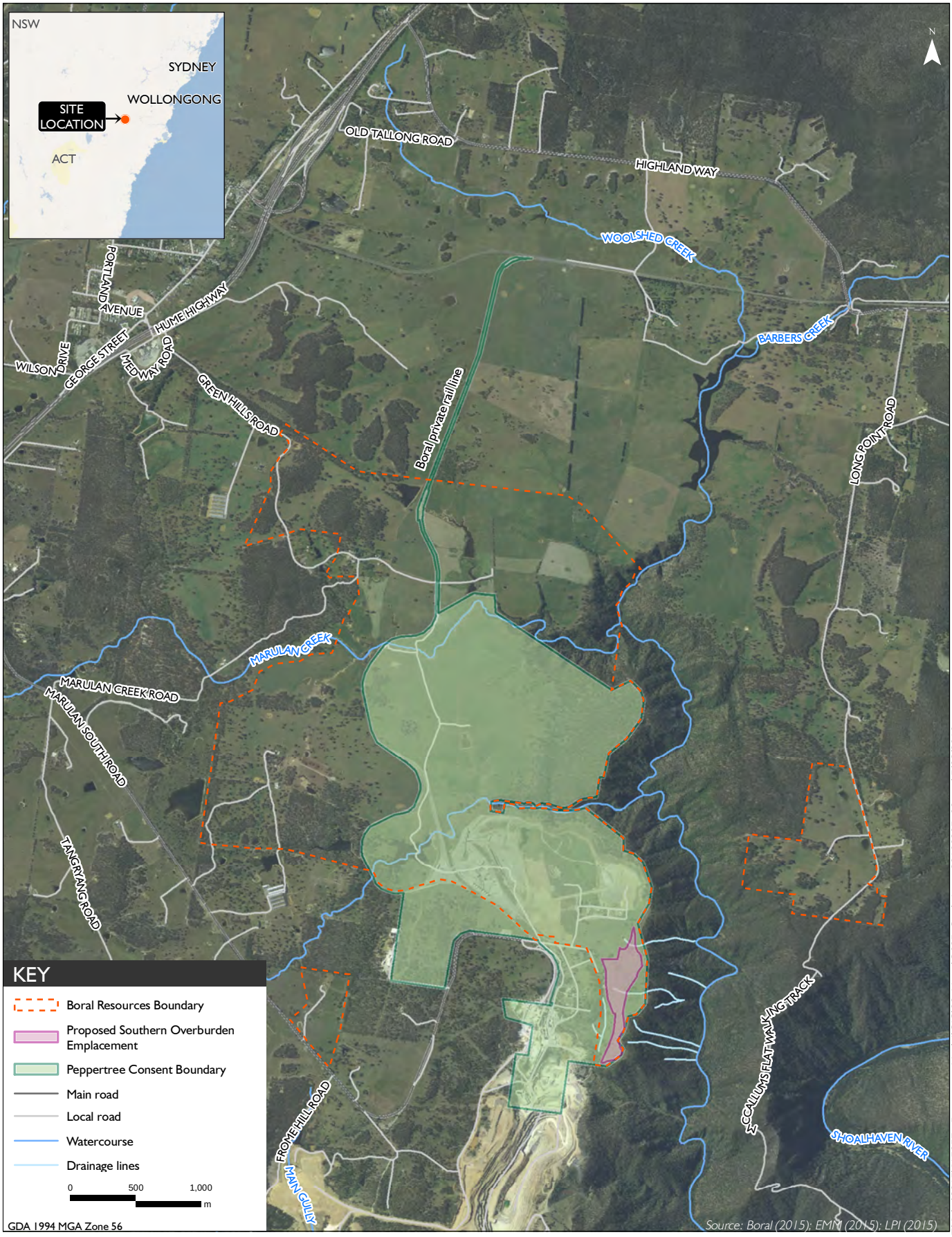
Loading of product from the Quarry onto trains and train movements occur 24 hours, seven days a week. This enables train trips on the Main Southern Railway to be scheduled away from peak commuter times.

1.3.3 Operating hours and workforce

The Quarry operates 24 hours, seven days a week with in-pit activities restricted to the hours of 7 am to 7 pm. Approved operating hours are outlined in detail in Table 1.1

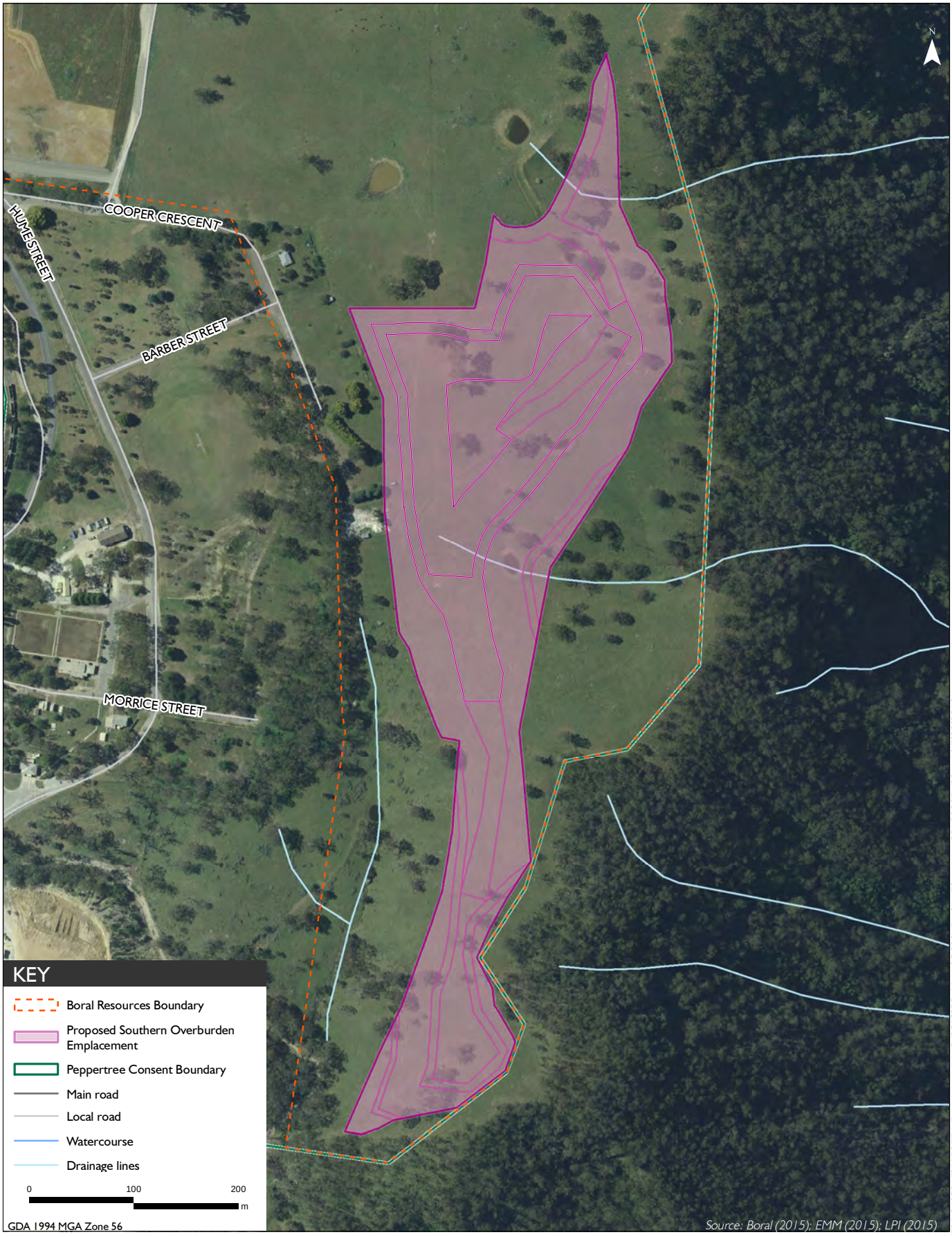
Table 1.1 Approved operating hours

Activity	Day	Time
Construction works	Monday – Friday	7 am –6 pm
	Saturday	8 am –1 pm
	Sundays and public holidays	None
Topsoil/overburden removal/emplacements	Any day	7 am –7 pm
Blasting	Monday – Saturday	9 am –5 pm
	Sundays and public holidays	None
In-pit activities (including drilling, extraction, processing, and transfer of material out of the pit)	Any day	7 am –7 pm
Out-of-pit activities (including processing, stockpiling, train loading and distribution, and maintenance)	Any day	24 hours



Study area

Peppertree Quarry Modification 4 Project
Aboriginal cultural and historic heritage assessment
Figure 1.1



Project elements

Peppertree Quarry Modification 4 Project

Aboriginal cultural and historic heritage assessment

Figure 1.2

1.4 Legislative framework

The Project Approval for the Quarry was granted under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Boral wishes to modify the Project Approval under Section 75W of the EP&A Act. Secretary's Environmental Assessment Requirements have not been issued for this modification, however the Department of Planning and Environment have accepted the proposed Aboriginal and historic heritage assessment methodologies outlined in the following sections.

1.5 Objectives of this assessment

The objectives of this assessment are to:

- identify Aboriginal and historic heritage values relevant to the study area through desktop analysis and field investigation;
- assess the significance of Aboriginal objects, sites and places identified in the course of field investigations and through Aboriginal community consultation;
- assess the significance of historic heritage items and places;
- assess the impact of the proposed modifications on the identified Aboriginal and historic heritage items; and
- identify appropriate management measures for Aboriginal and historic heritage that may be impacted by the modification.

1.6 Aboriginal cultural and archaeological heritage assessment method

1.6.1 Guidelines

The Aboriginal cultural heritage assessment has been prepared in accordance with best practice and using the following guidelines:

- *Draft guidelines for Aboriginal cultural heritage impact assessment and community consultation* (DEC 2005) the guideline required for Part 3A matters;
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (DECCW 2011); and
- *Code of practice for archaeological investigation of Aboriginal objects in NSW* (the Code) (DECCW 2010).

1.6.2 Method

Aboriginal heritage values have been identified using the following methods:

- consultation with members of the Quarries Aboriginal Management Committee (AMC) in accordance with the existing Project Aboriginal Heritage Management Plan (AHMP) to identify cultural and social values of the study area and places of special significance that should be considered;

- a search of the Aboriginal Heritage Information Management System (AHIMS - Aboriginal sites register) for records of previously registered Aboriginal sites;
- a review of Aboriginal heritage reports covering the study area;
- a review of environmental characteristics to develop a predictive model for Aboriginal archaeological sites;
- an archaeological survey with AMC members in accordance with the Code focusing on landform transects in impact areas; and
- the recommendation of management and mitigation measures as required.

1.7 Historic heritage assessment method

1.7.1 Guidelines

This assessment is conducted using the principles of *The Australian International Council on Monuments and Sites, Charter for Places of Cultural Significance* (also known as the *Burra Charter,* Australian ICOMOS 2013) and the New South Wales (NSW) *Heritage Manual* (Heritage Office 2006). OEH provides other best practice guides which have informed this report including:

- *Statements of Heritage Impact Guidelines* (Heritage Office 2006);
- *Investigating Heritage Significance* (Heritage Office 2004); and
- *Assessing Significance for Historical Archaeological Sites and 'Relics'* (Heritage Branch Department of Planning 2009).

1.7.2 Heritage listings

Research has been undertaken through the review of statutory and non-statutory registers. All registers were searched online and included:

Statutory

- The National Heritage Register (NHL) made under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- The Commonwealth Heritage Register (CHL) made under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- The State Heritage Register (SHR) made under Part 3A of the *Heritage Act 1977* (Heritage Act). Items on the SHR undergo a rigorous assessment process and must reach a high significance threshold to be included. Inclusion on the SHR is directed by the Minister of the agency that administers the Heritage Act.
- The Heritage and Conservation Register (s170 register) made under Section 170 of the Heritage Act. It is a register of heritage items that are owned or managed by state government authorities. Items on the s170 register may also be listed on other registers.

- Schedule 5 of the *Goulburn Mulwaree Local Environmental Plan 2009* (LEP) Division 4 of the EP&A Act includes provision for the making of local environmental plans (LEPs) by the Minister. LEPs are prepared to a standard template, which includes environmental heritage in Schedule 5 (heritage schedule). Where an item is included in the heritage schedule, development applications must include an assessment of impacts to the item. Where a project is being assessed as an SSD, approval by the relevant council does not form part of the overall approval; however, the items require assessment and management if they are affected by the proposal.

- The State Heritage Inventory (SHI), which was cross-checked with the Schedule 5 and the s170 register.

Non-statutory

- National Trust of Australia, NSW (NT); and

- Register of the National Estate (RNE).

Archaeological sites are protected by Section 139 of the Heritage Act if they are assessed to be relics, that is, of local or State significance. A formal listing is not required to ensure that protection and impacts can only be undertaken with approval.

1.7.3 Research

Desktop primary and secondary sources were reviewed to understand the history of the study area.

Primary research included:

- newspaper articles;

- photographs;

- land titles information; and

- maps, plans and sketches.

Secondary sources included:

- consultant reports; and

- histories of the local area.

The following facilities were visited to obtain primary and secondary research material on the study area:

- Berrima District Historical & Family History Society Inc;

- Sydney University Library;

- National Library of Australia *Trove* Online;

- State Library (Mitchell Wing); and

- Wingecarribee Local Studies Library.

1.8 Authorship

The report was prepared by Rebecca Newell (archaeologist EMM) and reviewed by Pamela Kottaras (Heritage Services Manager EMM), Neville Hattingh (Director Element Environment) and Rod Wallace (Boral Property Group).

2 Aboriginal consultation

2.1 Overview

In compliance with condition 32 of the Project Approval for the Quarry an Aboriginal Heritage Management Plan (AHMP) was prepared. The plan details management procedures for Aboriginal heritage within the development area and continuing consultation with the Aboriginal community. Members of the Peppertree Quarry AMC were invited to participate in the field survey and provide feedback on the survey strategy, cultural heritage values and the measures in the draft report. All documents relating to consultation are included in Appendix A.

2.2 Introductory letter

An introductory letter was sent to all AMC members on 10 June 2015. It provided details of the proposed assessment and survey method and invited the AMC members to provide cultural heritage values for the site. The members of the AMC were provided with 20 days to respond.

No responses were received.

2.3 Cultural information

Efforts to undertake cultural mapping and further understand the significance of this area to the Aboriginal community have occurred during previous Aboriginal heritage assessments by ERM in 2006 and 2011. To date, no information has been received that identifies specific heritage value unrelated to the Aboriginal sites.

No cultural heritage information, further to that identified in previous assessments, was given to the archaeologist during meetings with the AMC. As a result, cultural mapping was not considered necessary for this modification. Participation of Aboriginal groups in the AMC continues to provide avenues for cultural heritage information to be communicated to Boral should it arise in the future.

2.4 Draft report review

The draft report was provided to AMC members. Table 2.1 provides the AMC's feedback.

Table 2.1 Feedback from AMC

Group	Feedback points	Response
Ngunawal Heritage Aboriginal Corporation	Pleased that the scarred tree is out of the project boundary area and will be fenced off during Mod 4 activities.	
	Recommend sub surface testing of an area of moderate PAD that will be destroyed during construction	Extensive sub surface testing undertaken for the Marulan South Limestone Mine Project as well as archaeological salvage excavation at Peppertree Quarry, have provided a clear understanding of the subsurface character of the site and no further investigation is necessary. Refer to Section 8 for a detailed justification on

Table 2.1 Feedback from AMC

Group	Feedback points	Response
		why further test excavations of the proposed Southern Overburden Emplacement area are not required.
	Recommend monitoring of topsoil during road construction	Monitoring topsoil removal is considered to be unnecessary from an archaeological perspective. The archaeological landscape character of the region immediately surrounding the project area, which includes the Marulan South Limestone Mine and Peppertree Quarry, has been subjected to extensive archaeologically testing. Moreover, a large area of Peppertree Quarry has been extensively excavated for cultural purposes and areas of significance on the Marulan South Limestone Mine project footprint will be archaeologically salvaged. It is considered that further archaeological salvage excavation and monitoring is unjustified in this instance.
	Request information regarding another site that was identified during survey but not mentioned in the report	During the archaeological field survey, three potential stone artefacts were photographed and a GPS point recorded, however, subsequent lab analysis indicated that these stones were not artefacts and the objects were not recorded as a site.
Buru Ngunawal Aboriginal Corporation	Reiterated the importance of understanding the cultural value, that Aboriginal people have for tangible and intangible heritage items, rather than just their scientific value.	EMM and Boral respect and value the cultural importance that both tangible and intangible objects and places have for Aboriginal people within the natural cultural landscape. This assertion is demonstrated by the cultural excavation being undertaken at Peppertree Quarry from 2014 to the present, and through the extensive Aboriginal cultural consultation process being undertaken for the Marulan South Limestone Mine project, which has involved the thorough investigation of a potential cultural site.
	Supported the management recommendations as set out in 9.2.1 - 9.2.3.	No changes to the recommendations are anticipated.
	Requested that if any changes are made to these recommendations that may impact on any of the sites, BNAC should be consulted.	No changes will occur without appropriate consultation with the AMC.

3 Aboriginal background

3.1 Pre-European history

Information about the socio-cultural structure of Aboriginal society prior to European contact largely comes from ethno-historic accounts made by Europeans. These accounts and observations were made after massive social disruption due to disease and displacement. As a result, this information is often contentious, particularly in relation to language area boundaries.

The study area is located on the boundary of four Aboriginal groups (based on Tindale 1974);

- the Ngunawal whose territory extended to the south-west from Queanbeyan to Yass and east to beyond Goulburn;
- the Gandangara whose territory extended to the north-west at Goulburn and Berrima, down the Hawkesbury River to Camden and who's name incorporates terms meaning west and east;
- the Wodi Wodi whose territory extends to the north-east north of the Shoalhaven River to Wollongong; and
- the Wandandian whose territory extends to the south-east from Ulladulla to the Shoalhaven River and Nowra.

Generally Aboriginal people lived in family based clan groups of between 30 and 50 people living within a defined area. Each group would have been mobile for at least part of the year and comprised of various ages males and females with approximately four to eight pairs of husband and wives. Most men were considered to have only one wife though Govett (1836) notes that the chiefs of each tribe were able to have two wives.

Covered sleeping areas known as gunyahs were erected at campsites using bark and tree branches and may have been reused (Bluett 1927 p.11). Timber and bark were also used to make tools and weapons adhered with natural glue. Local and imported stones including quartz and silcrete were used to make a variety of tools.

Aboriginal people subsisted on plant foods, aquatic life from the surrounding waterways and ate variety of animal life such as possum, kangaroo, snakes and lizards. Migrating Bogong moths were the basis of the food supply during the summer months and may have been the basis for large tribal gatherings during these months (Matthews 2007).

Burial in the region appeared to occur in a number of ways. Individuals could be interred in the ground in a shallow grave covered by stone, rocks or cobbles. Positioning of the burial may have been associated with ownership of areas (ERM 2012). Other reports of burial included placing the corpse in a hollow tree or in a sitting position in the ground (Gillespie 1988 p.2).

As a result of its location at the centre of a number of different geographic areas, it has been hypothesised (ERM 2012 p.26) that the Marulan and Marulan South area may have been suitable for large or regular ceremonial and tribal meetings.

3.2 Previous Aboriginal archaeological investigations

3.2.1 Regional studies

Archaeological investigations have been undertaken around the study area over the last 20 years. The following section presents a summary of those archaeological investigations which have occurred in the Southern Highlands and Southern Tablelands region and are relevant to the proposed modification.

Lance and Koettig 1986, *An Aboriginal Resource Planning Study for the City of Goulburn*, report by ANUTECH to Goulburn City Council.

Lance and Koettig undertook a large scale investigation aimed at identifying land use patterns in the Marulan region as part of a regional study for the City of Goulburn. The results of the investigation predicted that stone artefacts scatters would be found within 50 to 100 m of water. They also hypothesised that the largest and most dense artefact scatters would be found at the junctions of creeks and rivers with site size and frequency decreasing with the increased distance from water.

RPS HSO, 2009, Cultural Heritage Assessment Marulan South Limestone Mine, report prepared for Blue Circle Southern Cement.

RPS HSO conducted an Aboriginal heritage assessment for a Review of Environmental Factors to support the continued mine operations within CML 16. Marulan South Limestone Mine is located 1 km to the south of the study area. The assessment included a pedestrian survey during which a total of 16 Aboriginal sites, including 11 isolated finds and 5 artefact scatters, were recorded. The majority of these sites were located on lower slope landform units adjacent to water sources. Two artefacts were located outside the boundaries of impact areas so were not impacted by the project. An additional area on the western side of their study area was not surveyed because of the steepness of the terrain.

The primary recommendation was to protect the archaeological resource by redesigning the overburden emplacement areas. If redesign was not feasible, it was recommended that archaeological salvage be undertaken to minimise the loss of information by project impacts. The sites are currently in-situ and have not been subject to impacts from overburden emplacement areas.

Lynwood Quarry Project, Marulan (Umwelt 2005, 2007a, 2007b, 2007c, 2008a, 2008b, 2008c, 2008d, 2008e, 2009, 2012 draft).

The following summarises the investigations completed as part of the approvals for the Lynwood Quarry facility, located approximately 5 km north-west of the study area. To date the investigations have included survey, test and salvage excavation and a detailed artefact analysis and excavation report is in production.

The survey area for this report was approximately 5 km north-west of the study area. The first stage of survey involved sampling transects over the different landscapes in the project area. The survey located 52 Aboriginal sites including 30 artefact scatters, 13 isolated finds and seven culturally modified trees and two stone arrangements. Several artefact scatters with more than 150 stone artefacts were recorded. Artefact material included silcrete, quartz and chert.

Umwelt also developed an identification system based on archaeological terrain units (ATUs). The ATUs take into account both the environmental and cultural context of the Lynwood Quarry project area and are used as part of the predictive model for surface and subsurface sites.

An additional survey was conducted for proposed transmission lines at the Lynwood Quarry area approximately 1 km south of the study area. The survey identified 15 sites, eight of which were within the boundary of their project area. The sites generally consisted of artefact scatters with no more than ten artefacts. Dominant raw material included silcrete and quartz.

The results of the survey and impact assessment were used to inform three stages of test and salvage excavation:

- Stage 1 included three separate stages of excavation. Stage 1a consisted of the excavation of 20 power pole locations. Over 300 artefacts were identified including flakes, flaked pieces and cores. The dominant raw material type was quartz followed by quartzite, silcrete and chert. Stage 1b involved five additional testing sites and 110 test pits, which yielded a total of 52 artefacts. Stage 1c involved artefact analysis.

- Stage 2 consisted of four stages of investigation. Stage 2a included subsurface testing of known sites and Stage 2b tested the remaining ATUs in the development impact area. Stage 2c involved monitoring of the historic heritage investigations at Old Marulan Town and Stage 2d consisted of reporting and updates to AHIPs to ensure works were able to proceed.

- Stage 3 consisted of two stages of investigation. Stage 3a involved further subsurface salvage of ATUs and PADs and Stage 3b consisted of a final report incorporating the results of all stages (in production).

As a result of proposed modifications to the Lynwood Quarry facilities an additional survey and assessment was completed of an additional 10ha area located approximately 5 km to the north of the original project area. The assessment included survey and consultation with registered Aboriginal stakeholders. The survey did not identify any artefacts but three areas were identified as potential archaeological deposits. Additional impacts were also proposed in areas previously identified as containing Aboriginal sites and potential archaeological deposits. The recommendations for the project included retaining topsoil in the project areas and a variation to the existing AHIP #1100264 to allow additional construction elements. The variation to AHIP #1100264 included subsurface testing of areas of potential archaeological deposit.

The combined survey and excavation program at Lynwood Quarry identified 94 Aboriginal sites. Ten of these sites have been combined into one site (Joarimin Creek South). A total of 34 ATUs were identified with survey and testing identifying 29 with Aboriginal sites present. The preliminary analysis of the results of the survey and three stages of excavation have identified that:

- The largest numbers of known sites are within the Bindook Porphyry geological unit, on spur crest and gentle slope landforms.

- The entire area was used by Aboriginal people including for ceremonial purposes. All ATUs provided light background artefact scatter.

- Areas associated with ridge crests, saddles on ridge crests, saddles on spur crests and slopes of moderate gradient reflect transient use.

- Four areas have artefact numbers and densities which may reflect long term occupation including spur crests, parts of Joarimi Creek South and gentle slopes in association with a reliable water source.

- Silcrete and quartz were the dominant raw materials used and it was assessed that most of the stone used for tool manufacture was brought into the area.

Management of the identified sites included the creation of a cultural heritage management zone (CHMZ) to conserve 11 Aboriginal sites long term, with an additional 51 Aboriginal sites conserved in-situ outside the project area. A total of 32 sites will be subject to partial or total impact by the project.

AMBS 2012, *Goulburn Mulwaree LGA Aboriginal Heritage Study,* prepared for Goulburn Mulwaree Council.

AMBS undertook a comprehensive historical and ethnographic study of the region, which identified areas of Aboriginal sensitivity within the Goulburn Mulwaree LGA. The outcomes of the study are for proponent and Council consideration during developments in the LGA. This study identified the area around South Marulan as an area of Aboriginal heritage significance.

EMM 2015 (draft), Aboriginal Cultural Heritage Assessment Marulan South Limestone Mine Continued Operations Project (including the results of a test excavation).

EMM is currently preparing an Aboriginal Cultural Heritage Assessment for the Marulan South Limestone Mine Continued Operations Project. The assessment will include the results of a pedestrian survey and test excavation program. Marulan South Limestone Mine is located approximately 1 km west from the study area. The preliminary results of the survey identified 36 Aboriginal sites across the project area with the majority located along Marulan Creek north of Peppertree Quarry. The preliminary results of the test excavation identified variable use across the project area, closely linked to the landforms and soil profiles. The highest numbers of artefacts were identified in areas close to Marulan Creek, with smaller numbers on gently inclined hill slopes adjacent to drainage depressions. Areas such as ridgelines, particularly those closest to Bungonia Gorge had comparatively few sites or subsurface artefacts with a shallow soil profile and artefact densities of less than 5 artefacts per square metre.

3.2.2 Previous investigations at Peppertree Quarry

ERM 2006, *Marulan South Quarry Aboriginal Heritage Assessment*, prepared for Boral Resources (NSW) Pty Limited.

ERM completed an Aboriginal heritage assessment as part of the Environmental Assessment of the Peppertree Quarry. The assessment identified 11 sites, comprising predominantly silcrete and quartz flakes and cores, within the quarry footprint and a proposed water storage dam along Tangarang Creek. A recommendation was made for salvage excavation in areas along Tangarang Creek, which was completed in 2010.

ERM 2012, Peppertree Quarry Archaeological Excavation Report, prepared for Boral Resources (NSW) Pty Limited (draft only).

As part of the requirements of the project approval and the Aboriginal Heritage Management Plan, ERM undertook a large scale test and salvage excavation prior to the commencement of quarry activities.

The test excavation followed that of Umwelt (2007- 2008) for the excavation of the Lynwood Quarry with landforms across the project area sampled along linear transects. A total of ten test transects covered six landforms within the Tangarang Creek Dam area and another three outside this area. Test pits were located at 5 m intervals along each transect. This resulted in the excavation of 103 test pits and a total of 2,089 artefacts recovered.

The areas determined for salvage excavation were based on the results of the test transects. Ten open area trenches were expanded and salvaged. These ten trenches were distributed across four hills.

A total of 122 m^2 of open excavation was undertaken with 20,956 artefacts excavated. During the open area excavation a number of high density artefact concentrations, hearths and ovens and a human burial were uncovered (ERM 2012, p. 51). The results of the salvage excavation identified seven domiciliary areas around high artefact concentrations, suggesting the varied and long term use of the area for habitation. Flakes dominate the assemblage, with backed artefacts, cores and retouched flakes also present. Seven types of raw material were present, dominated by silcrete, quartz, quartzite and chert. Chalcedony, basalt and granite artefacts are present in low numbers.

The occupation pattern from the excavations demonstrated that the preferred camping area was shallow hill slopes and hill tops associated with Tangarang Creek. Long term and frequent habitation by a large group is suggested by the relatively high technological diversity of artefacts, volume of artefacts and the presence of non-transportable items such as grinding stones. There was also evidence of a lack of initial manufacture stages across the quarry site, and suggests that initial reduction of material may have occurred in another area. Thus the tools in the project area are the result of later stages of tool manufacture and tool maintenance (Hiscock 2001). It was also considered possible that the area was used as a trading or ceremonial location considering the size and type of artefacts recovered and the location of the project area at the boundaries of four Aboriginal clan groups.

3.3 AHIMS search

The most recent extensive search of the AHIMS register was conducted on 2 February 2016 for an area approximately 10 km by 10 km and covering the study area. The search area was sufficient to define the pattern of previously recorded sites in the landscape. The AHIMS search results are located in Appendix B.

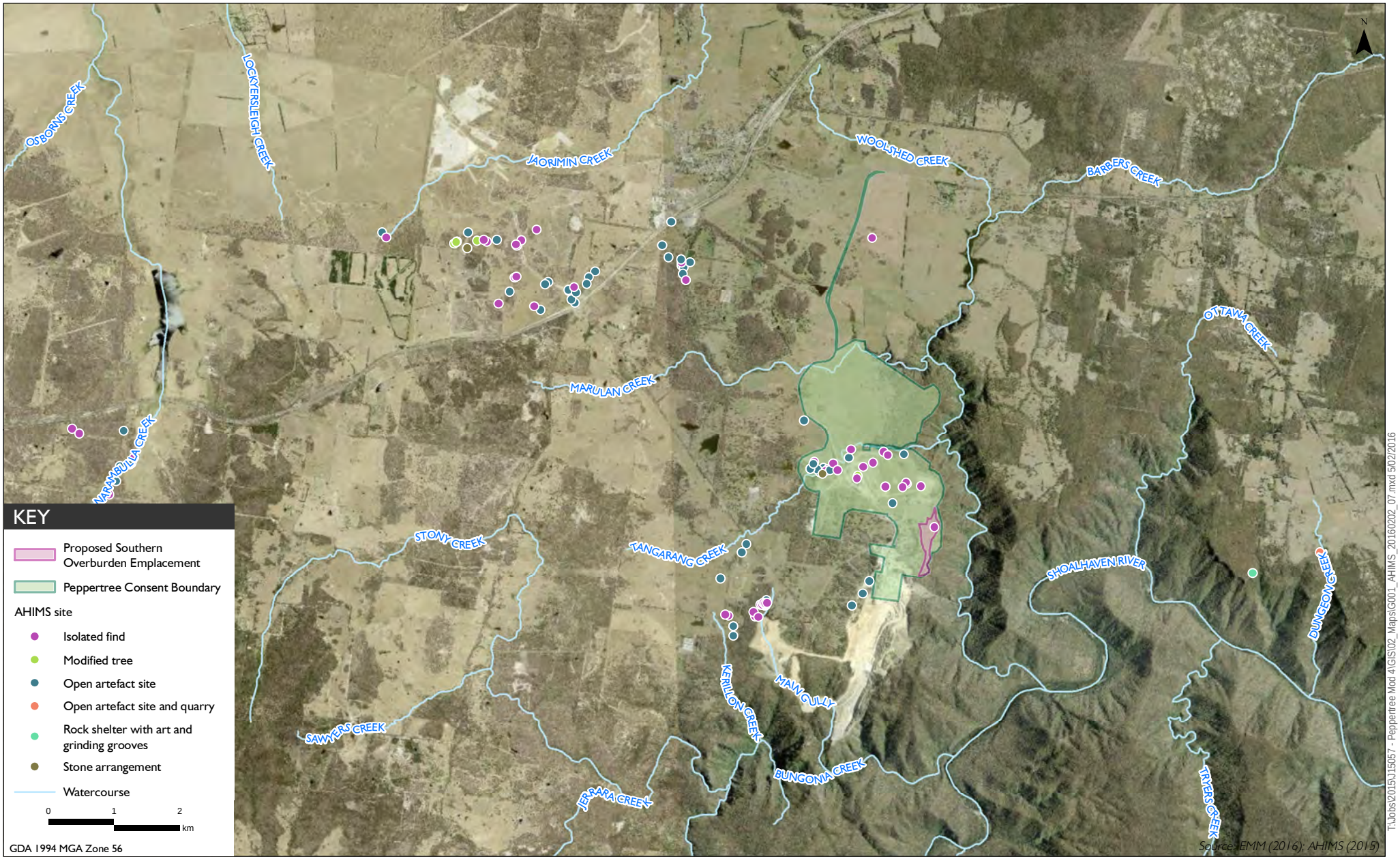
A wide variety of Aboriginal site types and their distribution across multiple landforms are represented. 112 Aboriginal sites were identified within the search area (Figure 3.1and Table 3.1). The most common Aboriginal site types were isolated finds and open artefact sites which made up over 90% of the total sites in the region. Artefacts sites recorded in AHIMS without specifying the number of artefacts have been designated as open artifact sites in Table 3.1. A small number of culturally modified trees and stone arrangements were also present; one rock shelter with art was also identified.

Table 3.1 AHIMS registered sites in the search area

Site type	Number of sites	Percentage
Isolated find	49	44%
Open artefact site	54	48%
Quarry	1	1%
Shelter with art	1	1%
Culturally modified tree	5	4%
Stone arrangement	2	2%
Total	**112**	**100%**

Out of the 112 Aboriginal sites identified, one site, MQ25 (52-4-0297) was recorded within the study area. MQ25 was an isolated find that has been collected. A number of sites were also located adjacent to the study area in Peppertree Quarry. Most have been removed in a salvage excavation program as part of the project approval; however 17 remain conserved in the following ways:

- MQ6, MQ7 and MQ27 are fenced;
- MQ18, MS26, MQ28, MQ29, MQ32, MQ33 and MQ34 have been left *in situ* beneath overburden emplacement for noise bunds or are located in-situ beyond the noise bunds; and
- MQ9, MQ10, MQ12, MQ13, MQ14 and MQ17 are located within the Habitat Management Area and were not targeted during the salvage excavation and remain *in situ*.



AHIMS search results

Peppertree Quarry Modification 4 Project

Aboriginal cultural and historic heritage assessment

Figure 3.1

4 Historical background

4.1 Post settlement history

European explorers first visited the Southern Tablelands as early as 1798 when John Wilson was sent to the area by Governor Hunter (Chisholm 2006). His reason for exploring the area was to dispel the myth that convicts would be able to walk to China (Higginbotham 2009, p.21). He ascended Mt Towrang and viewed the Goulburn Plains before returning home.

The most well known of the roads created from Sydney to the Southern Tablelands was Mitchell's Great South Road progressively opened from 1820 to 1843. In addition to this road there was the South or Argyle Road (1818 to 1833) and Macquarie's Government Road (1822 to 1839) (Higginbotham 2009, p.55). Smaller road systems also crisscrossed the area.

Pastoral settlement necessitated that homesteads and the communities living there were self sufficient due to the large distances between homesteads and centres of produce such as Goulburn and Sydney. This self sufficiency also affected the establishment of towns, which was slower in areas where large pastoral stations were equipped with all they required. The settlement of towns is also based on the placement of infrastructure, with Goulburn and Old Marulan established based on the location of the South or Argyle Road respectively.

Major towns included Marulan, which was established first in 1834 and then moved approximately 2 km to the north-west in 1868 when the Great South Railway Line was constructed. Other towns established in the area included Bungonia (1836), Tallong (1869) and Wingello (1871). The town of Marulan South was created in the mid-twentieth century to service the Marulan South Limestone Quarry. Marulan South became a community hub for the miners and their families and a well known place in the local district. The town was closed in 1998 when the decision was made to close the town rather than complete additional repairs and upgrades. People's houses were transported to Marulan as part of the closure and a large wake was held to farewell the town.

Stock and cattle stations were established in the 1820s throughout the Goulburn plains and the wool industry dominated the area during the 1800s (Firth 1983). Pastoralists set up stations run by the convict labour force. The wealthiest pastoralists ran their stations from Sydney or the Cumberland Plans sending sons or overseers to run the day to day operations (Higginbotham 2009, p.27).

Expansion of the wool industry continued until the end of convict transportation and the resulting withdrawal of cheap convict labour. Along with the drought that started in 1839, affecting wool and wheat prices and its continued economic reliance on England, New South Wales experienced a depression that was to usher in hardship for the citizens of the British colony. By 1845 the depression was officially over and life went back to normal (My place for teachers online).

This precipitated the 1841 Depression and a collapse in the price of wool. A recovery in the industry was made nearly impossible by the discovery of gold in 1851. It once again reduced the labour pool as prospectors raced to the goldfields. The gold rush petered out by the 1850s allowing a return to pastoral occupations and a resulting economic growth period to the 1890s (Higginbotham 2009, p.27). The area directly around Marulan South has remained grazing land until the present day.

One of the largest pastoral holdings in the area was the Glenrock Estate along Marulan South Road. It was purchased in 1862 by John Morris (The Sydney Morning Herald 1862).

Peppertree Quarry commenced operations in early 2014 and the area has been modified through development of the quarry pit and associated infrastructure. The land on which the new southern overburden emplacement is proposed is currently grazing paddocks. The heads of first and second order watercourses are located in the eastern edge of the study area and drain to Barbers Creek to the east. Morton National Park is located to the southeast of the study area.

4.2 Previous heritage studies

Historic heritage investigations have included two publications used in the historical background above (Eddy 1985 and Leighton-Daly 2010) as well as many publications on aspects of mining and domestic life in the Southern Tablelands. Investigations specific to the study area have been completed as part of various environmental assessments for the Quarry operations.

A historic heritage investigation was completed by ERM (2006) for the Environmental Assessment for the Quarry. It did not identify any listed heritage items or archaeological evidence in the Quarry footprint. The project was not considered to have a significant impact on historic heritage.

EMM (2013) completed a historic heritage investigation as part of a modification to the project approval. It did not identify any historic heritage items or areas of archaeological potential. The modification was not considered to have a significant impact on historic heritage.

4.2.1 Previously identified historic heritage items

The heritage registers listed in Section 1.6.2 were searched and no items of historic heritage significance were identified in the study area or immediate vicinity. No areas of archaeological potential were identified.

Further afield and approximately 3 km from the study area, Bungonia National Park and the Bungonia State Conservation area are consolidated into one local listing on the *Goulburn Mulwaree Local Environmental Plan 2009* as Bungonia State Recreation Area (Item No. I027). It is considered to be significant for its natural and cultural associations.

The site of Old Marulan Town, an item listed on the State Heritage Register (Item number 00127) is located approximately 10 km from the study area, in the vicinity of the Hume Highway – Marulan South Road Intersection. It is considered significant for its ability to illustrate details of an early colonial service, predominantly from 1835-67 through its archaeological resource.

5 Environmental background

5.1 Overview

The study area is located in the Southern Tablelands of NSW - a plateau surrounded by steep gorges and valleys. Prominent landforms in the vicinity are the Barbers Creek Gorge to the east and Bungonia Creek Gorge to the south, but generally the study area is comprised of gently rolling hills. It lies within the Lachlan Ford Belt. Geology in the study area is Palaeozoic sequences. The regional geological pattern includes Middle Devonian Bindook Porphyry which includes quartz, tuff and feldspar.

The soils in the study area are acid-sodic soils with a thin topsoil A horizon and a clay B horizon. Deeper alluvial deposits have been formed along watercourses (Kelton 1997).

The water system of the region lies within the catchment of the Shoalhaven River which is located 3 km south east of the study area. A number of small first and second order streams start on the eastern edge of the study area and flow into Barbers Creek, which confluences with the Shoalhaven River to the southeast of the study area. Tangarang Creek is a perennial tributary of Barbers Creek and is located approximately 1 km to the north of the study area, flowing from west to east immediately north of the Quarry. Other nearby watercourses are Marulan Creek, located 3 km to the north, and Bungonia Creek, located 4 km to the south.

5.2 Land use and disturbance

Current land use in the study area is grazing and quarrying activities. An agricultural lime processing plant is located approximately 2 km to the west of the study area, while Boral's Marulan South Limestone Mine is located immediately to the south-west. Archaeological salvage excavation occurred in this area prior to commencement of quarry activities, and has resulted in considerable disturbance to the north of the study area. The Hume Highway is to the north-west.

The study area has experienced moderate disturbance from agricultural practices, clearing of vegetation and the activities of the nearby Marulan South Limestone Mine. Post deposition factors such as land clearing, cattle grazing and quarrying activities may have disturbed stone artefacts. Disturbance would have resulted in the displacement of Aboriginal objects within the soil but would not fully diminish their archaeological and cultural value. Erosion also has the potential to more significantly displace Aboriginal objects through sheet wash and gully erosion, particularly on slopes and crests near watercourses.

5.3 Predictive model of Aboriginal site location

5.3.1 Overview

A predictive model of Aboriginal site location is based on the landscape features of the study area including landform, soil types, geology and access to reliable water. The distribution of Aboriginal archaeological sites as described in previous reports and the AHIMS register support the predictive mode.

The surface geology of the area provides stone for use in the manufacture of stone tools including quartz, feldspar and tuff. Chert outcrops are also known to occur along the Wollondilly River approximately 25 km to the north-west. Silcrete outcrops were evident along Marulan Creek.

The temperate climate was suitable for Aboriginal occupation of the area. The environment of the study area would have provided a variety of resources for exploitation by Aboriginal people including plants and animals for food, adequate water supplies in the nearby creeks and rivers. Vegetation in the study area would also have provided wood to make implements and shelters.

The results from the regional and local studies have indicated that the most common Aboriginal site types are open artefact scatters and isolated finds. These sites are usually found in relation to water with site size and frequency dependant on the distance to the water source. The majority of large sites are located along major creeks or at the confluences of minor creeks and drainage lines. Sites decrease in size and frequency as the distance from water increases. Sparse sites may exist on ridgelines and may represent evidence of the travelling routes used across the wider Southern Tablelands landscape.

The study area has a number of different landscape factors which influences the potential for Aboriginal sites to be identified. A number of drainage lines exist the vicinity of the study area; however all are adjacent to moderate or steep slopes and the ridgelines of the Barbers Creek Gorge. These steeper slope landforms are less likely to contain Aboriginal artefacts, despite their proximity to watercourses. Aboriginal sites from these environments are usually isolated finds which do not indicate the presence of archaeological deposit. Culturally modified trees, while rare, have been previously identified in the AHIMS search area but outside the study area (See Section 3.3) and may remain if trees of a suitable age have been retained in the landscape.

5.3.2 Summary

Based on the items described above the following predictions can be made of the study area:

- there is limited potential for rock shelter sites;
- if sites occur, they are likely to consist of flaked stone artefact scatters and isolated finds;
- if sites occur they are likely to be located on gentle slope landforms adjacent to reliable watercourses;
- silcrete from local and regional sources would be the most commonly used raw material; and
- culturally modified trees are rare, but may be present where mature native trees remain in the study area.

6 Survey

6.1 Method

An archaeological survey of the area was undertaken by Rebecca Newell (EMM), Sharon Makin (Boral), Glen Freeman, Graeme Dobson and Greg Little (AMC representatives) on 2 July 2015.

The survey covered all areas of impact not previously surveyed. Transects were walked across defined landform types within the study area. Participants were spread out across a 40 m wide path, where possible, and the ground was visually inspected in detail with a focus on soil exposures. All mature trees were inspected for scars of Aboriginal origin and areas of exposed granodiorite were inspected for grooves.

Site locations were recorded using a hand-held GPS unit and with recorded data confirmed on GIS. Transects were accurately recorded and mapped by downloading the daily tracks recorded on GPS, which was supplemented by daily field notebook entries and photos. In all instances GPS-recorded locations corresponded exactly with ground exposures on geo-referenced air photos displayed in GIS (Mapinfo and ArcMap).

For the purposes of this assessment an Aboriginal site is defined as a location where a person in the present day can observe one or more Aboriginal objects. The boundaries of a site are limited to the extent of observed Aboriginal objects. A site does not include the assumed extent of unobserved Aboriginal objects (such as archaeological deposit). 'Aboriginal objects' are items or objects owing their form to past Aboriginal activity.

Artefacts are distinguished by morphology and context, thus are classified as stone objects with features derived from past Aboriginal activity such as intentional fracture, abrasion or impact. Typically flaked stone artefacts are distinguished from naturally broken stone by recognition of certain fracture features. A clear marginal fracture initiation is normally observed on a flaked stone artefact (typically displayed in a bulb of force feature on the fracture surface, or distinct shattering at the point of impact) on highly siliceous stone types.

The survey also aimed to identify any items of historic heritage significance and areas of historic archaeological potential.

6.2 Results

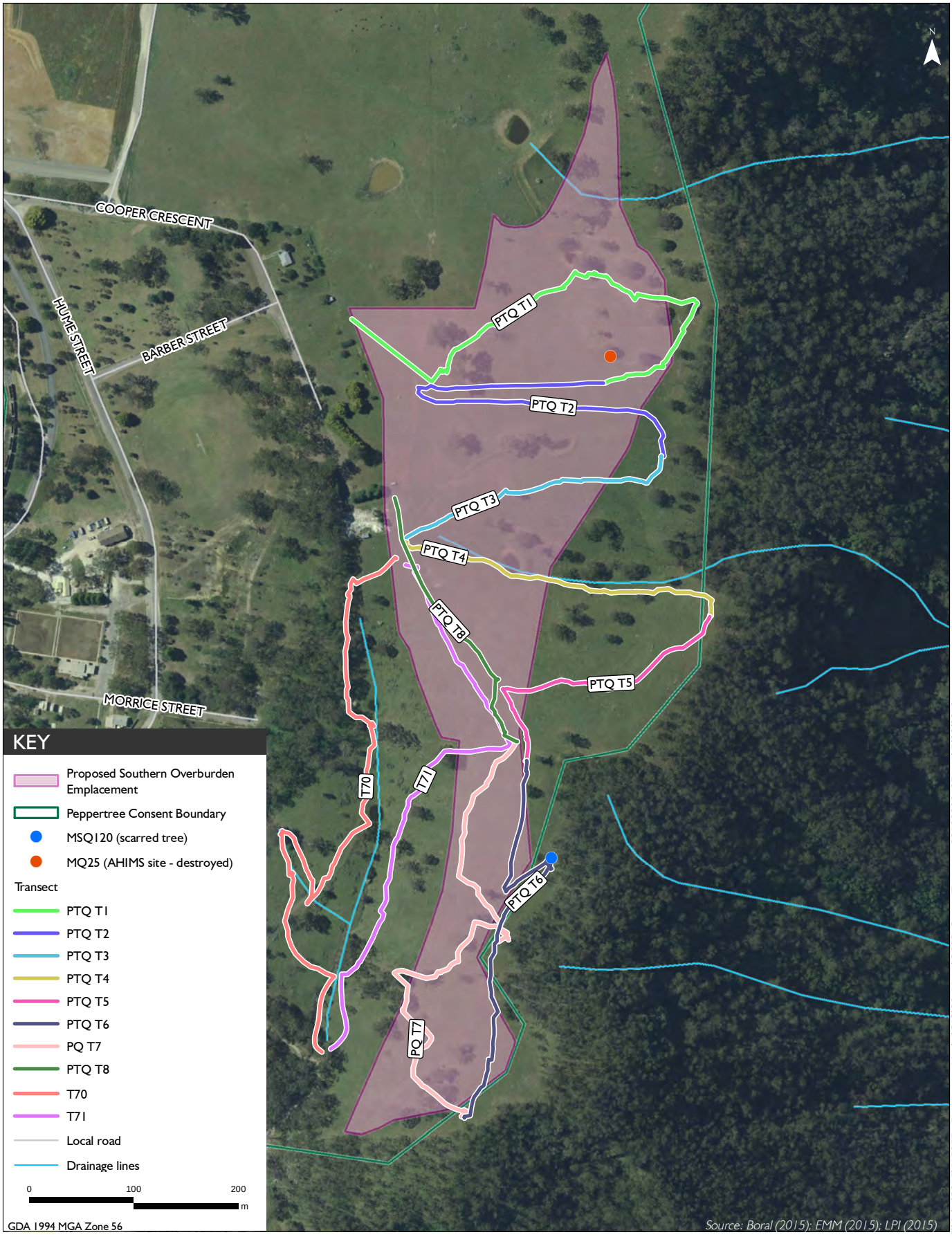
6.2.1 Aboriginal heritage

i Survey units

A total of 10 transects were walked across the study area. Two transects were walked during a previous survey for the Marulan South Limestone Mine Continued Operations Project and have been included in this results section due to their direct relevance. The survey transects covered 4.7 km and are shown in Figure 6.1. Appendix C contains representative photographs of all transects and detailed transect information.

Photograph 6.1 **View on transect 6 looking over the drainage line facing west (EMM 2014)**

Photograph 6.2 **View on transect 7 showing gradient of slope towards the drainage line in the right of image (EMM 2015)**



Survey transects and Aboriginal heritage sites

Peppertree Quarry Modification 4 Project

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Figure 6.1

ii Effective survey coverage

Effective survey coverage is presented in Table 6.1.

Table 6.1 Effective survey coverage

Landform	Length (m)	Area (sq m)	Area available for detection (sq m)	Effective coverage (%)
Hill slope	1,486	59,440	1,513.6	2.5
Hill spur	1,285	51,400	1,203.8	2.3
Ridge	631	25,240	504.8	2
Watercourse	1,384	69,200	3,114	4.5
Total	**4,786**	**205,280**	**6,336.2**	3

The results from Table 6.1 indicate low effective survey coverage of between 4.5% and 2%. This correlates with the low visibility during the survey due to the dense vegetation and paddock grass. Areas of visibility were targeted during the survey but were limited to exposures resulting from vehicle tracks and cattle tread. Effective survey coverage in the lower range, such as these results, is common and highlights a conservative approach to estimating exposure and visibility.

The disturbance across the study area was generally low. The majority of the study area comprised of cleared grassed paddocks resulting from historic vegetation clearance and this may have slightly displaced Aboriginal objects within the soil matrix without fully diminishing their archaeological and cultural value.

iii Aboriginal heritage sites

One Aboriginal site was identified during the survey and is shown in Figure 6.2. MQ120 a culturally modified tree identified on a ridge landform (Photograph 6.3 and 6.4). MQ120 is located outside the project boundary.

A site card for MQ120 is contained in Appendix B and will be submitted to the AHIMS register.

iv Archaeological sensitivity

The area around Peppertree Quarry has been shown to contain large numbers of Aboriginal sites and objects. Detailed information on the subsurface assemblage has been collected in large scale excavations some of which are ongoing through overburden removal. This information was used alongside the field data to ascertain archaeological sensitivity for the study area and guide recommendations for management. Archaeological sensitivity is divided into three categories; low moderate and high based on the likelihood of subsurface Aboriginal artefacts being present. Low represents no potential for artefacts to be present while high represents the highest likelihood that subsurface Aboriginal artefacts will be present.

The landscape of the study area is considered to have areas of moderate and low archaeological sensitivity. As noted in the predictive model, the landscape of the study area contains watercourses, moderate and steep slopes, some areas of gentle slopes and a ridgeline overlooking the Barbers Creek Gorge. The study area itself is located on a ridge with different slope gradients throughout. Generally, ridgelines are considered to be travel routes or areas used for short-term events with areas near reliable watercourse such as Tangarang Creek providing more suitable areas for long term habitation. However, the ridge itself contains an area of gentle slope which may be suitable as a camping location considering their proximity to watercourses. As a result, areas of between 0 and 10 degrees of slope within 100 m of a watercourse are considered to be of moderate archaeological sensitivity.

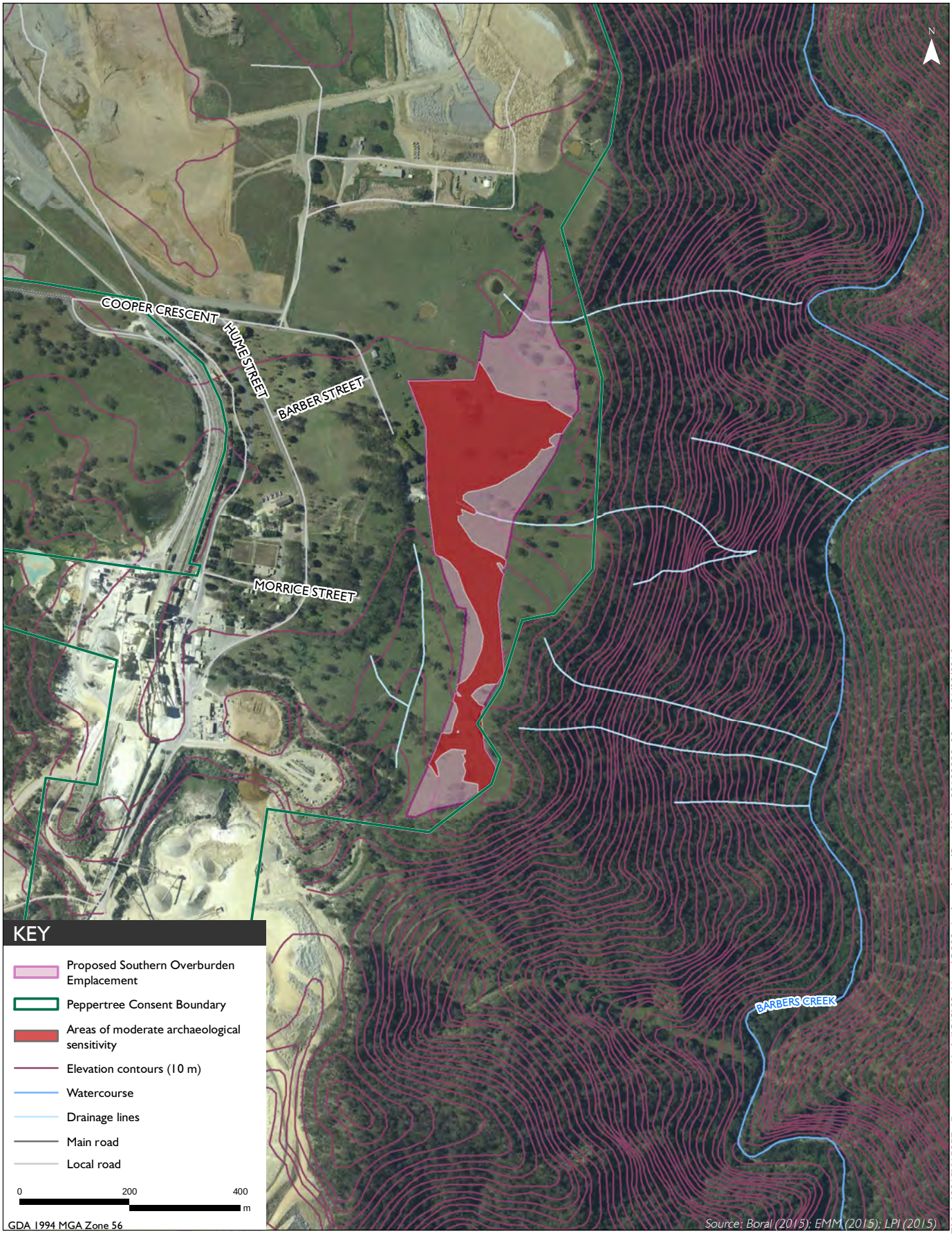
Photograph 6.3 Site MQ120 showing scarring on tree (EMM 2015)

Photograph 6.4 **Site MQ120 showing context on ridge adjacent to slope (EMM 2015)**

Photograph 6.5 View from site MQ120 facing north (EMM 2015)

6.2.2 Historic heritage

No items of historic heritage significance were identified in the survey.



Areas of archaeological sensitivity

Peppertree Quarry Modification 4 Project

Aboriginal cultural and historic heritage assessment

Figure 6.2

7 Significance assessment

7.1 Aboriginal heritage significance

7.1.1 Socio-cultural value: significance to the Aboriginal community

Research and consultation with the Aboriginal community was conducted to determine whether any socio-cultural heritage value relates specifically to the study area regardless of archaeological evidence. While it is accepted that the broader landscape is of significance to Aboriginal people, this study sought to identify whether the study areas held specific values either in themselves, or as part of a specific local area of particular significance.

Efforts to undertake cultural mapping and further understand the significance of this area to the Aboriginal community have occurred during previous Aboriginal Heritage Assessments by ERM in 2006 and 2011. To date, no information has been received that identifies specific heritage value unrelated to the Aboriginal sites. Aboriginal heritage sites with archaeological evidence are all of value to the Aboriginal community through the tangible connection that they represent to past Aboriginal land use.

7.1.2 Statement of cultural significance

Insert information obtained from the Aboriginal groups.

7.1.3 Scientific value

i Overview

Scientific value is assessed according to the following categories.

ii Research potential

Research potential or demonstrated research importance is considered according to the contribution that a heritage site can make to present understanding of human society and the human past. Those heritage sites, objects or places of high scientific significance are those which provide an uncommon opportunity to inform us about the specific age of people in an area, or provide a rare glimpse of artistic endeavour or provide a rare chronological record of changing life through deep archaeological stratigraphy.

iii Rarity

The comparative rarity of a site is a consideration in assessing scientific significance. A certain site type may be ‘one of a kind’ in one region, but very common in another. Artefacts of a particular type may be common in one region, but outside the known distribution in another.

iv Integrity

The integrity of a site is also a consideration in determining scientific significance. While disturbance of a topsoil deposit with artefacts does not entirely diminish research value, it may limit the types of questions that may be addressed. A heavily cultivated paddock may be unsuited to addressing research questions of small-scale site structure, but it may still be suitable for answering more general questions of stone tool distribution in a region and raw material logistics.

v Research themes

The capacity of a site to address research questions is predicated on a definition of what the key research issues are for a region. In the local region, the key research issues revolve around the chronology of Aboriginal occupation and variability in stone artefact manufacturing technology.

vi Educational value

Educational value relates to the capacity of a site to portray more easily recognisable archaeological features. While the educational potential of Aboriginal sites can only be effectively realised through interpretation, those sites with more obtrusive elements and suitable settings offer greater potential to illustrate the main features of Aboriginal activity.

7.1.4 Sites and significance

i MQ120

Site MQ120 is a culturally modified tree, with moderate integrity. Culturally modified trees are rare in the landscape due to large scale land clearing. The scar itself is of moderate research potential and educational value with one scar visible. The site is of moderate scientific significance.

ii Area of archaeological sensitivity

The study area has been assessed with having moderate potential for buried sites with low artefact densities.

7.2 Historic heritage significance

No historic heritage evidence was uncovered during the research phase or field survey of the study area and as such no further significance assessment is required. No areas of historic views or community heritage value have been identified.

Table 7.1 Statement of scientific significance for surface and subsurface Aboriginal sites

Site name	Research potential	Rarity and representativeness	Integrity	Research themes	Educational value	Overall archaeological significance rating
MQ120 Scar tree	**Low:** In isolation the scar tree has a limited amount or research potential as it is now in a modified landscape.	**High:** The scar tree represents a past activity that is now rare in practice and preservation.	**Moderate:** The scar tree is alive and part of a small clump of native vegetation.	**Moderate:** The site does not contribute to issues of chronology or tool manufacture.	**Moderate:** As the tree is alive and part of a stand of native vegetation, it is a visual element of Aboriginal culture.	**Moderate:** The scar tree is of moderate archaeological significance for its ability to demonstrate past Aboriginal activity in the area.
Area of archaeological sensitivity	**Low** One location in the study area has been assessed as possessing moderate archaeological potential. Research potential however, has been assessed as low because the level of investigation in the surrounding landscape has been high with significant results for sites of all densities.	**Low:** The area assessed with moderate sensitivity is not rare with respect to preservation and research. It is likely to be representative of landscapes with background scatter.	**Low:** The study area (including the area of sensitivity) has been assessed as being moderately disturbed through vegetation clearance and ploughing occurring in the historic period.	**Low:** The site has limited potential to answer research themes that have not been explored in other test and salvage excavations in the region, including the Peppertree Quarry expansion and the Marulan South Limestone Mine Continued Operations project.	**Low:** The study are has low educational value as the assemblage of archaeological features on the landscape is low. The scar tree has educational value (see above) but will be protected and is outside the project boundary.	**Low:** The study area overall has a low level of archaeological significance.

8 Impact assessment

8.1 Aboriginal heritage impact assessment

8.1.1 Definition of impact

The element of the proposed modification that has the potential to impact on Aboriginal heritage is the southern overburden emplacement area. The creation of the southern overburden emplacement area will include the extension of an existing haul road to provide access between the Quarry and the proposed emplacement area and the depositing of overburden. The topsoil will not be stripped from the southern overburden emplacement area. Overburden material will be stripped from the pit and placed within the proposed southern overburden emplacement area following the method currently approved and used in the development of the existing eastern overburden emplacement.

One scarred tree (MQ120) was recorded outside the southern overburden emplacement disturbance footprint. MQ120 will be fenced off and will not be impacted by the project. One known Aboriginal site (MQ25) is recorded on AHIMs as located within the proposed southern overburden emplacement area. However, this site has been previously destroyed through collection (see AHIMS register in Appendix B).

The modification will also impact an area of moderate archaeological sensitivity as defined in Section 6.2 of the report. The southern overburden emplacement therefore has the potential to result in disturbance to unidentified Aboriginal sites through the compaction of topsoil during the emplacement of overburden. Buried Aboriginal objects, if they exist, have the potential to be compacted, disturbed and moved a short distance during overburden emplacement resulting in a loss of context and spatial patterning.

Recent investigations on the short term impacts of emplacement areas (in cases where the topsoil is not stripped prior to emplacement) (KNC 2012 and 2013) indicate that archaeological deposits beneath emplacements would degenerate and devalue over time, as bioturbation causes the stockpile soils to mix with the archaeological deposit. This loss of a secure context could reduce the scientific value of a site. However, as outlined in Section 7, the overall archaeological significance rating and scientific value of the study area is low. Therefore the potential degeneration of unidentified archaeological deposits, buried beneath the proposed southern overburden emplacement, is unlikely to have a material effect on the scientific (archaeological) value of the study area.

Furthermore, the ridgeline type of landscape on which the southern overburden emplacement is proposed, has been previously investigated in excavations for Peppertree Quarry, Marulan South Limestone Mine and throughout the wider Southern Tablelands region. These results have found that areas of ridgelines generally contain artefact densities of less than five artefacts per square meter and a low background scatter of artefacts. These areas have been adequately tested and the information from previous excavations can be extrapolated to the study area where it is highly likely that similar low density scatters may be present. The study area would therefore not be able to provide information additional to what has been uncovered in the region, particularly the main Peppertree Quarry project area, which has been subject to detailed archaeological investigation and which has provided a comprehensive picture of the Aboriginal archaeological landscape.

The proposed southern overburden emplacement is therefore unlikely to result in significant impacts on Aboriginal heritage sites of archaeological significance.

8.1.2 Measures to minimise harm and alternatives

Harm to Aboriginal objects may occur through the construction of the emplacement area and through compaction and mixing of any sites or objects that will be beneath the deposited soil. The location of the southern overburden emplacement area is constrained by Barbers Creek Gorge to the east, the main Peppertree Quarry pit and approved emplacement areas to the north and the Marulan South Limestone Mine to the west.

One of the approved locations for the emplacement of overburden from Peppertree Quarry was the South Pit of the Marulan South Limestone Mine. As all the available capacity of the Marulan South Limestone Mine South Pit is required for the continued operation of the limestone mine, an alternative location for the emplacement of Peppertree Quarry overburden is required. The current study area is the only feasible alternative location for an overburden emplacement for Peppertree Quarry that is located within Peppertree Quarry's consent boundary and in proximity to the Quarry Pit. Obtaining approval for an additional overburden emplacement area is crucial for the continued operations at Peppertree Quarry and will support Boral's contribution to the construction industry in NSW by continuing to be one of the key providers of construction materials.

8.1.3 Ecologically sustainable development (ESD) considerations

Aboriginal heritage management is based on the principle of *intergenerational equity* which has the intention to ensure present generations consider future generations when making management decisions. This principle is possibly the most relevant part of the notion of *ecologically sustainable development* (ESD) when considering Aboriginal heritage management.

This principle can be achieved by a regional program of protection for representative cultural landscapes and sites. This has occurred at Peppertree Quarry where 16 sites have been conserved, including six sites as part of a habitat management area. The habitat management area will also conserve landscape features in an area of high cultural and archaeological significance. The conservation of these sites has ensured that a representative sample of the landscape and Aboriginal sites will be preserved. Additionally, a large scale monitoring program has helped to obtained extensive information about the types of Aboriginal objects present in the landscape. The preservation of some sites, as well as the investigation of others, has contributed to intergenerational equity through conservation and education.

8.1.4 Cumulative harm

The potential for unavoidable harm to Aboriginal objects is acknowledged as a result of the proposed new southern overburden emplacement. The impacts to Aboriginal heritage in the Southern Tablelands region are not substantial as the current balance at Peppertree Quarry between preservation of some areas of Aboriginal sites and landscapes ensures that harm is only partial across the Peppertree Quarry area and retains some of the most significant sites identified. It does not represent a total loss of the Aboriginal archaeological records in the area and the impacted Aboriginal sites are predicted to continue outside the study area.

8.2 Historic heritage impact assessment

The modification will not impact known historic heritage as no evidence of historic heritage items were found in the study area.

9 Conclusion and management

9.1 Conclusion

This report has considered the available environmental and archaeological information for the study area including previous reports as well as the nature of the proposed activities.

The desktop and field survey did not identify any historic heritage items in the study area. No impacts to historic heritage are predicted and as such, the only management measure is an unexpected finds protocol.

A review of previous Aboriginal cultural heritage investigations in the vicinity of the study area indicates that sites have been found in the region, usually on moderate slopes adjacent to reliable watercourses. Aboriginal sites are usually open artefact scatters, isolated finds or culturally modified trees. Most stone tools are made of silcrete and quartz.

As part of the investigation for the project, desktop research identified one record, MQ25, within the disturbance footprint. MQ25 has been destroyed, through collection, therefore does not pose a constraint to the project. Field survey identified a culturally modified tree (MQ120), which is outside the project boundary and will not be impacted by the development.

A portion of the identified area of moderate archaeological sensitivity will be subject to impact as a result of the overburden emplacement area. However this ridgeline type of landscape has been previously investigated in excavations for Peppertree Quarry, Marulan South Limestone Mine and throughout the wider Southern Tablelands region. These results have found that areas of ridgelines generally contain artefact densities of less than five artefacts per square metre and a low background scatter of artefacts. These areas have been adequately tested and the information from previous excavations can be extrapolated to the study area where it is highly likely that similar low density scatters may be present. The study area would not be able to provide information additional to what has been uncovered in the region, particularly the main Peppertree Quarry project area, which has been subject to detailed archaeological investigation and which has provided a comprehensive picture of the Aboriginal archaeological landscape. Further investigation in the modification area is not considered warranted.

The following management recommendations have been made based on the analysis of results and the research completed for this report. The following management recommendations are designed to be consistent with the existing recommendations as contained in the approved Peppertree Quarry Aboriginal Heritage Management Plan.

9.2 Management recommendations

9.2.1 Recommendation 1

That MQ 120 is fenced and avoided during development of the southern overburden emplacement area.

9.2.2 Recommendation 2

Update the Aboriginal Heritage Management Plan to include the results of this survey and the management recommendations.

9.2.3 Recommendation 3

If unexpected historical archaeology is discovered during construction, work in the immediate area must cease and an archaeologist must be contacted to make an assessment of the find. If it is determined to be a relic under the Heritage Act, further investigation may be required. Examples of unexpected finds may include consolidated bricks, sandstone blocks and artefact deposits.

Glossary of Terms

Many of these definitions have been taken from the *Code of Practice for archaeological investigation of Aboriginal objects in NSW* (DECCW 2010).

Aboriginal object: A physical manifestation of past Aboriginal activity. The legal term is defined in the National Parks and Wildlife Act 1974 section 5 as: any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.

Typical examples include stone artefacts, grinding grooves, Aboriginal rock shelters which by definition include physical evidence of occupation, midden shell, hearths, stone arrangements and other landscape features which derive from past Aboriginal activity.

Archaeological survey: A method of data collection for Aboriginal heritage assessment. It involved a survey team walking over the land in a systematic way recording information. Activities are not invasive or destructive.

Aboriginal culturally modified tree: A tree of sufficient age to have been mature at the time of traditional Aboriginal hunter-gatherer life and therefore generally, but not always, of more than 220 years of age with evidence of bark or cambium wood removal for the purpose of implement manufacture, footholds, bark sheet removal for shelter, or extraction of animals or other food. Care must be taken to distinguish Aboriginal scars from the much more common natural causes of branch tear, insect attack, animal impact, lightning strike and dieback. Culturally modified tree recognition guidelines exist to distinguish these features. Naturally scarred trees are often misidentified as Aboriginal culturally modified trees.

Aboriginal site: The location where a person in the present day can observe one or more Aboriginal objects. The boundaries of a site are limited to the extent of the observed evidence. In the context of this report a 'site' does not include the assumed extent of unobserved Aboriginal objects (such as archaeological deposit). Different archaeologists can have varying definitions of a 'site' and may use the term to reflect the assumed extent of past Aboriginal activity beyond visible Aboriginal objects. Such use of the term risks defining all of Australia as a single 'site'.

Aboriginal stone artefact: A stone object with morphological features derived from past Aboriginal activity such as intentional fracture, abrasion or impact. Artefacts are distinguished by morphology and context. Typically flaked stone artefacts are distinguished from naturally broken stone by recognition of clear marginal fracture initiation (typically herzian/conchoidal or wedging initiation) on highly siliceous stone types which can often be exotic to the area. Care must be taken to distinguish modern broken stone in machine impacted contexts and therefore context must be carefully considered as well as morphology.

AHIMS: Aboriginal Heritage Information Management System – a computer software system employed by the Office of Environment and Heritage to manage many aspects of Aboriginal site recording and permitting. AHIMS includes an Aboriginal sites database which can be accessed via an internet portal.

Archaeological deposit: Aboriginal objects occurring in one or more soil strata. The most common form of archaeological deposit relates to the presence of a single conflated layer of Aboriginal stone artefacts worked into the topsoil through bioturbation.

Backed artefact: A thin flake or blade-flake that has been shaped by secondary flaking (retouch) along one lateral margin. The retouched margin is typically steep and bipolar to form a blunt 'back' in the manner of a modern scalpel blade. Distinctive symmetrical and asymmetrical forms are typically found called geometric microliths and bondi points respectively. A thick symmetrical form, called an elouera, is typically the size of a mandarin segment.

Culturally modified tree: A tree that has been scarred, carved or modified by an Aboriginal person using traditional methods.

Conchoidal: A term used in relation to fracture surfaces on Aboriginal stone artefacts - bulb-like in the manner of a bulbous protrusion on a bivalve shell.

Exposure: estimates the area with a likelihood of revealing buried artefacts or deposits, not just an observation of the amount of bare ground.

Grinding grooves: Grinding grooves typically derive from the sharpening of stone hatchet heads on sandstone rock. Grooves appear as elliptical depressions of around 25 cm length with smooth bases. Although mostly occurring in association with water to wash the abraded stone dust away from the groove, such sites have been recorded away from water. Narrow grooves or broad abraded areas may occur less commonly and may be derived from spear sharpening or other grinding activities.

Holocene: A period of time generally 10,000 years, which marks the end of the last ice age, to the present.

Midden: A collection of shells and associated economic remains resulting from Aboriginal food gathering and processing activity. Middens comprise shellfish remains of consistent size in a rich dark earth matrix commonly associated with stone artefacts, fish bone and animal bone although shells are commonly the most obtrusive element.

Keeping place: A room or facility with the express and exclusive purpose of storing Aboriginal cultural heritage materials with accompanying documentation in a secure and accessible manner, which protects their cultural heritage values.

Open stone artefact site/stone artefact site: An unenclosed area where Aboriginal stone artefacts occur – typically exposed from a topsoil archaeological deposit by erosion. Typically the term is used to refer to two or more artefacts although this is an arbitrary distinction. A general 'rule of thumb' boundary definition employed by archaeologists is that artefacts or features more than 50 m apart are regarded as separate sites, however there is no theoretical imperative dictating such as rule. (The 50 m separation rule is used for the most part in EMM's work).

Potential Archaeological Deposit: An area where there is an inferred presence of Aboriginal objects in the soil based on the environmental context which is typically associated with discovery of Aboriginal objects in analogous areas. This is not strictly a 'site' type, although AHIMS records it as such for the purpose of associating Aboriginal heritage Impact Permits with geographical areas.

Survey Unit: A unit of land which have been surveyed on foot, and is used as the minimum analytical or descriptive unit for the survey.

Visibility: The amount of bare ground on exposures which might reveal artefacts or other archaeological materials.

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Abbreviations

Abbreviation	Term
AHIMS	Aboriginal heritage information management system
c	circa
cm	centimetres
DEC	Department of Environment and Conservation
DECCW	Department of Environment, Climate Change and Water
DP	Deposited Plan
EMM	EMM Consulting Pty Limited
EPBC	*Environmental Protection and Biodiversity Conservation Act, 1999*
EP&A Act	*Environmental Planning and Assessment Act 1979*
km	kilometres
LEP	Local Environmental Plan
LGA	Local Government Area
m	metres
m^2	metres squared
mm	millimetres
Mtpa	Million tonnes per annum
NSW	New South Wales
OEH	Office of Environment and Heritage
PA	Project approval
PAD	Potential archaeological deposit
RMS	Roads and Maritime Services
S170 register	Heritage and conservation register
SHR	State Heritage Register
t	Tonne
TP	Test pit

Appendix A

Aboriginal consultation documentation

10 June 2015

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Re: Peppertree Quarry Modification 4 – Aboriginal cultural heritage assessment

Dear AMC Member,

1 Introduction

Boral Quarries (Boral) has engaged EMGA Mitchell McLennan Pty Ltd (EMM) to prepare an Aboriginal cultural heritage assessment to accompany an application to modify the project approval (PA06_0074) for Peppertree Quarry.

In accordance with the Aboriginal heritage management plan (AHMP) for Peppertree Quarry (page 14) we are writing to the three groups who are part of the Aboriginal Management Committee (AMC) for the project to obtain their feedback into the proposed modifications to the project approval. The current AHMP for Peppertree Quarry specifies the three groups which can be consulted for modifications for the project and only those groups will be contacted.

This letter presents information on the proposed modifications and describes a draft ACHA method for your review and comment. We welcome your written feedback at your earliest opportunity, and no later than **30 June 2015. Letters attached to email is the preferred mode of written communication as it will reduce postal waiting periods.**

2 Project overview

Boral is seeking approval for a modification to their project approval for the following aspects:

- An additional overburden emplacement area (Figure 1); and
- An extension of their in-pit operations by six hours (extraction and crushing of hard rock) from the consent period of 7am – 7pm.

3 Aboriginal heritage values

EMM welcomes and relies on advice from the AMC members about any form of Aboriginal heritage values (which might include archaeological sites or other types of values) relevant to the modification study area. We are happy to meet to discuss any information which you may be willing to share, and will respect confidentiality where requested. Email is our preferred method of communication but we will also accept letters and faxes, and information given in person.

We invite you to include the following in a letter:

- how the project area land is significant to Aboriginal people; and
- your views on the site survey method described below.

4 Draft assessment methodology

4.1 Overview

Extensive previous investigations have been completed and are ongoing at Peppertree Quarry. Over 30,000 artefacts have been identified though excavation and monitoring works. The sites identified include open artefact scatters, hearths and potential grave sites. The identified sites at Peppertree have contributed to an understanding of a complex and significant landscape which contains evidence of long term occupation.

The results from the regional and local studies have indicated that the most common Aboriginal site types are open artefact scatters and isolated finds. These sites are usually found in relation to water with site size and frequency dependant on the distance to the water source. As the project is a modification of an existing project approval the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (the guidelines — DEC 2005) are the ACHA framework. As stipulated in the 2005 guidelines, the *Aboriginal Cultural Heritage Standards and Guidelines Kit* (guidelines kit) (DEC 1997) provides the framework for the archaeological assessment component of the ACHA. As noted above, consultation will be completed with AMC members as part of this modification.

4.2 Draft assessment method

A draft method is suggested here for your review and comment. We welcome your feedback at your earliest opportunity but no later than **1 July 2015.**

The purpose of the assessment is to identify the Aboriginal heritage values of the areas to be affected by the modification. This method is consistent with methods previously employed at Peppertree Quarry for the investigation of Aboriginal heritage.

Aboriginal heritage values will be identified from the following methods:

- consultation with registered Aboriginal parties to identify social values of the study area and places of special significance that should be considered;
- an updated search of the Aboriginal Heritage Information Management System (AHIMS - Aboriginal sites register) for records of previously registered Aboriginal sites (a completed search has not identified any previously recorded sites within the study area);
- a review of past Aboriginal heritage reports covering the study area;
- a review of environmental characteristics to develop a landscape map of possible archaeological site location; and
- an archaeological inspection or survey with Aboriginal stakeholders focusing on landform transects in impact areas; and
- the provision of management and mitigation measures if applicable.

4.3 Field survey

4.3.1 Overview

The Aboriginal heritage field survey will be a full coverage survey of all the areas impacted by the proposed modification. The aim of the archaeological survey is to identify Aboriginal sites and areas of potential archaeological deposit (PAD). Only those areas with Aboriginal objects will be recorded and reported as Aboriginal sites and areas of PAD will be recorded as possessing 'archaeological sensitivity'. Other places or features of interest will be noted in the ACHA.

The field survey is planned for Thursday 2 July 2015. Each group is invited to provide one paid representative for the survey. We will be meeting at 8am at the Peppertree Quarry administration building. Each group will be employed by Boral. Terms will be as currently agreed for the Aboriginal heritage works occurring at Peppertree Quarry.

4.3.2 Field survey strategy

A pedestrian field survey is proposed, led by EMM's archaeologists and involving one member from each AMC group. The surveys will take place over one day. A series of survey tracks (transects) will be walked over the impact area.

The survey will inspect all areas of ground within survey transects which will be covered by survey participants spread out across a c. 50 m path where possible. All mature trees will be inspected for scars of Aboriginal origin and areas relevant stone outcrops inspected for grinding grooves. It is expected that visibility in paddocks and heavily vegetated areas will be constrained so transects will aim to target areas of exposures within these areas e.g. vehicle or cattle tracks. All Aboriginal sites will be marked through flagging and then GPS waypoint recording by an archaeologist.

Survey transects will be undertaken with reference to a survey plan that will be prepared prior to fieldwork. The survey effort will generally follow predetermined transects comprised of discrete landform units that have been identified using topographic maps. However, there will be provision for changes to the survey plan once on site, to account for inaccessible areas or where landform units, unfruitful for the survey effort, are identified.

4.3.3 Landform division for sampling

The survey will cover extensive areas as a continuous series of transects covering a representative sample of landform elements across the study area. The broad spread of landforms anticipated comprises:

- watercourses — generally second order (Strahler System) and above, including their near banks;
- open depressions — such as ephemeral drainage lines dissecting slopes or open depressions eroded by sheet wash;
- slopes — comprising simple, upper, mid and lower slopes;
- flat — such as alluvial floodplains, terraces and valley floors;
- spur crests;
- ridge tops — comprising ridge crests and saddles; and
- cliff/scarp — comprising the head and foot of the cliff/scarp and its slope if accessible.

4.4 Post-fieldwork

After fieldwork, a draft report will be prepared by EMM. Each AMC member group will be invited to review and comment on the draft report. All comments will be addressed in the final report.

5 What's next?

We look forward to receiving any response your organisation wishes to make about the proposed methodology by **1 July 2015.** Your response will be documented and considered for the assessment.

Most importantly, your cultural information is also welcome within this timeframe but it can also be submitted up until the completion of the draft ACHA.

We also look forward to your participation in survey on **Thursday 2 July 2015.**

6 Any questions?

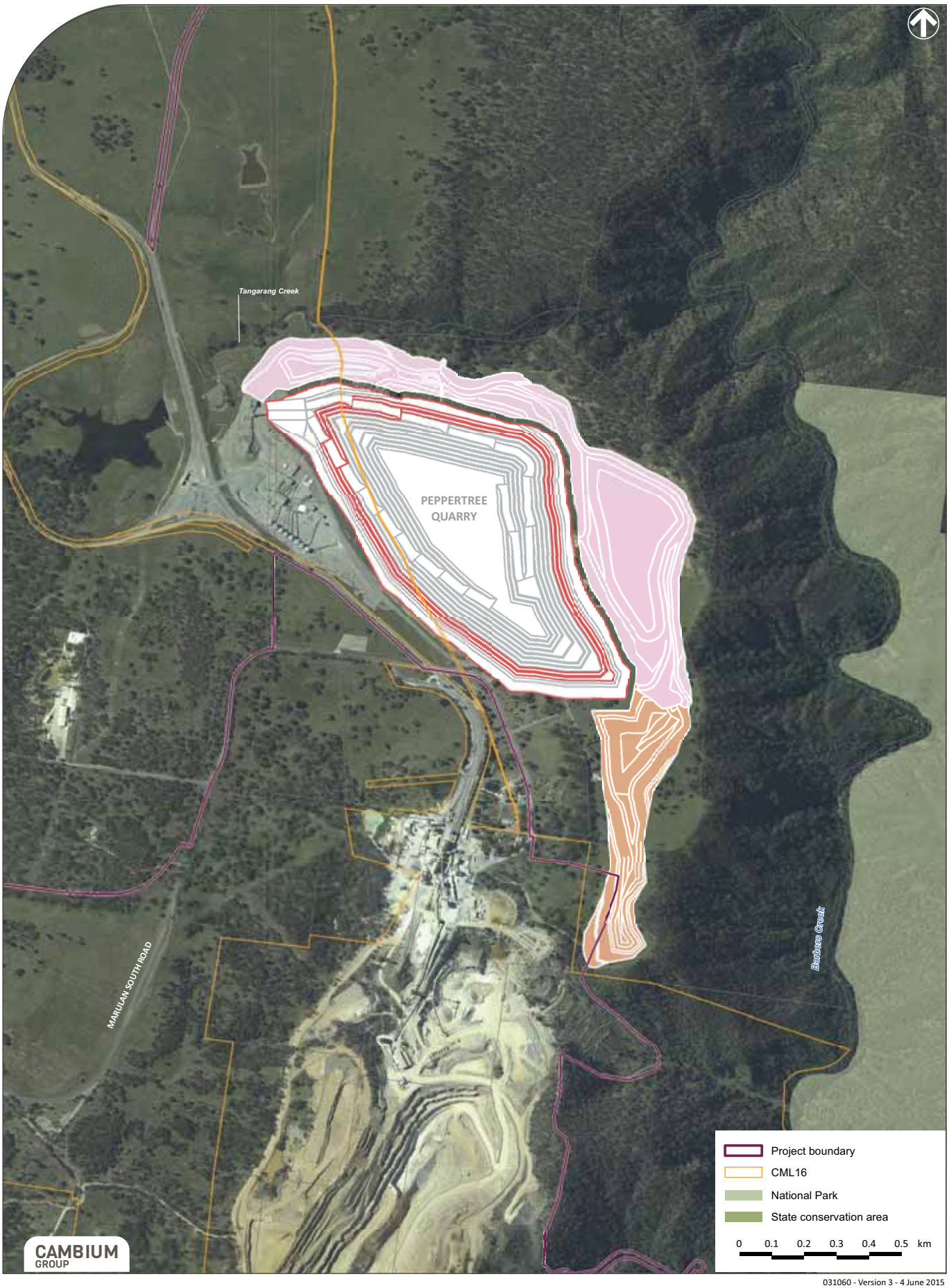
Please feel free to contact me with any questions or queries about the project via email (provided below) or telephone on 02 9493 9539.

Yours sincerely

Rebecca Newell
Archaeologist
rnewell@emgamm.com

FIGURE 2
The project
FOR INFORMATION ONLY

PEPPERTREE QUARRY MODIFICATION 4



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Pamela Kottaras

From: Ngunawal Heritage Aboriginal Corporation [ngunawalhac@gmail.com]
Sent: Sunday, 21 February 2016 9:04 PM
To: Pamela Kottaras
Subject: Peppertree Mod 4

Follow Up Flag: Follow up
Flag Status: Completed

Hi Pamela

Thank you for sending the Peppertree Quarry Mod 4 report.

We are pleased that the scarred tree is out of the project boundary area and it will be fenced off and no harm will come to it during the construction of the new Overburden Emplacement area.
However as a result of the new Overburden, an area of moderate Archaeological Potential will be destroyed. The Ngunawal Heritage Aboriginal Corporation recommends sub surface testing be undertaken in this area. Also if any topsoil is to be disturbed to construct a road, then this activity should be monitored.
Also there was another site which was identified, but it hasn't been recorded or mentioned in the report. By memory it consisted of approximately 4 - 8 stone artefacts and was identified by Glen Freeman. Could you please ask Rebecca about this site.

Kind Regards

Graeme Dobson

Buru Ngunawal Aboriginal Corporation
ABN : 24 059 704 833

25 February 2016

EMGA Mitchell McLennan
PO Box 21
St Leonards NSW 1590

Attention: Pamela Kottaras

Peppertree Quarry Modification 4 Report
Review/Comments

Thank you for providing a copy of the above report pertaining to the results of surveys and investigation works undertaken at the Peppertree Quarry Mine for which a request for input from Buru Ngunawal Aboriginal Corporation (BNAC) as the Traditional Custodian group that participated.

Accordingly, BNAC wish to state that we consider all Aboriginal sites to be of significance to us as the Traditional Carers for this area. BNAC also consider all sites to be of value to us socially, culturally and spiritually.

It is a concern BNAC have with any Aboriginal Cultural Heritage Assessments that too much emphasis is placed on the scientific archaeological values. This in turn diminishes the cultural significance that we as Aboriginal people hold for both tangible and intangible objects/places within the natural cultural landscape.

The Australia ICOMOS Burra Charter 2013, defines cultural significance as follows:

"Cultural significance means aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects. Places may have a range of values for different individuals or groups." (ICOMOS 2013).

This definition should motivate all archaeologists to develop a better understanding of the Aboriginal culture they are assessing. A more sensitive and understanding approach may encourage more dialogue between archaeologists and the Aboriginal peoples whose culture is being scrutinised.

This report under Sub-section 2.3 Cultural information states:

Efforts to undertake cultural mapping and further understand the significance of this area to the Aboriginal community have occurred during previous Aboriginal heritage assessments by ERM in 2006 and 2011. To date, no information has been received that identifies specific heritage value unrelated to the Aboriginal sites.
No cultural heritage information, further to that identified in previous assessments, was given to the archaeologist during meetings with the AMC. As a result, cultural mapping was not considered

necessary for this modification. Participation of Aboriginal groups in the AMC continues to provide avenues for cultural heritage information to be communicated to Boral should it arise in the future.

BNAC has highlighted in previous correspondence that there appears to be an apparent lack of sensitivity for the Aboriginal person providing evidence of a spiritual place through a developed cultural connection that is on a level that makes it hard to explain to non-Aboriginal persons. Compassion and a willingness to understand a viewpoint that differs from the scientific being displayed may lead to an inclination to divulge relevant information. It must also be understood that under Aboriginal lore the imparting of some information is strictly forbidden and must be respected.

To state that no information was forthcoming to date demonstrates a reluctance to provide information because no value or trust is being placed on Aboriginal people who come forward and provide such advice.

BNAC provide the following comment in response to the documentation provided, with particular reference to 9.2 Management Recommendations:

> 9.2.1 Recommendation 1
> *That MQ 120 is fenced and avoided during development of the southern overburden emplacement area.*
>
> *9.2.2 Recommendation 2*
> *Update the Aboriginal Heritage Management Plan to include the results of this survey and the management recommendations.*
>
> *9.2.3 Recommendation 3*
> *If unexpected historical archaeology is discovered during construction, work in the immediate area must cease and an archaeologist must be contacted to make an assessment of the find. If it is determined to be a relic under the Heritage Act, further investigation may be required. Examples of unexpected finds may include consolidated bricks, sandstone blocks and artefact deposits.*

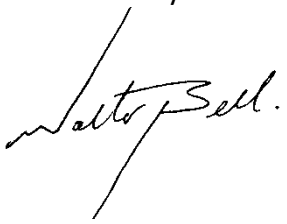
BNAC agrees with the Management Recommendations as proposed from a scientific archaeological viewpoint.

BNAC would suggest that if there are to be any changes made to the recommendations as proposed that may impact on any of the sites detailed as non or partial impact that we be consulted immediately.

Thank you for the opportunity to provide comment and we look forward to working with you collaboratively on this project.

If you have any queries, please contact me.

Yours faithfully



Wally Bell
Director/Chair

PO Box 255, Kippax ACT 2615 Mb: 0419 425347 Email: wally@ngunawal.com.au#

Appendix B

AHIMS search results

AHIMS Web Services (AWS)

Your Ref/PO Number : J14107 - Marulan 3

Client Service ID : 146358

Note: This Excel report shows the sites found in AHIMS on the 02/02/2016. If this date is not the same as the original date of the Search Results letter obtained during the Basic Search, then the search results might be different. The PDF version of this report will always coincide with the Basic Search Results letter.

Site ID	Site name	Datum	Zone	Easting	Northing	Context	Site status	Primary contact	Site features	Site types	Recorders	Reports	Permits	Longitude GDA94	Latitude GDA94
51-6-0102	Isolated Find 3	AGD	55	777420	6153370	Open site	Valid		Artefact : -	Isolated Find	Mrs.Caryll Sefton	99404		150.03	-34.72
51-6-0101	Isolated Find 2	AGD	55	774550	6152900	Open site	Valid		Artefact : -	Isolated Find	Mrs.Caryll Sefton	99404		150.00	-34.73
52-4-0027	Dungeon Creek Quarry	AGD	56	234810	6148750	Open site	Valid		Stone Quarry : -, Artefac	Quarry	Mr.Doug Williams,Ms.Sue Feary			150.10	-34.77
52-4-0002	South Marulan;Caoura;	AGD	56	233778	6148430	Closed sit	Valid		Grinding Groove : 1, Art	Shelter with Art	Kinsella			150.09	-34.77
51-6-0091	Marulan 6	AGD	55	774310	6153270	Open site	Valid		Artefact : -	Open Camp Site	Mrs.Caryll Sefton	3605,99404		150.00	-34.72
51-6-0059	Marulan Quarry 1	AGD	55	771860	6152890	Open site	Valid		Artefact : -	Open Camp Site	Peter Higgins,J Klavin,K	1995,99404		149.97	-34.73
51-6-0086	Marulan 1	AGD	55	774500	6153130	Open site	Valid		Artefact : -	Open Camp Site	Mrs.Caryll Sefton	99404		150.00	-34.73
51-6-0087	Marulan 2	AGD	55	774530	6153100	Open site	Valid		Artefact : -	Open Camp Site	Mrs.Caryll Sefton	99404		150.00	-34.73
51-6-0088	Marulan 3	AGD	55	774630	6153170	Open site	Valid		Artefact : -	Open Camp Site	Mrs.Caryll Sefton	99404		150.00	-34.72
51-6-0089	Marulan 4	AGD	55	774510	6153000	Open site	Valid		Artefact : -	Open Camp Site	Mrs.Caryll Sefton	99404		150.00	-34.73
51-6-0090	Marulan 5	AGD	55	774380	6153800	Open site	Valid		Artefact : -	Open Camp Site	Mrs.Caryll Sefton	99404		150.00	-34.72
51-6-0092	Marulan 7	AGD	55	774220	6153450	Open site	Valid		Artefact : -	Open Camp Site	Mrs.Caryll Sefton	99404		150.00	-34.72
51-6-0093	MF 1 - Winfarthing Roa	AGD	55	765080	6151200	Open site	Valid		Artefact : -	Isolated Find	Mr.Charles Dearling	99404,102090,102091,102092		149.90	-34.75
51-6-0094	MF 3 - Narambulla Cre	AGD	55	765870	6151120	Open site	Valid		Artefact : -	Open Camp Site	Mr.Charles Dearling	99404,102090,102091,102092		149.91	-34.75
51-6-0095	MF 2 - Winfarthing Roa	AGD	55	765190	6151120	Open site	Valid		Artefact : -	Isolated Find	Mr.Charles Dearling	99404,102090,102091,:1607		149.90	-34.75
51-6-0096	MF 4 - Narambulla Cre	AGD	55	765950	6150620	Open site	Valid		Artefact : -	Open Camp Site	Mr.Charles Dearling	99404,102090,102091,102092		149.91	-34.75
51-6-0097	MF 5 - Narambulla Cre	AGD	55	765700	6150360	Open site	Valid		Artefact : -	Open Camp Site	Mr.Charles Dearling	99404,102090,102091,102092		149.90	-34.75
51-6-0098	MF 6 - Narambulla Cre	AGD	55	765590	6150170	Open site	Valid		Artefact : -	Isolated Find	Mr.Charles Dearling	99404,102090,102091,102092		149.90	-34.75
51-6-0103	Isolated Find 1	AGD	55	774500	6153170	Open site	Valid		Artefact : -	Isolated Find	Mrs.Caryll Sefton	99404		150.00	-34.73
51-6-0104	Isolated Find 4	AGD	55	774550	6152900	Open site	Valid		Artefact : -	Isolated Find	Mrs.Caryll Sefton			150.00	-34.73
51-6-0105	Marulan ER Site 1	AGD	55	774500	6153220	Open site	Valid		Artefact : -	Open Camp Site	Miss.Jackie Taylor	99404		150.00	-34.72
51-6-0060	Marulan Quarry 2	AGD	55	772450	6153000	Open site	Valid		Artefact : -	Open Camp Site	Kerry Navin	1995,99404,100613,10(	2760,2761	149.98	-34.73
51-6-0242	MRN1	AGD	55	773179	6153116	Open site	Valid	Searle	Artefact : 3		Mr.Graham Houghton			149.98	-34.73
51-6-0243	MRN2	AGD	55	773077	6153038	Open site	Valid	Searle	Artefact : 6		Mr.Graham Houghton			149.98	-34.73
51-6-0244	MRN3	AGD	55	773043	6152939	Open site	Valid	Searle	Artefact : 8		Mr.Graham Houghton			149.98	-34.73
51-6-0245	MRN4	AGD	55	772313	6152581	Open site	Valid	Searle	Artefact : 6		Mr.Graham Houghton	100614		149.98	-34.73
51-6-0246	MRN5	AGD	55	772404	6152969	Open site	Valid	Searle	Artefact : 6		Mr.Graham Houghton	100613,100615,100637	2760,2761	149.98	-34.73
51-6-0249	MRN8	AGD	55	771061	6153668	Open site	Valid	Searle	Modified Tree (Carved or Scarred) : 1		Mr.Graham Houghton			149.96	-34.72
51-6-0250	MRN9	AGD	55	771252	6153592	Open site	Valid	Mr.Bill Hardie	Stone Arrangement : -		Mr.Graham Houghton			149.96	-34.72
51-6-0251	MRN 10	AGD	55	771106	6153698	Open site	Valid	Searle	Modified Tree (Carved or Scarred) : -		Mr.Graham Houghton			149.96	-34.72
51-6-0252	MRN 11	AGD	55	771093	6153692	Open site	Valid	Searle	Modified Tree (Carved or Scarred) : -		Mr.Graham Houghton			149.96	-34.72
51-6-0254	MRN 13	AGD	55	771280	6153826	Open site	Valid	Searle	Artefact : 20		Mr.Graham Houghton			149.96	-34.72
51-6-0259	MRN18	AGD	55	772327	6153801	Open site	Valid	Searle	Artefact : 1		Mr.Graham Houghton			149.98	-34.72
51-6-0262	MRN21	AGD	55	771559	6153669	Open site	Valid	Searle	Artefact : 1		Mr.Graham Houghton			149.97	-34.72
51-6-0263	MRN22	AGD	55	771713	6153691	Open site	Valid	Searle	Artefact : 11		Mr.Graham Houghton			149.97	-34.72
51-6-0265	MRN24	AGD	55	771946	6153098	Open site	Valid	Searle	Artefact : 1		Mr.Graham Houghton			149.97	-34.73
48-4-0086	DP1056566 Lot 11/1	AGD	56	225675	6148350	Open site	Valid	T Russell	Artefact : 12		Mr.Doug Williams	99346,99362	2536,2675,2676	150.00	-34.77
48-4-0087	DP1056566 Lot 11/2	AGD	56	226075	6148875	Open site	Valid	T Russell	Artefact : 37		Mr.Doug Williams	99346,99362	2536,2675,2676	150.01	-34.76
48-4-0088	DP1056566 Lot 11/3	AGD	56	226000	6148750	Open site	Valid	T Russell	Artefact : 3		Mr.Doug Williams	99346,99362	2536,2675,2676	150.01	-34.76
48-4-0089	DP1056566 Lot 12/1	AGD	56	225875	6147475	Open site	Valid	T Russell	Artefact : 21		Mr.Doug Williams	99346,99362		150.01	-34.78
48-4-0090	DP1056566 Lot 12/2	AGD	56	225875	6147625	Open site	Valid	T Russell	Artefact : 8		Mr.Doug Williams	99346,99362		150.01	-34.78
48-4-0091	DP1056566 Lot 12/3	AGD	56	225875	6147625	Open site	Valid	T Russell	Artefact : 8		Mr.Doug Williams	99346,99362		150.01	-34.78
48-4-0092	DP1056566 Lot 12/IF1	AGD	56	225800	6147780	Open site	Valid	T Russell	Artefact : 1		Mr.Doug Williams	99346,99362		150.00	-34.77
48-4-0093	DP1056566 Lot 12/IF2	AGD	56	225750	6147800	Open site	Valid	T Russell	Artefact : 1		Mr.Doug Williams	99346,99362		150.00	-34.77
51-6-0378	LA 23	AGD	55	769978	6153907	Open site	Valid	Searle	Artefact : 2		Archaeological Heritage	99620		149.95	-34.72
51-6-0381	LA 26	AGD	55	770030	6153824	Open site	Valid	Searle	Artefact : 1		Archaeological Heritage	99620		149.95	-34.72
52-4-0143	MSQ 1	GDA	56	228406	6149690	Open site	Destroyed	Searle	Artefact : -		Mr.Chris Lange,ERM Au	103137		150.03	-34.76
52-4-0144	MSQ2	GDA	56	228292	6149943	Open site	Destroyed	Searle	Artefact : 3		Mr.Chris Lange,ERM Au	103137		150.03	-34.76
52-4-0145	MSQ3	GDA	56	228625	6149982	Open site	Destroyed	Searle	Artefact : 1		Mr.Chris Lange,ERM Au	103137		150.04	-34.76
52-4-0146	MSQ4	GDA	56	228608	6150001	Open site	Destroyed	Searle	Artefact : 1		Mr.Chris Lange,ERM Au	103137		150.04	-34.76
52-4-0147	MSQ5	GDA	56	228557	6149936	Open site	Destroyed	Searle	Artefact : 1		Mr.Chris Lange,ERM Au	103137		150.03	-34.76
52-4-0148	MSQ6	GDA	56	227050	6150950	Open site	Valid	Searle	Artefact : 2		Mr.Chris Lange	103137		150.02	-34.75
52-4-0149	MSQ7	GDA	56	227735	6150380	Open site	Valid	Searle	Artefact : 2		Mr.Chris Lange	103137		150.03	-34.75
52-4-0150	MSQ8	GDA	56	227353	6150223	Open site	Destroyed	Searle	Artefact : 9		Mr.Neville Baker,ERM A	103083,103137		150.02	-34.75
52-4-0151	MSQ9	GDA	56	227297	6150151	Open site	Destroyed	Searle	Artefact : 4		Mr.Neville Baker,ERM A	103083,103137		150.02	-34.75
52-4-0152	MSQ10	GDA	56	227252	6150208	Open site	Destroyed	Searle	Artefact : 2		Mr.Neville Baker,ERM A	103083,103137		150.02	-34.75
52-4-0153	MSQ11	GDA	56	227153	6150213	Open site	Destroyed	Searle	Artefact : 8		Mr.Neville Baker,ERM A	103137		150.02	-34.75
52-4-0154	MSQ12	GDA	56	227213	6150319	Open site	Destroyed	Searle	Artefact : 1		Mr.Neville Baker,ERM A	103083,103137		150.02	-34.75
52-4-0155	MSQ13	GDA	56	227153	6150213	Open site	Destroyed	Searle	Artefact : 4		Mr.Neville Baker,ERM A	103083,103137		150.02	-34.75
52-4-0156	MSQ14	GDA	56	227414	6150203	Open site	Destroyed	Searle	Artefact : 1		Mr.Neville Baker,ERM A	103083,103137		150.02	-34.75
52-4-0157	MSQ15	GDA	56	227383	6150181	Open site	Destroyed	Searle	Artefact : 1		Mr.Neville Baker,ERM A	103083,103137		150.02	-34.75
52-4-0158	MSQ16	GDA	56	227447	6150191	Open site	Destroyed	Searle	Artefact : 2		ERM Australia Pty Ltd-S	103083,103137		150.02	-34.75
52-4-0159	MSQ17	GDA	56	227198	6150283	Open site	Destroyed	Searle	Artefact : 3		ERM Australia Pty Ltd-S	103083,103137		150.02	-34.75
52-4-0160	MSQ18	GDA	56	228576	6150429	Open site	Destroyed	Searle	Artefact : -		ERM Australia Pty Ltd-S	103137		150.03	-34.75
52-4-0161	BCSC1	GDA	56	227944	6148309	Open site	Destroyed	Searle	Artefact : -		ERM Australia Pty Ltd-S	100467	2687,2976	150.03	-34.77
51-6-0428	Winfarthing Road - Isol	AGD	55	765994	6150702	Open site	Valid	T Russell	Artefact : 1		Navin Officer Heritage Consultants Pty Ltd			149.91	-34.75

51-6-0429	Winfarthing Road - WR	AGD	55	765920	6150600	Open site	Valid	T Russell	Artefact : -	Navin Officer Heritage Consultants Pty Ltd		149.91	-34.75
51-6-0430	Winfarthing Road - WR	AGD	55	765672	6149673	Open site	Valid	T Russell	Artefact : 3	Navin Officer Heritage Consultants Pty Ltd		149.90	-34.76
51-6-0422	Winfarthing Road - WR	GDA	55	765887	6150772	Open site	Valid	Searle	Artefact : 14	Navin Officer Heritage Consultants Pty Ltd		149.90	-34.75
51-6-0467	Marulan T6 S1	AGD	55	772216	6152641	Open site	Valid	T Russell	Artefact : 1	Umwelt (Australia) Pty L	100614	149.97	-34.73
51-6-0468	Marulan T6 S2	AGD	55	772010	6153579	Open site	Valid	T Russell	Artefact : 1	Umwelt (Australia) Pty L	100614	149.97	-34.72
51-6-0469	Marulan T6 S4	AGD	55	772089	6153660	Open site	Valid	T Russell	Artefact : 1	Umwelt (Australia) Pty L	100614	149.97	-34.72
51-6-0470	Marulan T6 S3	AGD	55	771997	6153599	Open site	Valid	T Russell	Artefact : 1	Umwelt (Australia) Pty L	100614	149.97	-34.72
52-4-0195	M1 (BCSC1)	AGD	56	227940	6148310	Open site	Destroyed		Artefact : -	ERM Australia Pty Ltd-	100467,101390	2687,2976	150.03	-34.77
51-6-0638	MRN73	AGD	55	772847	6152659	Open site	Valid		Artefact : -	Umwelt (Australia) Pty Limited			149.98	-34.73
51-6-0628	MRN67	AGD	55	772764	6152846	Open site	Valid		Artefact : -	Umwelt (Australia) Pty L	101034		149.98	-34.73
51-6-0631	MRN70	AGD	55	772755	6152859	Open site	Valid		Artefact : -	Umwelt (Australia) Pty L	101034		149.98	-34.73
51-6-0632	MRN71	AGD	55	772797	6152713	Open site	Valid		Artefact : -	Umwelt (Australia) Pty L	101034		149.98	-34.73
51-6-0633	MRN72	AGD	55	772868	6152814	Open site	Valid		Artefact : -	Umwelt (Australia) Pty Limited			149.98	-34.73
51-6-0636	MRN76	AGD	55	771409	6153691	Open site	Valid		Modified Tree (Carved or Scarred) : 1	Umwelt (Australia) Pty Limited			149.97	-34.72
52-4-0246	M2	GDA	56	227783	6148128	Open site	Valid		Artefact : 3	ERM Australia Pty Ltd- Sydney CBD			150.03	-34.77
52-4-0264	Peppertree Burial 01 (s	GDA	56	227335	6150132	Open site	Valid		Stone Arrangement : 1	GML Heritage Pty Ltd,D	103137		150.02	-34.75
52-4-0265	Peppertree Scarred Tre	GDA	56	227874	6150107	Open site	Valid		Modified Tree (Carved or Scarred) : -	GML Heritage Pty Ltd,D	103137		150.03	-34.75
52-4-0266	BCSC AS1	AGD	56	226352	6147944	Open site	Valid		Artefact : 8	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0267	BCSC AS2	AGD	56	226371	6147950	Open site	Valid		Artefact : 2	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0268	BCSC AS3	AGD	56	226381	6147968	Open site	Valid		Artefact : 2	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0269	BCSC AS4	AGD	56	226380	6148020	Open site	Valid		Artefact : 22	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0270	BCSC IF2	AGD	56	226284	6147952	Open site	Valid		Artefact : 1	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0271	BCSC IF3	AGD	56	226206	6147767	Open site	Valid		Artefact : 1	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0272	BCSC IF4	AGD	56	226182	6147840	Open site	Valid		Artefact : 1	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0273	BCSC IF7	AGD	56	226313	6147951	Open site	Valid		Artefact : 1	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0274	BCSC IF8	AGD	56	226313	6147951	Open site	Valid		Artefact : 1	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0275	BCSC IF9	AGD	56	226333	6147978	Open site	Valid		Artefact : 1	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0276	BCSC IF11	GDA	56	226354	6147952	Open site	Valid		Artefact : 1	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0277	BCSC IF12	AGD	56	226357	6147961	Open site	Valid		Artefact : 1	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0278	BCSC IF13	AGD	56	226359	6147974	Open site	Valid		Artefact : 1	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0279	BCSC IF14	AGD	56	226386	6147978	Open site	Valid		Artefact : 1	RPS Australia East Pty Ltd -Hamilton			150.01	-34.77
52-4-0291	MQ 19	GDA	56	227498	6150292	Open site	Valid		Artefact : 1	ERM Australia Pty Ltd-	103083,103137		150.02	-34.75
52-4-0292	MQ 20	GDA	56	227952	6150239	Open site	Destroyed		Artefact : 1	ERM Australia Pty Ltd-	103137		150.03	-34.75
52-4-0293	MQ 21	GDA	56	228103	6150306	Open site	Destroyed		Artefact : 1	ERM Australia Pty Ltd-	103137		150.03	-34.75
52-4-0294	MQ 22	GDA	56	228292	6149943	Open site	Destroyed		Artefact : 1	ERM Australia Pty Ltd-	103137		150.03	-34.76
52-4-0295	MQ 23	GDA	56	227565	6150191	Open site	Destroyed		Artefact : 1	ERM Australia Pty Ltd-	103083,103137		150.02	-34.75
52-4-0296	MQ 24	GDA	56	227864	6150067	Open site	Destroyed		Artefact : 1	ERM Australia Pty Ltd-	103083,103137		150.03	-34.76
52-4-0297	MQ 25	GDA	56	229040	6149327	Open site	Destroyed		Artefact : 1	ERM Australia Pty Ltd-	103137		150.04	-34.76
52-4-0298	MQ 26	GDA	56	228833	6149949	Open site	Destroyed		Artefact : 1	ERM Australia Pty Ltd-	103137		150.04	-34.76
52-4-0299	MQ 27	GDA	56	227770	6150502	Open site	Valid		Artefact : 1	ERM Australia Pty Ltd-	103137		150.03	-34.75
52-4-0300	MQ 28	GDA	56	228264	6150468	Open site	Destroyed		Artefact : 1	ERM Australia Pty Ltd-	103137		150.03	-34.75
52-4-0301	MQ 29	GDA	56	228330	6150417	Open site	Destroyed		Artefact : 1	ERM Australia Pty Ltd-	103137		150.03	-34.75
51-6-0704	MRN85	GDA	55	771793	6152895	Open site	Valid		Artefact : 1	Umwelt (Australia) Pty Limited			149.97	-34.73
51-6-0705	MRN82	GDA	55	772955	6153079	Open site	Valid		Artefact : 1	Umwelt (Australia) Pty Limited			149.98	-34.73
51-6-0706	MRN83	GDA	55	771622	6153881	Open site	Valid		Artefact : 1	Umwelt (Australia) Pty Limited			149.97	-34.72
51-6-0707	MRN84	GDA	55	772089	6153292	Open site	Valid		Artefact : 1	Umwelt (Australia) Pty Limited			149.97	-34.73

Report generated by AHIMS Web Service on 02/02/2016 for Rebecca Newell for the following area at Lat, Long From : -34.77, 149.9 - Lat, Long To : -34.73, 150.1 with a Buffer of 1000 meters. Additional Info : environmental assessment - Aboriginal cultural heritage assessment. Number of Aboriginal sites and Aboriginal objects found is 112

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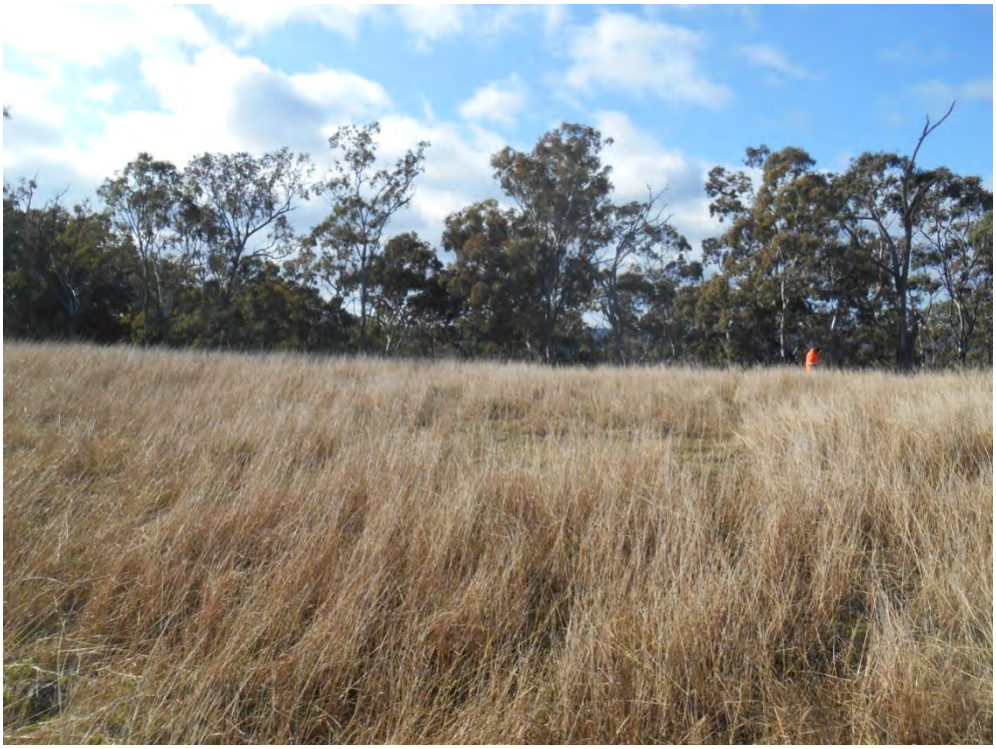
Appendix C

Survey transect results

Stage	Transect	Date	Method	Landform pattern	Landform element	Distance to Temp water (minimum) (m)	Distance to permanent water (minimum) (m)	Length (m)	Width (m)	Area (m²)	Exposure	Visibility	Exposure 2	Visibility 2	Visible area (m²)	Area available for detection (m²)	Effective coverage %	Comments	Representative Photographs	Soil landscape	Underlying geology	Rock outcrop material	Rock outcrop form	Extent of rock outcrop %	Ground cover types	Exposure types	Vegetation
Mod 4	T1	2/07/2015	Pedestrian survey	Hills	Hill slope	3	10	575	40	23000	30	10	0.3	0.1	2300	690	3	Transect through a hill slope landform vegetation very high and many granite boulders present. Transect adjacent to a drainage depression and finished overlooking the Barbers Creek George.	1741 - 1750	Marulan	Marulan Granite Batholith	Granite	Boulders	20	Grass/imported and natural gravels	Vehicle, wind and water erosion, cattle tracks	Grassed paddock
Mod 4	T2	2/07/2015	Pedestrian survey	Hills	Hill spur	4	10	456	40	18240	40	10	0.4	0.1	1824	729.6	4	Transect through a hill spur landform, many granite boulders and very low visibility, very high native and weed grasses. Trees generally eucalyptus but very young. No artefacts and very difficult to see any due to low visibility. Little erosion, mostly from cattle grazing and vehicle tracks, dam creation and wombats.	1751- 1756	Marulan	Marulan Granite Batholith	Granite	Boulders	20	Grass/imported and natural gravels	Vehicle, wind and water erosion, cattle tracks	Grassed paddock
Mod 4	T3	2/07/2015	Pedestrian survey	Hills	Hill slope	5	9	289	40	11560	30	10	0.3	0.1	1156	346.8	3	Transect through a hill slope landform vegetation very high and many granite boulders present. Transect adjacent to a drainage depression and finished overlooking the Barbers Creek George. Slopes are steep with granite outcropping on higher areas. No water currently present in associated drainage lines	1757-1758	Marulan	Marulan Granite Batholith	Granite	Boulders	20	Grass/imported and natural gravels	Vehicle, wind and water erosion, cattle tracks	Grassed paddock
Mod 4	T4	2/07/2015	Pedestrian survey	Hills	Hill slope	5	8	337	40	13480	20	5	0.2	0.05	674	134.8	1	Transect through a lower hill slope next to the drainage line slope is steep	1759-1768	Marulan	Marulan Granite Batholith	Granite	Boulders	20	Grass/imported and natural gravels	Vehicle, wind and water erosion, cattle tracks	Grassed paddock
Mod 4	T5	2/07/2015	Pedestrian survey	Hills	Hill spur	3	10	315	40	12600	10	5	0.1	0.05	630	63	0.5	transect through a spur landform little to no visibility spur crest was steep and covered in weeds, pasture grasses and very few larger trees	1769 -1771	Marulan	Marulan Granite Batholith	Granite	Boulders	20	Grass/imported and natural gravels	Vehicle, wind and water erosion, cattle tracks	Grassed paddock
Mod 4	T6	2/07/2015	Pedestrian survey	Hills	Hill spur	10	10	514	40	20560	20	10	0.2	0.1	2056	411.2	2	Transect along hill spur slightly flat and near the ridge vegetation dense pasture grasses and weeds	1772-1793	Marulan	Marulan Granite Batholith	Granite	Boulders	20	Grass/imported and natural gravels	Vehicle, wind and water erosion, cattle tracks	Grassed paddock
Mod 4	T7	2/07/2015	Pedestrian survey	Hills	Ridge	10	10	631	40	25240	20	10	0.2	0.1	2524	504.8	2	Transect along ridge line overlooking the Barbers Creek Gorge, very steep some eucalypt trees on the other side of the fence showing the original vegetation, the are was mainly pasture grasses and weeds	1794-1797	Marulan	Marulan Granite Batholith	Granite	Boulders	20	Grass/imported and natural gravels	Vehicle, wind and water erosion, cattle tracks	Grassed paddock
Mod 4	T8	2/07/2015	Pedestrian survey	Hills	Hill slope	10	5	285	40	11400	30	10	0.3	0.1	1140	342	3	Transect along slope adjacent to creek line native and weed grasses and very low visibility	1806-1808	Marulan	Marulan Granite Batholith	Granite	Boulders	20	Grass/imported and natural gravels	Vehicle, wind and water erosion, cattle tracks	Grassed paddock
MS	T70	17/04/2015	Pedestrian survey	Low Hills	Watercourse	10	10	692	50	34600	20	30	0.2	0.3	10380	2076	6	the bank of a creek running towards the Bungong George. Disturbed through erosion, farm tracks, and the use of concrete and dumping at the end of transect		Marulan	Marulan Granite Batholith	Granite, silcrete		10	Grass/imported and natural gravels	Vehicle, wind and water erosion, cattle tracks	Grassed paddock
MS	T71	17/04/2015	Pedestrian survey	Low Hills	Watercourse	10	10	692	50	34600	10	30	0.1	0.3	10380	1038	3	the bank of a creek running towards the Bungong George. Disturbed through erosion, farm tracks, and the use of concrete and dumping at the end of transect		Marulan	Marulan Granite Batholith	Granite, silcrete		10	Grass/imported and natural gravels	Vehicle, wind and water erosion, cattle tracks	Grassed paddock

Photograph 0.1 **Transect 1 representative photograph, facing east (EMM2015)**



Photograph 0.2 **Transect 2 representative photograph facing east (EMM 2015)**

Photograph 0.3 **Transect 3 representative photograph, facing west (EMM 2105)**

Photograph 0.4 **Transect 4 representative photograph, facing south (EMM 2015)**

Photograph 0.5 **Transect 5 representative photograph, facing north (EMM 2015)**

Photograph 0.6 **Transect 6 representative photograph, facing south-west (EMM 2015)**

Photograph 0.7 **Transect 7 representative photograph, facing west (EMM 2015)**

Photograph 0.8 **Transect 8 representative photograph, facing south (EMM 2015)**

Appendix D

New site cards for the study area

Aboriginal Site Recording Form

AHIMS Registrar
PO Box 1967, Hurstville NSW 2220

NSW GOVERNMENT Office of Environment & Heritage

Office Use Only

Site Number | | | _ | | _ | | | | | |

Date received / / Date entered into system / / Date catalogued / /

Entered by (I.D.)

Information Access

Office Use Only

☐ Gender/male ☐ Gender/female ☐ Location restriction ☐ General restriction ☐ No access

For Further Information Contact:

☐ **Nominated Trustee**

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Client on system ☐

☐ **Knowledge Holder**

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Client on system ☐

Aboriginal Heritage Unit or Cultural Heritage Division Contacts

Geographic Location

Site Name MQ120

Easting 228983 Northing 6148847 AGD/GDA GDA

Mapsheet

Zone 56 Location Method Non-Differential GPS

Other Registration

Primary Recorder

Title | Surname | First Name | Initials

MRS | Newell | Rebecca

Organisation EMM

Address PO BOX 21 St Leonards NSW

Phone number 94939500 Fax

Date recorded 02/07/2015

Client on system ☐

NPWS Aboriginal Site Recording Form - Site Information

OPEN/CLOSE SITE Open Site

Site Context

Landform

- [ ] Mountainous
- [ ] Plain
- [ ] Rolling hills
- [x] Steep hills
- [ ] Undulating plain

Landform Unit

- [ ] Beach
- [ ] Coastal rock platform
- [ ] Dune
- [ ] Intertidal flat
- [ ] Lagoon
- [ ] Tidal Creek
- [ ] Tidal Flat
- [ ] Cliff
- [ ] Crest
- [ ] Flat
- [ ] Lower slope
- [ ] Mid slope
- [ ] Upper slope
- [ ] Plain
- [x] Ridge
- [ ] Tor
- [ ] Valley flat
- [ ] Levy
- [ ] Stream bank
- [ ] Stream channel
- [ ] Swamp
- [ ] Terrace
- [ ] Terrace flat

Slope

[ ] degrees

Vegetation

- [ ] Closed forest
- [ ] Grasslands
- [ ] Isolated clumps of trees
- [x] Open forest
- [ ] Open woodland
- [ ] Scrub
- [ ] Woodland
- [ ] Cleared
- [ ] Revegetated
- [ ] N/A

Land use

- [ ] Conservation
- [ ] Established urban
- [ ] Farming-intensive
- [ ] Farming-low intensity
- [ ] Forestry
- [ ] Industrial
- [ ] Mining
- [x] Pastoral/grazing
- [ ] Recreation
- [ ] Semi-rural
- [ ] Service corridor
- [ ] Transport corridor
- [ ] Urban expansion
- [ ] Residential

Water

Distance to permanent water source	1,000	metres
Distance to temporary water source	10	metres
Name of nearest permanent water source	Shoalhaven River	
Name of nearest temporary water	Unknown Creek	

Directions for Relocation

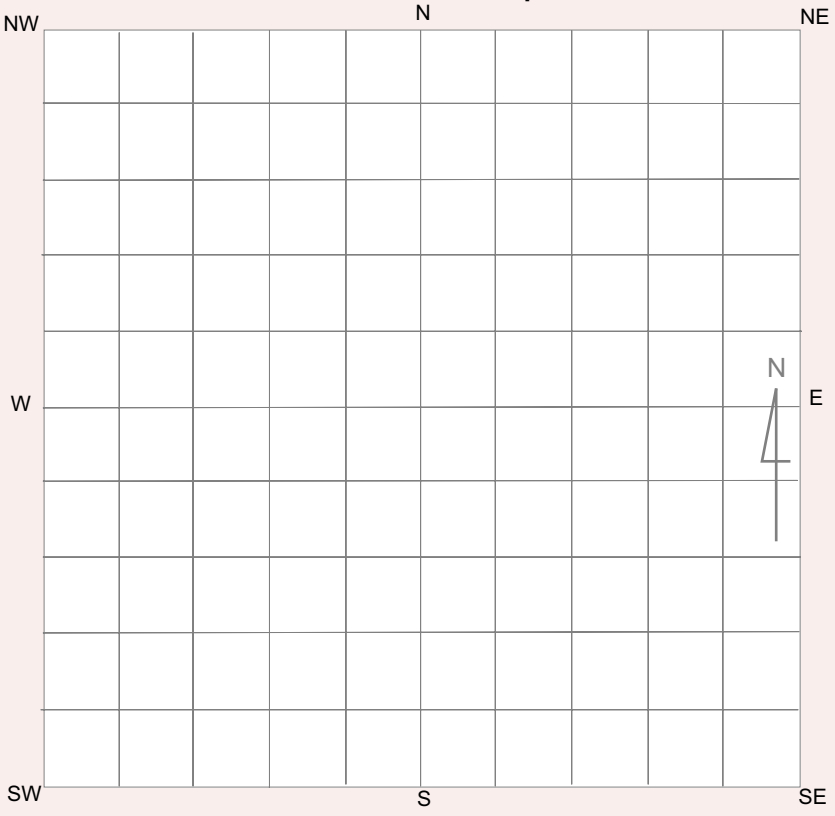
Current Land Tenure

- [ ] Public
- [x] Private

National Park / other Government Dept.

Primary report **I.D.** (I.D. Office Use only)

Site Location Map



NPWS Aboriginal Site Recording Form - Site Information

General Site Information

Closed Site

Shelter/Cave Formation

- ☐ Boulder
- ☐ Wind erosion
- ☐ Water erosion
- ☐ Rock collapse

Rock Surface Condition

- ☐ Boulder
- ☐ Sandstone platform
- ☐ Silica gloss
- ☐ Tessellated
- ☐ Weathered
- ☐ Other platform

Condition of Ceiling

- ☐ Boulder
- ☐ Sandstone platform
- ☐ Silica gloss
- ☐ Tessellated
- ☐ Weathered
- ☐ Other platform

Shelter Aspect

- ☐ North
- ☐ North East
- ☐ East
- ☐ South East
- ☐ South
- ☐ South West
- ☐ West
- ☐ North West

Open Site

Site Orientation

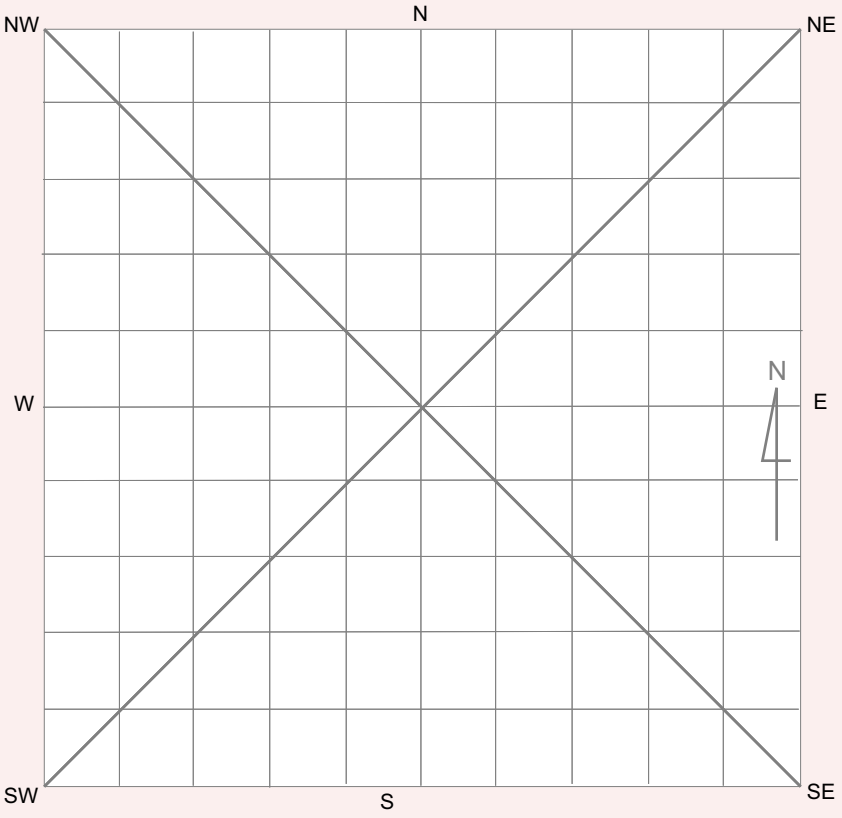
- ☐ N-S
- ☐ NE-SW
- ☐ E-W
- ☐ SE-NW
- ☐ N/A

Features

- ☐ 1. Aboriginal Ceremony & Dreaming
- ☐ 2. Aboriginal Resource & Gathering
- ☐ 3. Art
- ☐ 4. Artefact
- ☐ 5. Burial
- ☐ 6. Ceremonial Ring
- ☐ 7. Conflict
- ☐ 8. Earth Mound
- ☐ 9. Fish Trap
- ☐ 10. Grinding Groove
- ☐ 11. Habitation Structure
- ☐ 12. Hearth
- ☐ 13. Non Human Bone & Organic Material
- ☐ 14. Ochre quarry
- ☐ 15. Potential Archaeological Deposit
- ☐ 16. Stone Quarry
- ☐ 17. Shell
- ☐ 18. Stone Arrangement
- ☑ 19. Modified Tree
- ☐ 20. Water Hole

Site Plan

Indicate scale, boundaries of site, features



Site Dimensions

Closed Site Dimensions (m)

- ☐ Internal length
- ☐ Internal width
- ☐ Shelter height
- ☐ Shelter floor area

Open Site Dimensions (m)

- 1 Total length of visible site
- 1 Average width of visible site
- 1 Estimated area of visible site
- 1 Length of assessed site area

Aboriginal Community Interpretation and Management Recommendations

Preliminary Site Assessment

Site Cultural & Scientific Analysis and Preliminary Management Recommendations

The site is of moderate significance, due to it's rarity in the local area.

This section should only be filled in by the Endorsees

Endorsed by: ☐ Knowledge Holder ☐ Nominated Trustee ☐ Native Title Holder ☐ Community Consensus

Title | Surname | First Name | Initials

Organisation

Address

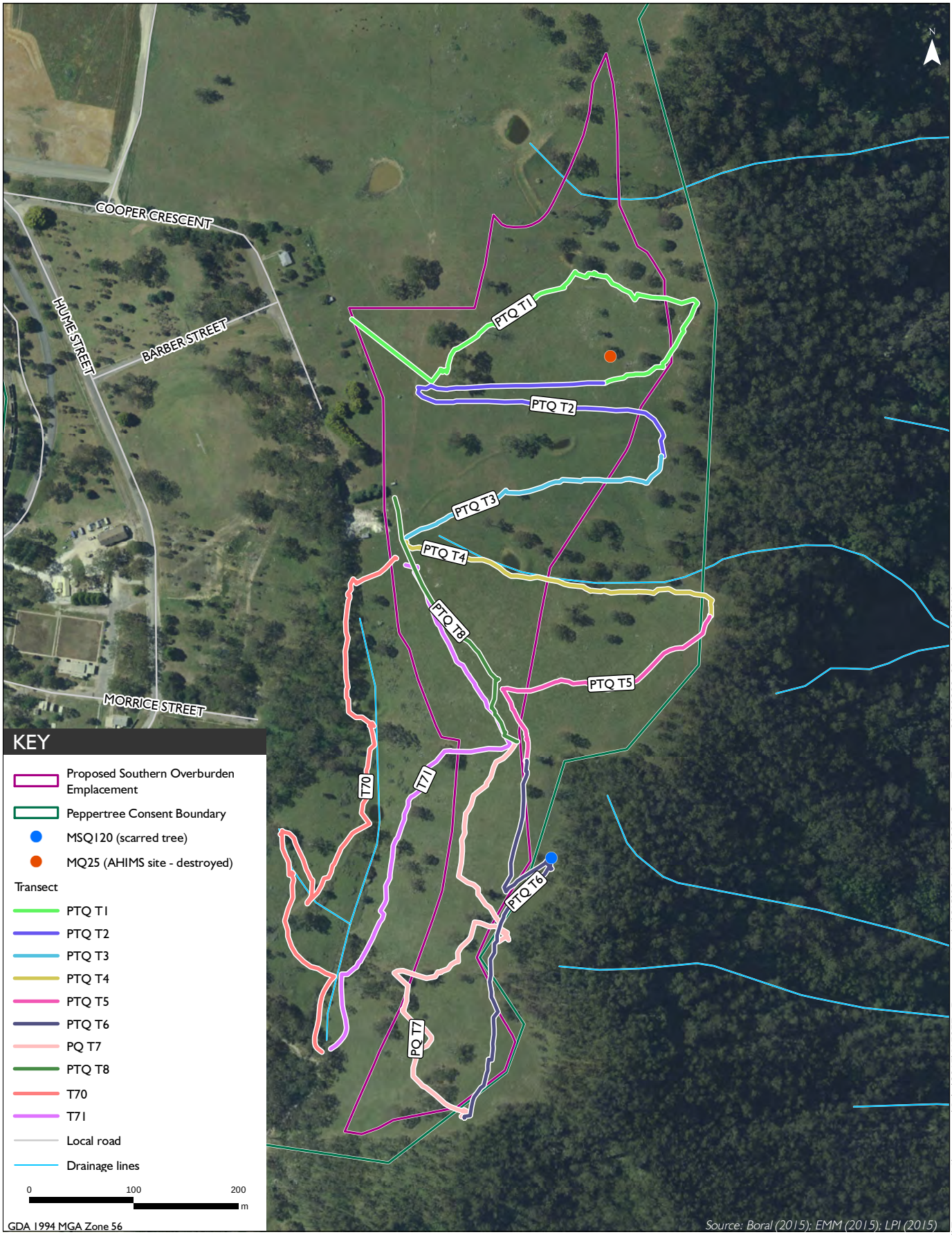
Phone number | Fax

Attachments (No.)

- ☑ A4 location map
- ☐ B/W photographs
- ☑ Colour photographs
- ☐ Slides
- ☐ Aerial photographs
- ☐ Site plans, drawings
- ☐ Recording tables
- ☐ Other
- ☐ Feature inserts-No. ☐

Comments

A scarred tree bearing a small oval scar, located on a ridge overlooking the Bungonia Gorge and Shollhaven River.



Survey transects and Aboriginal heritage sites

Peppertree Quarry Modification 4 Project

Aboriginal cultural and historic heritage assessment

Figure 6.1