Appendix I

Biodiversity assessment

Biodiversity Assessment Report

Gunlake Quarry Extension Project

Prepared for Gunlake Quarry Pty Ltd | 29 March 2016

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Biodiversity Assessment Report

Final

Report J14119RP2 | Prepared for Gunlake Quarry Pty Ltd | 29 March 2016

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Date	29 March 2016	Date	29 March 2016

Document Control

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Executive Summary

Gunlake Quarry Pty Ltd (Gunlake) is preparing a state significant development (SSD) application to extend operations of the Gunlake Quarry. The extension project will assist to meet the identified demand for construction materials, including quarried aggregate for the local area and Sydney. The extension project includes the production of 2 million tonnes per annum (Mtpa) of saleable product for 30 years.

This Biodiversity Assessment Report has been prepared in accordance with the NSW Offset Policy for Major Proposals (OEH 2014b) and includes the information required by the Framework for Biodiversity Assessment (FBA).

Previous surveys and information relevant to the extension area were reviewed and database searches were performed to inform the field surveys. Detailed field surveys were undertaken in accordance with the FBA requirements and threatened species and populations identified from the desktop review and the BioBanking Credit Calculator were targeted in accordance with *Threatened Species Survey and Assessment: Guidelines for Developments and Activities* (working draft) (DEC 2004).

Two plant community types (PCTs) were recorded in the extension area:

- Yellow Box - Blakely's Red Gum Grassy Woodland (PCT1330); and
- Broad-leaved Peppermint - Red Stringybark Grassy Open Forest (PCT734).

The areas of Yellow Box - Blakely's Red Gum Grassy Woodland meet the description of White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community (EEC) listed under the *Threatened Species Conservation Act 1995* (TSC Act) and Critically Endangered Ecological Community (CEEC) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (woodland vegetation only).

Six threatened fauna species were recorded in the extension area: the Square-tailed Kite, Speckled Warbler, Diamond Firetail, Eastern Bentwing Bat, Eastern False Pipistrelle and Little Bentwing Bat. Previous surveys also recorded the Little Lorikeet in the study area, and the Southern Myotis, Scarlet Robin, Little Eagle and Varied Sitella in the locality. Potential habitat is also present in the extension area for the Striped Legless Lizard and additional threatened woodland bird species such as the Brown Treecreeper.

Gunlake has investigated a number of options to avoid and minimise impacts on remnant vegetation from the extension project. A single pit extension is proposed to minimise impacts. In particular, the overburden emplacement has been located in an area, which is predominantly pasture to minimise impacts on woodland vegetation.

The extension project would directly impact:

- 8.4 ha of Yellow Box - Blakely's Red Gum Grassy Woodland (which meets the description of Box Gum Woodland EEC and Box Gum Woodland CEEC);
- 3.8 ha of Broad-leaved Peppermint - Red Stringybark Grassy Open Forest; and
- 41.9 ha of derived native grassland (7 ha meets the description of Box Gum Woodland EEC).

A total of 1,521 BioBanking ecosystem credits are required to compensate for the extension project's impacts on threatened species habitat.

No threatened species listed under the EPBC Act have been recorded in the study area. One threatened species listed under the EPBC Act has the potential to occur in the extension area; the Striped Legless Lizard. In addition, 8.4 ha of the EPBC Act listed Box Gum Woodland CEEC will be removed.

Assessments of significance have been prepared for these species. The assessments conclude that a significant impact is likely for Box Gum Woodland CEEC, but unlikely for the Striped Legless Lizard. Impacts to threatened species habitat listed under the EPBC Act will be offset in accordance with the FBA.

Additional offset areas will be added to the current Gunlake offset requirements to compensate for the unavoidable impacts of the extension project. The offset areas will be reconfigured to ensure that previous offset commitments and new offset requirements will be met. The resulting offset package will provide long-term protection and enhancement of habitat for threatened species and ecological communities.

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1 Introduction

1.1 Background

Development of the Gunlake Quarry (the Quarry) and associated infrastructure was approved by the New South Wales (NSW) Minister of Planning on 24 September 2008 under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Quarry commenced operations in 2010.

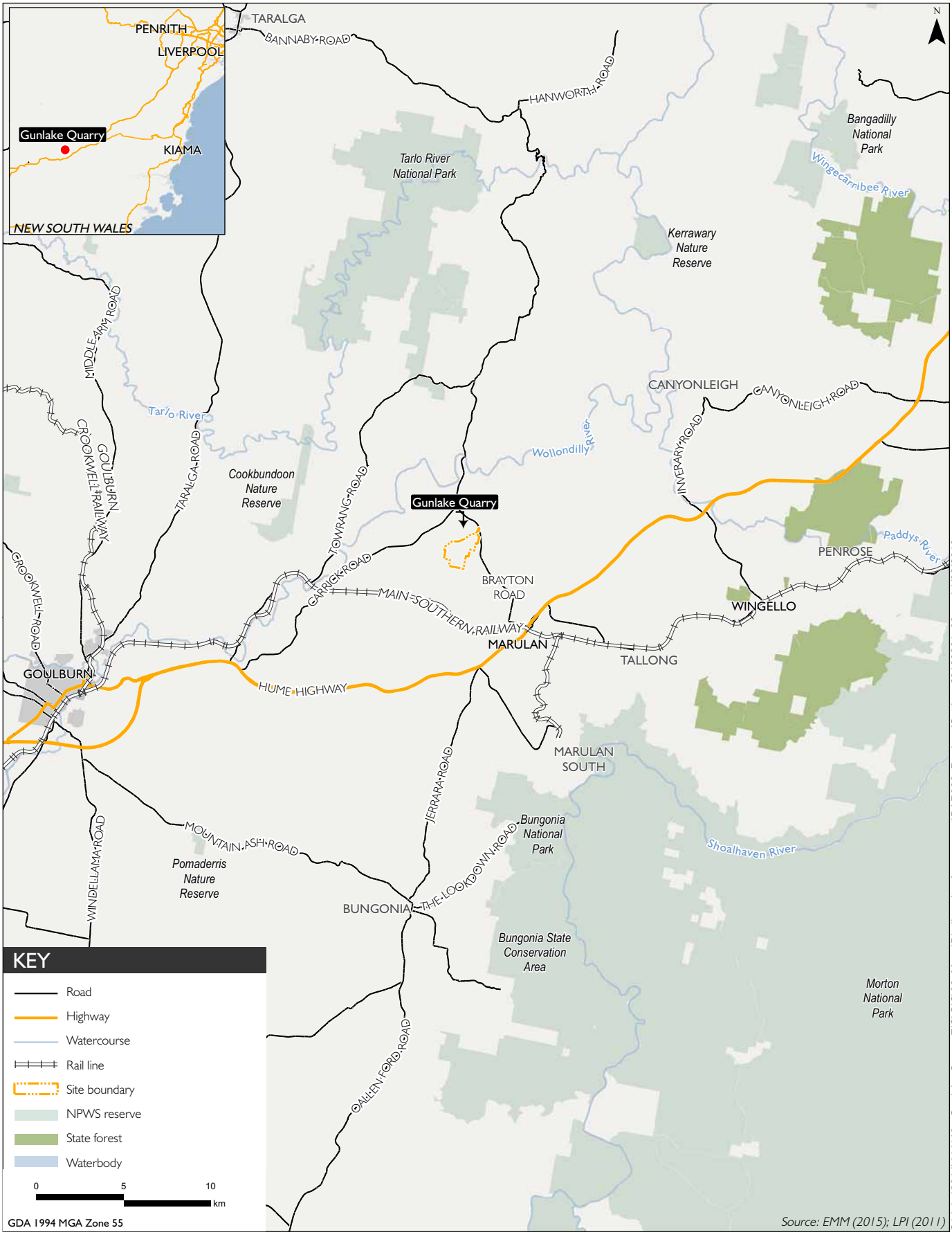
The approval was subsequently modified under Section 75W of the EP&A Act (Modification 1 [MOD1]) to allow quarry trucks to use a new overpass to access the bypass road to the quarry. The modification was approved by the Planning Assessment Commission (PAC) under the Minister's delegation on 5 March 2013.

An application to modify the existing approval was approved in April 2015 allowing:

- increased production to 0.75 Mtpa;
- increased truck movements (from 100 movements per day to 160 movements per day [2:00 am Monday to 6:00 pm Saturday unchanged]);
- on-site activities to continuously operate from 6:00 am Monday to 6:00 pm Saturday; and
- an extended pit footprint (an increase of about 25%).

Gunlake is preparing a SSD application to extend operations of the Quarry (the extension project). The SSD application will be lodged under Division 4.1 of Part 4 of the EP&A Act. An environmental impact statement (EIS) is required to identify and assess potential impacts of the extension project on the environment. This biodiversity assessment supports the EIS.

This biodiversity assessment has been prepared to assess the impacts of the extension project on biodiversity and to identify measures to avoid, mitigate and/or) offset any potential impacts. This report has been prepared in accordance with the Office of Environment and Heritage (OEH) *Framework for Biodiversity Assessment* (2014) (FBA). As such, it follows the required format of the FBA and includes the calculation of credit requirements to compensate for the extension project's impacts that cannot be avoided or minimised.



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Regional setting

Gunlake Quarry
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Figure 1.1

1.2 The extension project

The extension project seeks to enable an increased rate of extraction to assist to meet the identified demand for construction materials, including quarried aggregate, for the local area and Sydney. Gunlake seeks a new development consent that allows:

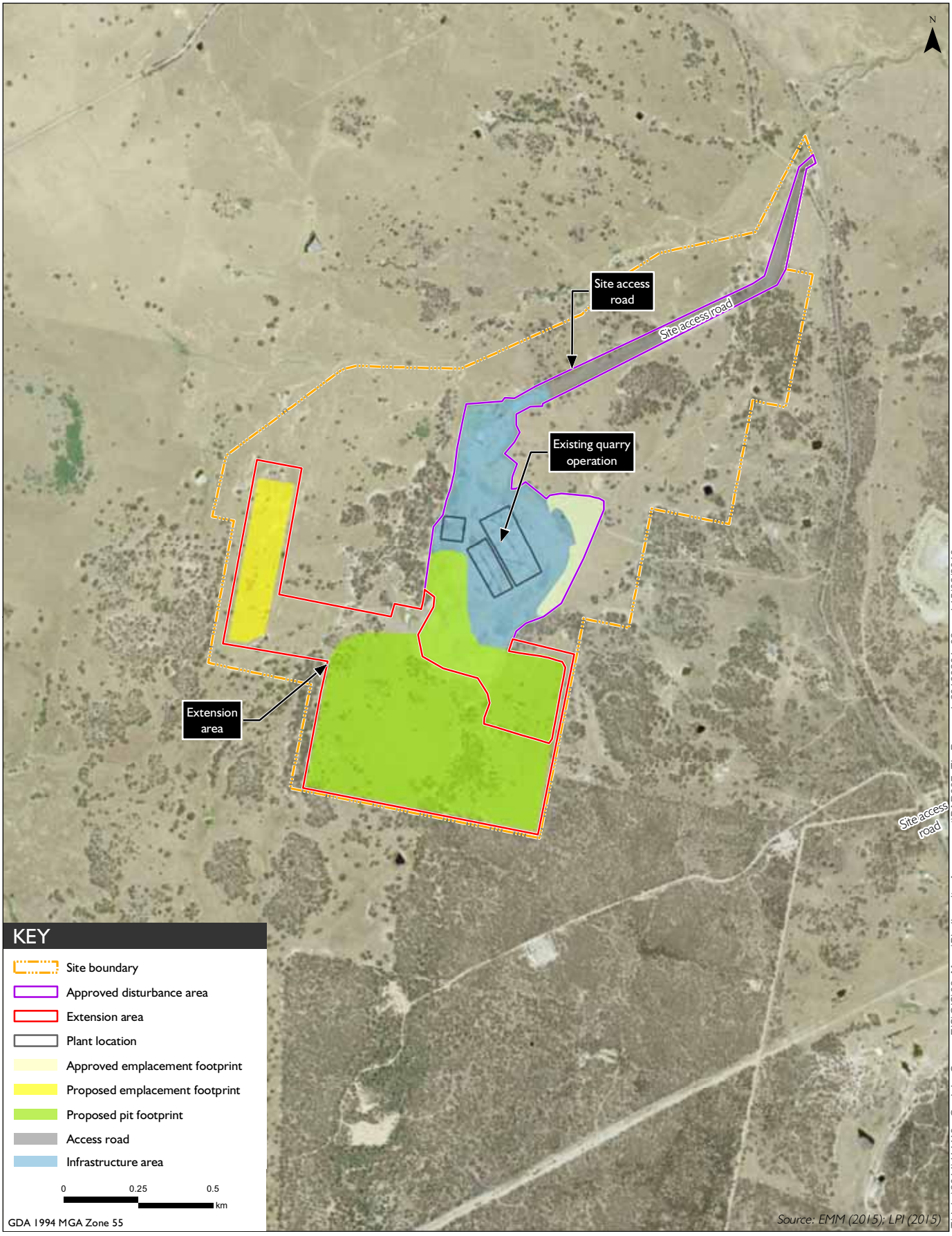
- 2 million tonnes per annum (Mtpa) of saleable products to be produced for 30 years;
- extension of the quarry pit footprint to approximately 49 hectares (ha);
- 24 hour (h) per day primary crushing;
- additional overburden emplacement to accommodate the increase in production;
- an increase in truck movements to an average of 440 movements per day; and
- blasting twice weekly.

In addition, Gunlake seeks to maintain the approval for all aspects of the existing operations under Proposal Approval 07-0074. The extension project area is shown in Figure 1.2.

1.3 Definitions

For the purpose of this report, the following definitions apply (Figure 1.2):

- Extension area: the area in which the extension project will occur, which is outside of the current area of quarry operations.
- Quarry site: the extension area and the approved quarry operations area.
- Study area: the area for which desktop assessments were completed and field assessments were undertaken. This encompasses the extension area, the remainder of the quarry site, and the potential offset areas.
- Locality: the wider locale beyond the study area. For the purposes of this assessment, the locality is the area within a 5 km radius of the centre of the study area.
- Region: the Eastern Highlands bioregion and the Bungonia sub-region as defined in An Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell 1995).



The Extension Project

Gunlake Quarry
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Figure 1.2

2 Methods

2.1 Desktop review

A range of databases, mapping, environmental assessment reports and relevant scientific literature were reviewed. A summary of the main documents reviewed and review outcomes are provided in the following sections.

2.1.1 Literature review

The following reports and mapping were reviewed:

- *Flora and Fauna Survey and Ecological Impacts Assessment Report: Proposed Hard Rock Quarry, Haul Road and Bypass Roads Near Marulan* (Ecotone 2008a);
- *Gunlake Quarry Proposal - Major Proposal Application 07-0074: Letter Report in response to comments by DECC* (Ecotone 2008b);
- *Extensions to Gunlake Quarry, Marulan: Supplementary Flora and Fauna Assessment* (Biosis 2014);
- *Gunlake Quarry Modification 2: Modification of Proposal Approval 07-0074 Response to Submissions* (EMM 2015a);
- *Threatened species profiles for the Hawkesbury Nepean CMA* (OEH 2013);
- *Terrestrial Vertebrate Fauna of the Greater Southern Sydney Region (DECC 2007A); and*
- *Native vegetation of southeast NSW* (Tozer et al 2010).

2.1.2 Database searches

Table 2.1 summarises the database searches and background research performed to identify threatened terrestrial and aquatic fauna species, important habitat for migratory species and critical habitats in and surrounding the extension area.

Table 2.1 Database search details

Source	Date	Search area
Atlas of NSW Wildlife www.environment.nsw.gov.au/atlasapp	7 April 2015	10 km radius
Threatened and protected species records viewer www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer	7 April 2015	Goulburn LGA
Protected Matters Search Tool www.environment.gov.au/webgis-framework-apps/pmst/pmst.jsf	7 April 2015	10 km radius
Critical habitat register www.environment.nsw.gov.au/criticalhabitat/CriticalHabitatProtectionByDoctype.htm	7 April 2015	Not applicable, as individual sites are listed as critical habitat in NSW
Australian Wetlands Database http://www.environment.gov.au/topics/water/water-our-environment/wetlands/australian-wetlands-database	7 April 2015	Names of local wetlands were searched

2.2 Field surveys

2.2.1 Previous surveys

The extension area and surrounds have been subject to a number of field surveys. These have included:

- comprehensive flora surveys of the originally proposed (and now approved) footprint on 15 and 16 January 2006 by Ecotone;
- comprehensive fauna surveys (Elliot trapping, hair tubes, diurnal bird census, diurnal reptile census, Koala scat search, dusk hollow watch, nocturnal playback and spotlighting, hand searches for frogs, harp trapping, ultrasonic call detection and habitat tree census) of the originally proposed footprint by Ecotone over 5 days and 4 nights in January 2007;
- flora survey on 22 August 2014 in the proposed (and now approved) Modification 2 footprint by Biosis; and
- bird surveys on 22 August, 29 August and 1 September 2014 in the Modification 2 footprint by Biosis.

Data from the previous surveys were used to identify the likelihood of threatened species occurring in the study area. These also formed the basis for the refinement of existing vegetation mapping.

2.2.2 EMM surveys

The following sections detail the surveys undertaken by EMM in the study area between December 2014 and March 2015. The surveys were completed over three survey events as detailed in Table 2.2 below. Weather conditions during the surveys are also included in the table.

Table 2.2 Overview of EMM surveys

Dates	Survey type	Min temp[1]	Max temp[1]	Rainfall (mm)[2]
5 December 2014	Preliminary site assessment, rapid vegetation assessments	7.6°C	29°C	13.2
12-13 January 2015	Floristic plots, targeted flora searches and reptile active searches	14.1°C	25.8°C	12.8
10-13 March 2015	Floristic plots, diurnal bird surveys, nocturnal bird and mammal surveys, nocturnal amphibian surveys, active reptile searches, anabat call detection and harp trapping	12.3°C	30.4°C	1.6

Notes: 1. Temperature data – minimum and maximum over survey period from Goulburn TAFE weather station.

2. Rainfall data – total over survey period from Marulan (Johnniefelds) weather station.

2.2.3 Preliminary site assessment

A preliminary site survey for the extension project biodiversity assessment was completed on 5 December 2014 to gain an appreciation of the vegetation and habitats present within the extension area and surrounds. This involved driving around the study area to identify the dominant species and habitat features in each part of Gunlake's property. The results informed the threatened species habitat assessment (Appendix A), determined targeted survey requirements and identified the broad vegetation types to determine the number of survey plots required in relation to the extension project.

2.2.4 Vegetation survey methods

Vegetation types were assessed in the field by EMM using a combination of plot-based surveys, rapid assessment surveys and native/exotic vegetation transects. Vegetation type boundaries were mapped either on foot or from a vehicle using a global positioning satellite (GPS) receiver, while referencing aerial photographs and topographic maps. Field based assessments were followed by historical and current aerial photograph interpretation (API) and analysis using a geographic information system (GIS) to create a comprehensive vegetation map of the extension area and broader study area.

Floristic and structural vegetation data was collected from five 20 m by 50 m nested quadrats and transects in accordance with the FBA. Thirteen plots were completed within the study area. As noted above, much of the vegetation within the extension area was surveyed previously as part of the original project application (Ecotone 2008a) and subsequent modifications (Biosis 2014 and EMM 2015). Figure 2.1 shows the flora survey locations completed for the current survey.

Site attributes recorded in the BioBanking plots and transects included:

- native plant species richness;
- percent cover of the native canopy, mid-storey and understorey;
- exotic plant cover;
- the number of trees with hollows;
- regeneration of canopy species; and
- the total length of fallen logs.

Rapid vegetation assessments were also completed to assist in defining the boundaries of vegetation types and determining grassland condition. At each rapid assessment location, the dominant flora species within each stratum were recorded, photographs were taken and any other points of interest were noted. Position in the landscape (eg slope, alluvial plain) and soils were also used to assist in determining vegetation type.

Vegetation types identified within the extension area were compared to the NSW Plant Community Types (PCT) Database (OEH 2015b). This comparison provided an appreciation of the vegetation types within the locality and region, benchmark condition and also an indication of the status in the IBRA subregion.

Vegetation plot data and rapid assessment data were reviewed against State and Commonwealth descriptions of Endangered Ecological Communities (EECs) and/or Critically Endangered Ecological Communities (CEECs) known from the region to determine their presence within the extension area. A comparison was also undertaken with published EEC species lists, habitat descriptions and distributions, and published identification guidelines.

The locations of vegetation communities and condition classes are shown in Figure 3.3.

2.2.5 Identification of groundwater dependent ecosystems

The *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources, Goulburn Fractured Groundwater Source* (NOW 2011) was reviewed to identify any high priority groundwater dependent ecosystems proximal to the extension area. The *Atlas of Groundwater Dependent Ecosystems* (BOM 2015) was also reviewed to identify ecosystems potentially reliant on groundwater that are close to the extension area.

The depth to groundwater and predicted drawdown were modelled in GIS for the extension area. The modelled groundwater depths were compared to the major surface geology types in the extension area to assist with identifying groundwater dependence. Native vegetation recorded in the area was then overlayed in GIS to determine which patches were potentially groundwater dependent (ie where shallow groundwater within 10 m of ground level is present).

2.2.6 Threatened species surveys

The field investigations were conducted in accordance with the NSW *Draft Guidelines for Threatened Species Assessment* (DEC & DPI 2005). The guidelines were complemented by information from threatened species profiles, and the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - working draft* (DEC 2004).

Where appropriate and available for the investigations, the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) threatened species survey guidelines were also used. These comprised:

- *Survey Guidelines for Australia's Threatened Birds* (SEWPaC 2011a);
- *Survey Guidelines for Australia's Threatened Mammals* (SEWPaC 2011b); and
- *Survey Guidelines for Australia's Threatened Reptiles* (SEWPaC 2011c).

i Targeted threatened flora searches

The results of the desktop study and preliminary site inspection identified threatened flora species to target during the surveys. Table 2.2 presents the list of threatened flora species previously recorded or predicted to occur within the study area, survey detection methods and timing. It also identifies if suitable habitat is present within the study area for each species. Flora search timing was completed to maximise the potential for identification of threatened flora species with the potential to occur.

Table 2.3 Target threatened flora survey methods and timing

Species	TSC Act status	EPBC Act status	Survey methods	Survey timing	Habitat present?
Austral Toadflax *Thesium australe*	-	V	Targeted search	Year round	Potential
Basalt Pepper-cress *Lepidium hyssopifolium*	-	E	Targeted search	Year round	Limited
Black Gum *Eucalyptus aggregata*	V	-	Targeted search	Year round	Limited
Camden Woollybutt *Eucalyptus macarthurii*	V	-	Targeted search	Year round	Limited
Hoary Sunray *Leucochrysum albicans* var. *tricolor*	-	E	Targeted search	November–January	Potential
Kangaloon Sun Orchid *Thelymitra kangaloonica*	-	CE	Targeted search	October–November	Unlikely
Kunzea cambagei	-	V	Targeted search	Year round	Unlikely
Omeo Stork's-bill *Pelargonium sp. striatellum*	-	E	Targeted search	November–December	Unlikely
Solanum celatum	E	-	Targeted search	August–January	Unlikely
Square Raspwort *Haloragis exalata* subsp. *exalata*	-	V	Targeted search	Year round	Limited
Tallong Midge Orchid *Genoplesium plumosum*	E	-	Targeted search	Late summer–autumn	Unlikely
Thick-lipped Spider-orchid *Caladenia tessellata*	-	V	Targeted search	September–November	Unlikely
Yellow Gnat-orchid *Genoplesium baueri*	-	E	Targeted search	February–March	Unlikely

Targeted searches for threatened flora were undertaken over 40 person hours within suitable habitats within the study area using systematic flora searches where suitable habitat was identified. Survey effort was based on the vegetation type and the likely presence of suitable habitats. Where a rare or threatened species was recorded, the following data was collected:

- number of individuals;
- reproductive status of the population (eg flowering/fruiting);
- the locations of each individual using a GPS (where individuals were less than one metre apart, a single point was recorded and the number of plants at that point noted);
- habitat features present (eg rocky outcrops and associated flora species);
- aspect and/or degree of slope;
- vegetation type; and

- threats (if any) and/or previous disturbances.

ii Targeted fauna species

Survey methods for fauna were determined following the results of the preliminary site visit and an assessment of the presence of suitable habitat (see Appendix A). Table 2.3 provides a list of threatened fauna species identified as having the potential to occur within the study area. It also includes an overview of survey methods and optimal timing for their detection.

Table 2.4 Targeted threatened fauna survey methods and timing

	Status				
Species	**TSC Act**	**EPBC Act**	**Survey methods**	**Survey timing**	**Habitat present?**
Fish					
Australian Grayling *Prototroctes maraena*	-	V	Habitat assessment	Year round	No
Macquarie Perch *Macquaria australasica*	-	E	Habitat assessment	Year round	No
Frogs					
Littlejohn's Tree Frog *Litoria littlejohni*	-	V	Nocturnal call surveys and active searches	Spring–summer	No
Reptiles					
Broad-headed Snake *Hoplocephalus bungaroides*	-	V	Spotlighting hollow trees	Summer	No
Striped Legless Lizard *Delma impar*	-	V	Rock turning and artificial shelter surveys	September–May	Moderate
Pink-tailed Worm-lizard *Aprasia parapulchella*	-	V	Rock turning	Year round - not hot days	Low
Birds					
Australasian Bittern *Botaurus poiciloptilus*	-	E	Wetland/waterbody search in morning/evening	Year round	Low
Australian Painted Snipe *Rostratula australis*	-	E	Searches in wetlands	Year round	Low
Brown Treecreeper (eastern subspecies) *Climacteris picumnus victoriae*	V	-	Timed area search, targeted search	Year round	Low
Diamond Firetail *Stagonopleura guttata*	V	-	Timed area search, targeted search	Year round	Moderate
Flame Robin *Petroica phoenicea*	V	-	Timed area search, targeted search	Year round	Moderate
Gang-gang Cockatoo *Callocephalon fimbriatum*	V	-	Timed area search, targeted search	Year round	Moderate
Glossy Black-Cockatoo *Calyptorhynchus lathami*	V	-	Timed area search, targeted search	Year round	No

Table 2.4 Targeted threatened fauna survey methods and timing

Species	Status		Survey methods	Survey timing	Habitat present?
	TSC Act	EPBC Act			
Hooded Robin (south-eastern form) *Melanodryas cucullata cucullata*	V	-	Timed area search, targeted search	Year round	Low
Little Eagle *Hieraaetus morphnoides*	V	-	Timed area search, targeted search	Year round	Moderate
Little Lorikeet *Glossopsitta pusilla*	V	-	Timed area search, targeted search	Year round	Moderate
Powerful Owl *Ninox strenua*	V	-	Spotlighting and call playback	Year round	Low
Regent Honeyeater *Anthochaera phrygia*	-	E	Timed area search, targeted search	Year round	Low
Scarlet Robin *Petroica boodang*	V	-	Timed area search, targeted search	Year round	Low
Speckled Warbler *Chthonicola sagittata*	V	-	Timed area search, targeted search	Year round	High
Swift Parrot *Lathamus discolor*	-	E	Timed area search, targeted search	March–July	No
Varied Sittella *Daphoenositta chrysoptera*	V	-	Timed area search, targeted search	Year round	Low
Bats					
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	V	-	Ultrasonic detection, harp trapping	October–March	Moderate
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	V	-	Ultrasonic detection, harp trapping	October–March	Moderate
Eastern Freetail-bat *Mormopterus norfolkensis*	V	-	Ultrasonic detection, harp trapping	October–March	Moderate
Greater Broad-nosed Bat *Scoteanax rueppellii*	V	-	Ultrasonic detection, harp trapping	October–March	Low
Grey-headed Flying-fox *Pteropus poliocephalus*	-	V	Spotlighting	Year round	Low
Large-eared Pied Bat *Chalinolobus dwyeri*	-	V	Ultrasonic detection, harp trapping	October–March	Low
Little Bentwing-bat *Miniopterus australis*	V	-	Ultrasonic detection, harp trapping	October–March	Low
Southern Myotis *Myotis macropus*	V	-	Ultrasonic detection, harp trapping	October–March	Moderate
Mammals					
Brush-tailed Rock-wallaby *Petrogale penicillata*	E	-	Search for scats and daytime searches	Year round	No
Koala *Phascolarctos cinereus*	V	V	Spot assessments and spotlighting/call playback	Year round	Low

Table 2.4 Targeted threatened fauna survey methods and timing

Species	Status		Survey methods	Survey timing	Habitat present?
	TSC Act	EPBC Act			
New Holland Mouse *Pseudomys novaehollandiae*	-	V	Elliot trapping	Year round	No
Spotted-tailed Quoll *Dasyurus maculatus maculatus*	V	E	Searches for habitat and signs, baited cameras	Year round	Low
Squirrel Glider *Petaurus norfolcensis*	V	-	Spotlighting/call playback	Year round	No
Yellow-bellied Glider *Petaurus australis*	V	-	Spotlighting/call playback	Year round	No

Notes: 1. TSC Act - Threatened Species Conservation Act 1995, EPBC Act - Environment Protection and Biodiversity Conservation Act 1999, V - vulnerable, E - endangered, CE - critically endangered, Mi - migratory.

iii Fauna habitat assessment

An assessment of fauna habitat types and habitat condition was undertaken at each plot location to determine appropriate locations for targeted sampling of fauna species. Specific habitat features that were searched for included:

- hollow-bearing trees, including stags;
- bush rock and rocky outcrops;
- logs and other artificial cover (eg discarded metal roofing etc);
- wetlands, streams, rivers, dams and other water bodies;
- nests, roosts, burrows and dens;
- glider feeding scars and Koala feed trees;
- chewed She-oak (*Allocasuarina spp*.) or Cypress Pine (*Callitris spp*.) cones;
- areas that could act as movement corridors for plant or animal species;
- winter-flowering eucalypts;
- permanent soaks and seepages; and
- scats.

Figure 2.1 shows the locations and the types of fauna surveys undertaken.

iv Targeted fauna survey methods

a. Amphibian surveys

Nocturnal call playback and active searches were used to identify amphibian species within and surrounding the extension area. Water bodies and creek lines were surveyed at night to identify frogs. Calls were identified onsite and if possible, frogs were located for visual confirmation of identification. Rocks and fallen timber were turned over to search for resting amphibians during the day.

b. Active reptile searches

Active reptile searches were targeted to reptile habitats including rocky outcrops and creeks. Reptile searches were conducted between 9:00 and 11:00am over four days to increase the likelihood of detection of different reptile species. Observations were made on rocky outcrops and along creeks by searching for basking reptiles. Rocks and fallen timber were also turned over to search for burrowing or resting reptiles. On warm nights, basking reptiles were surveyed by spotlighting large trees and dirt tracks. Identification of species was made in the field and taxonomy was as per Wilson and Swan (2010).

c. Bird surveys

Timed searches, 20 minutes in duration each, were used to survey diurnal (day active) birds at ten sites. Timed searches were extended to one person hour at sites where new species continued to be encountered.

The presence and abundance of all birds observed within the study area during the timed searches were recorded. Birds were identified visually, with the aid of binoculars or by call identification. Surveys commenced in the early morning, within an hour of sunrise when bird activity is greatest (Bibbly, Burgess and Hill 1992).

Nocturnal bird spotlighting surveys commenced at sunset (to capture species emerging from roost sites and hollows) during favourable weather (ie outside times of extreme wind during the survey period). Call broadcasting for threatened owl species was also conducted over three nights. Owl sign searches (eg pellets, wash on trees and used hollows) were completed during the fauna habitat assessments. Nocturnal surveys were completed in association with amphibian and spotlight surveys and encompassed the entire extension area and some of the offset areas, particularly the vegetated areas to the north and the north-east of the extension area.

d. Microbat surveys

Echolocation calls of microchiropteran bats (microbats) were recorded within representative habitat in the extension area and offset areas. Calls were recorded over the entire night using Wildlife Acoustics SM2Bat detectors. Detectors were located adjacent to harp traps and were placed in a total of three areas for two nights in each location, where possible.

Microbat sonograms were viewed in SongScope v4.1.3A (Wildlife Acoustics 2012), and were compared against local datasets to identify the species.

Harp traps were placed at three locations for a total of six trap nights. Traps were placed in suitable flyways throughout the study area to ensure that all major habitats were sampled. Individuals captured were identified to species level, together with other measurements and observations including age (canine wear), gender, sexual condition, weight, forearm length and ear length for Long-eared Bats (*Nyctophilus* spp.) as this is a character used to distinguish species.

e. Arboreal and ground-dwelling mammals

Spotlight searches were carried out for threatened nocturnal mammal, bird and frog species within the study area. Calls of the following nocturnal species were broadcast during the spotlighting to elicit responses:

- mammals: Koala, Yellow-bellied Glider, Squirrel Glider (*Petaurus norfolcensis*) and Koala; and
- nocturnal birds: Powerful Owl, Barking Owl (*Ninox connivens*), Masked Owl and Sooty Owl.

Opportunistic sightings of terrestrial mammal fauna were also recorded. Nocturnal surveys were conducted over a total of three nights. Where possible, nights with rainfall and greater moon influence were avoided as they are known to affect spotlight success (DEC 2004).

Opportunistic records of tracks, scats and signs (that indicate mammalian use of an area) were noted while completing other survey tasks. These tracks, scats and signs can sometimes lead to the identification of taxa to the species level and are therefore important presence indicators.

The spot assessment technique (SAT) (Phillips and Callaghan 2011) was used to assess the presence and activity level of Koalas within the study area at all plot locations that contained trees. In accordance with State Environmental Planning Policy 44 (SEPP 44), areas were identified as potential Koala habitat where feed trees listed in Schedule 2 of SEPP 44 comprised more than 15% of the total number of trees in the upper or lower strata of the tree component.

2.2.7 Survey effort summary

A summary of all survey methods, survey effort (ie number of hours spent surveying and number of plots surveyed) and survey timing is provided in Table 2.5.

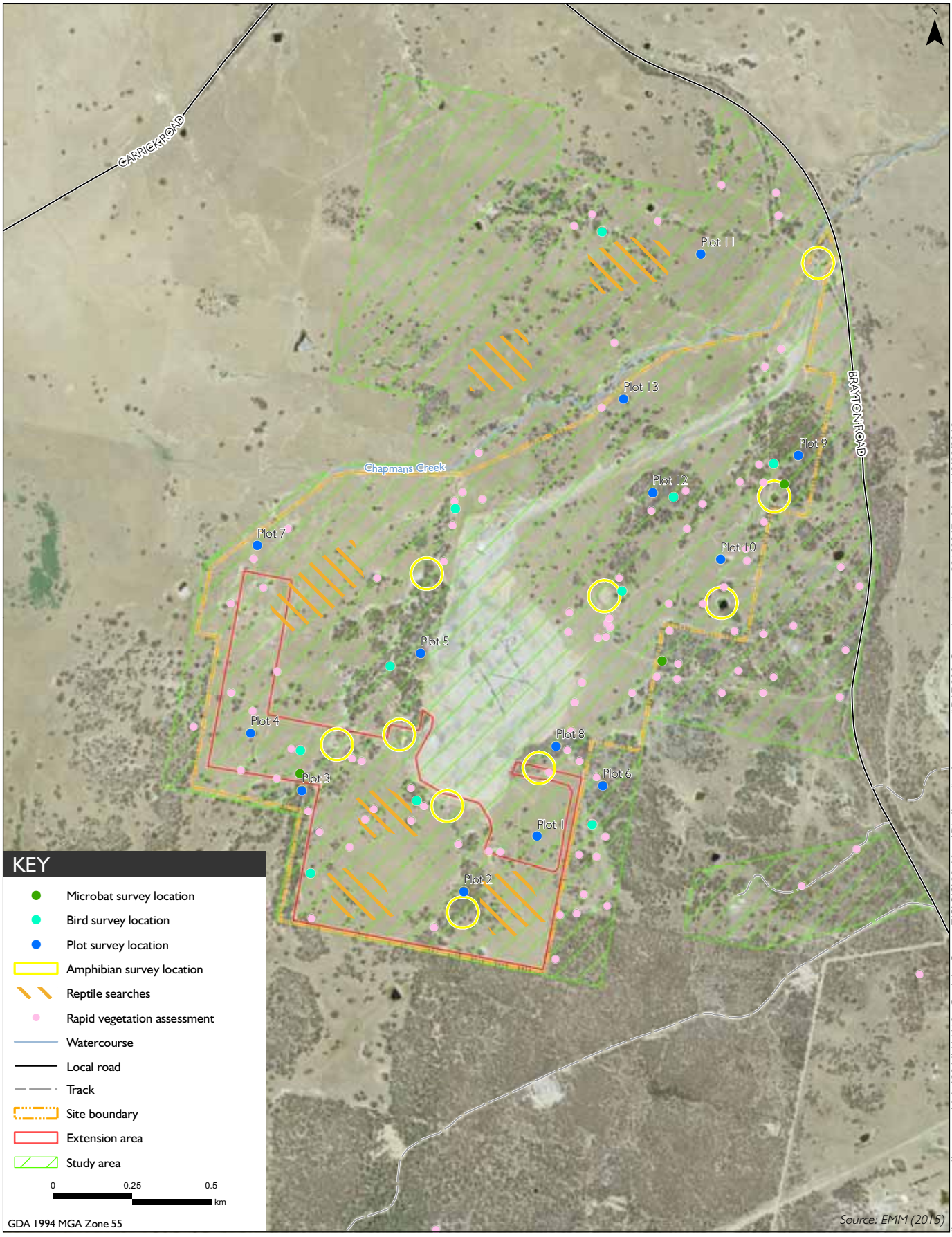
Table 2.5 Summary of survey effort

Taxa group	Survey method	EMM survey effort	Previous survey effort[1]
Flora	Plot and transect surveys	13 BioBanking plots	1 BioBanking plot (Biosis) 10 quadrats 20x20 m (Ecotone)
	Rapid vegetation assessments	Over 100 locations throughout the study area and surrounds	No rapid vegetation assessments completed
	Targeted threatened flora searches	6 days targeted searches in flowering period for Hoary Sunray	1 day targeted searches (Biosis) 2 days targeted searches (Ecotone)
Fauna	Habitat assessments and searches for signs	Surveys over 6 days by 2 people	Incidental observations over 5 days and hollow tree survey (Ecotone)
Frogs	Nocturnal searches and nocturnal call recognition	Surveys on 3 nights by 2 people	Surveys on 3 nights by 2 people (Ecotone)
Reptiles	Active search	Searches over 4 days by 2 people	1 hour diurnal survey (Ecotone)

Table 2.5 Summary of survey effort

Taxa group	Survey method	EMM survey effort	Previous survey effort[1]
Birds	Timed diurnal search	10 timed search areas over 3 days and incidental observations over 6 days by 2 people	Surveys on 3 days (Biosis) Nine 20 minute surveys (Ecotone)
Microchiropteran bats	Ultrasonic call detection	6 nights in 3 locations	4 nights in 8 locations (Ecotone)
	Harp trapping	6 trap nights in 3 locations	Up to 3 nights in 6 locations (Ecotone)
Koala	Spot assessment technique	Undertaken at each plot location with trees (8 spot assessments)	3 spot assessments (Ecotone)
Nocturnal birds, reptiles and mammals	Call broadcasting and spotlighting	Call playback and spotlighting on 3 nights by 2 people	Dusk hollow tree watch and call playback on 3 nights by 2 people (Ecotone)
	Mammal trapping	No trapping completed	3 trap lines, each with up to 10 ground and 10 tree Elliot traps (Ecotone) 4 lines of hairtubes (up to 8 tubes per line) (Ecotone)

Note: 1. See Section 2.2.1.



Survey locations

Gunlake Quarry
Biodiversity Assessment Report

Figure 2.1

3 Biodiversity values

3.1 Landscape features

Gunlake Quarry is in the southern highlands of NSW in the Goulburn Mulwaree Local Government Area (LGA), approximately 8 km north-west of Marulan (Figure 3.1).

The extension area and surrounds contain few areas of intact woodland vegetation, with most areas modified by historical agricultural use. Patches of remnant vegetation occur along drainage depressions and on slopes of lower agricultural utility. There are larger areas of remnant vegetation immediately to the south and south east of the Quarry and to the north-west across Carrick Road.

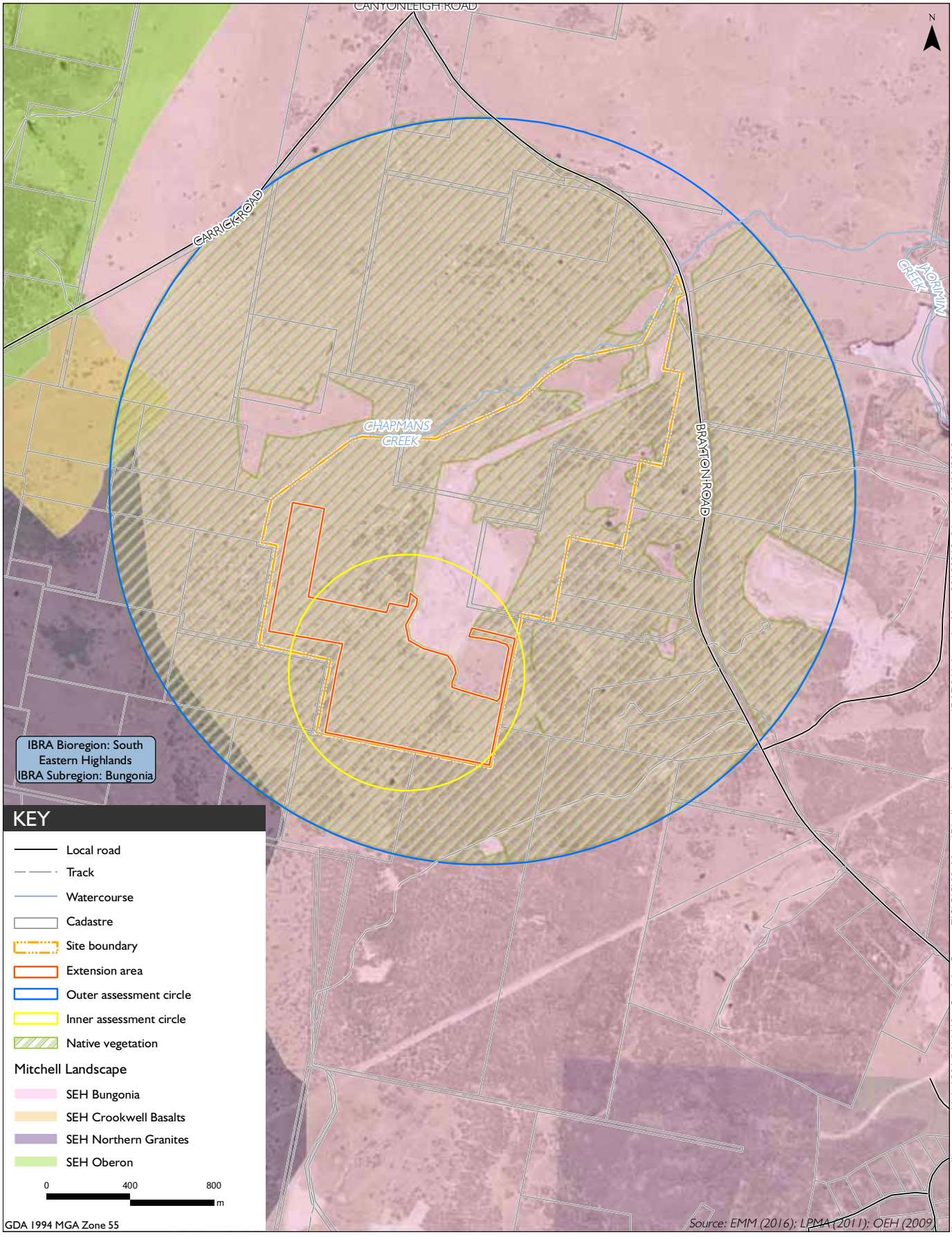
The Cookbundoon Nature Reserve occurs approximately 9 km to the west of the study area. The vegetation in the reserve is typically dry tableland communities, with a eucalypt-dominant canopy layer and sparse grassy or shrubby understorey. The majority of the reserve is dominated by Silvertop Ash (*Eucalyptus sieberi*) and Broad-leaved Peppermint (*E. dives*). Part of the eastern escarpment is characterised by Silvertop Ash, Blue-leaved Stringybark (*E. agglomerata*), Black She-oak (*Allocasuarina littoralis*) and Narrow-leaved Geebung (*Persoonia linearis*). The western lower slopes have areas with Brittle Gum (*E. mannifera*) and Broad-leaved Peppermint. Grey Gum (*E. punctata*) occurs along the western boundary in association with Blue-leaved Stringybark. A small area in the south-west is characterised by Red Stringybark (*E. macrorhyncha*), Inland Scribbly Gum (*E. rossii*) and Bundy (*E. goniocalyx*). Some areas associated with drainage lines have Snow Gum (*E. pauciflora*) and Candlebark (*E. rubida*) grassy woodlands. The reserve also has areas dominated by thick Allocasuarina regrowth (OEH 2014a).

The Quarry is in the Wollondilly – Bindook Tablelands and Gorges Mitchell Landscape (DECC 2002). This landscape is characterised by dissected tablelands, marginal gorges and scree slopes on massive Devonian quartz porphyry and small areas of massive Devonian granite. Soils contain thin gritty uniform profiles on steep slopes and around rock outcrops and grey and yellow texture-contrast profiles on flatter slopes. Woodland and open forest consist of Forest Red Gum (*Eucalyptus tereticornis*), Yellow Box (*Eucalyptus melliodora*), Grey Box (*Eucalyptus molucanna*), White Box (*Eucalyptus albens*), Black Wattle (*Acacia mearnsii*), Parramatta Wattle (*Acacia parramattensis*), Black She-oak (*Casuarina litoralis*) with numerous shrubs, Bracken (*Pteridium esculentum*) and grasses (DECC 2002).

The majority of the Gunlake property is characterised by pink (Joaramin) and blue (Barrillier) ignimbrite – the hard rock resource that is quarried. In the extension areas, particularly the pit extension area, rock outcropping is common with pink ignimbrite present. The soils in this area are very shallow and considered to be a Hydrosol, as the area was heavily waterlogged during the survey after only moderate summer rainfall. As such, these areas have low fertility.

3.1.1 IBRA bioregion

The Quarry is in the South Eastern Highlands bioregion, the Bungonia sub-region and the Hawkesbury/Nepean Catchment Management Area (CMA) region.



Location map
Gunlake Quarry
Biodiversity Assessment Report
Figure 3.1

3.1.2 Rivers and streams

Chapmans Creek and its tributaries are in the Quarry. Chapmans Creek is a second and third order stream through the Quarry. It flows north to the Wollondilly River. Soils along Chapman Creek and its tributaries are Quaternary alluvium. They are deeper and are more fertile than the surrounding slopes and hills. Within the Gunlake property, the riparian areas are dominated by Yellow Box (*Eucalyptus melliodora*) and Blakely's Red Gum (*E. blakelyi*) but also occasional Apple Box (*E. bridgesiana*) and Ribbon Gum (*E. viminalis*).

3.1.3 Wetlands

There are no wetlands within the study area. There are however a number of small dams, some with aquatic vegetation. There is a large dam on Joarimin Creek, approximately 2 km to the north-east of the Quarry.

3.1.4 Biodiversity links

The Chief Executive of the OEH has not approved any corridor plans in NSW. Therefore, no recognised state or regional biodiversity links are considered in this assessment.

3.2 Native vegetation

Historic aerial photographs of the study area were examined from the 1960's. The site was largely cleared of most vegetation by the 1960's, with paddock trees remaining in some areas. The areas mapped as woodland vegetation in the current study, generally correlate to the areas of remnant paddock trees where regeneration has occurred over the past 50 years (Figure 3.2). However, as much of the vegetation has regrown since this time, few trees in the study area are over-matured and contain hollows.

The study area and surrounds contain few areas of intact woodland vegetation, with most areas modified by historical agricultural use including clearing and grazing. The few remaining patches of remnant vegetation occur in drainage depressions and on slopes of lower agricultural utility in the study area. Large tracts of native vegetation also occur to the west and south of the quarry. Despite this, much of the grassland has not been substantially modified and mainly comprises native pasture, and has been included as native vegetation for the landscape value assessment (Figure 3.1).

The areas of native vegetation shown on Figure 3.1 have been verified in the study area and its surrounds. Historical aerial photographs were used to map the woodland communities to determine where derived native grasslands within the study area were most likely to occur and the original community from which these were derived (Figure 3.2). Regional vegetation mapping has been used where sites could not be accessed, and the topography, historical land use and API interpretation was used to delineate likely areas of disturbed and derived grassland communities.

Two native vegetation communities have been identified in the study area, a remnant floodplain community and a stringybark community on hillslopes. Disturbed grasslands, which are largely native pasture occur throughout. Some areas are derived from the floodplain community while the majority are derived from the stringybark community. Profiles for these vegetation communities are provided in the following sections.

3.2.1 Landscape value

The project is a site based development in the BioBanking Credit Calculator (BBCC). The landscape value has been calculated based on a range of input values including native vegetation, connectivity, patch size and the Mitchell landscape. These details are included in Table 2.1 below.

Table 3.1 Landscape value assessment

Value	Before development	After development	% Native score
Outer assessment circle	86-90%	76-80%	4.6
Inner assessment circle	76-80%	31-35%	
Connectivity value class	>100m-500m	0-5m	
Connectivity – overstorey condition	PFC at benchmark	PFC at benchmark	
Connectivity – mid/ground condition	PFC at benchmark	PFC at benchmark	
Mitchell Landscape	Wollondilly – Binbook Tablelands and Gorges		
Patch size	501		
Patch size score	12		

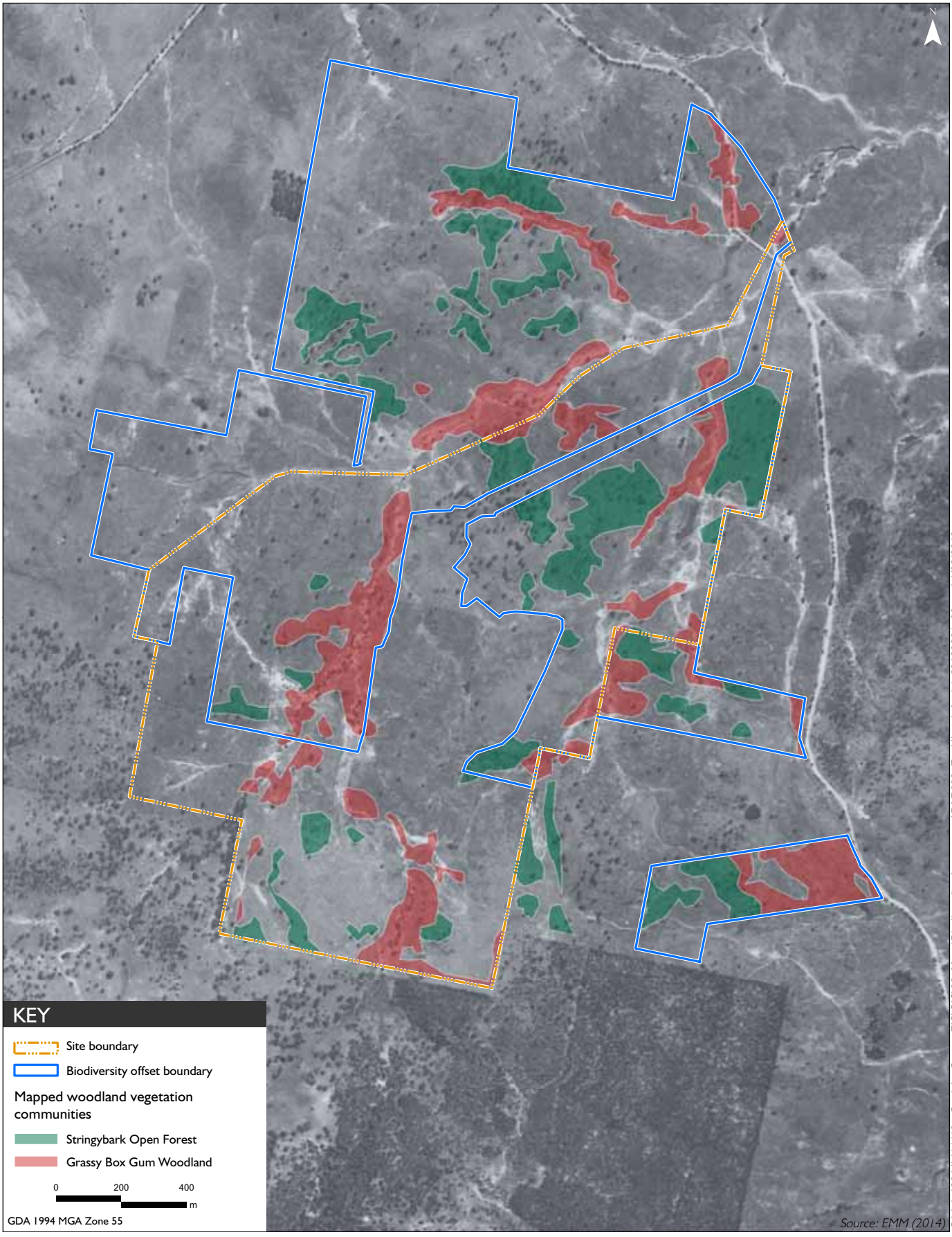
The connectivity value is based on the linkage of the southern part of the tributary connecting to Chapmans Creek that flows through the proposed extension area. This is considered to be the area where connectivity will be most affected by the proposal. It is assumed that the vegetation that will remain as part of this link (that is not be directly impacted by the project) will remain in benchmark condition after the extension project has been developed.

3.2.2 Plant Community Types

Two PCTs were recorded in the study area:

- Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands; and
- Broad-leaved Peppermint – Red Stringybark Grassy Open Forest and Derived Native Grassland (Figure 3.3).

These PCTs are described in detail in the following sections.



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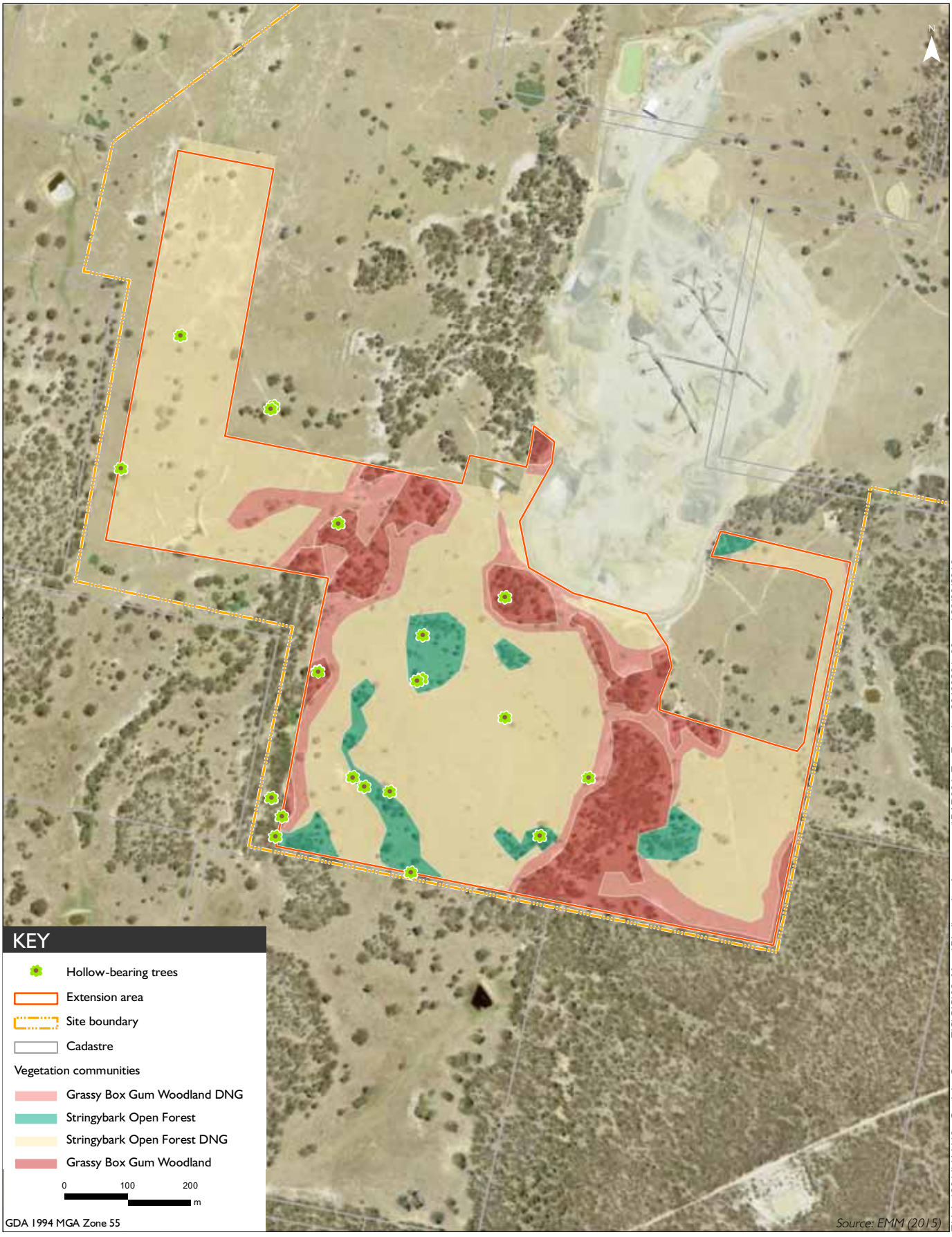
Historical aerial photograph

Gunlake Quarry
Biodiversity Assessment Report

Figure 3.2



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EMM

Mapped vegetation communities and condition classes

Gunlake Quarry
Biodiversity Assessment Report

Figure 3.3

i Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grasslands

Vegetation formation: Grassy Woodlands

Vegetation class: Southern Tableland Grassy Woodlands

BVT: HN614 Yellow Box - Blakely's Red Gum Grassy Woodland on the tablelands, South Eastern Highlands

PCT: 1330

Tozer et al (2010): GW p24 Tableland Grassy Box-Gum Woodland

Condition classes: This community occurs in two condition classes at the site: a woodland form and derived native grassland form

Conservation status: The woodland form of this community is consistent with White Box-Yellow Box-Blakely's Red Gum Woodland EEC

Estimate of percent cleared: 90%

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	16–25 m	13–29%	*Eucalyptus blakelyi, E. melliodora, E. bridgesiana, E. viminalis, E. amplifolia and E. eugenioides*
Small trees	2–10 m	5–15%	*Eucalyptus blakelyi, E. melliodora and E. eugenioides*
Shrubs	n/a		
Ground covers	0–0.3 m	20–90%	*Microlaena stipoides var. stipoides, Bothriochloa macra, Nassella trichotoma*, Hypochaeris radicata*, Chrysocephalum apiculatum, Lomandra filiformis subsp. coriace and Asperula conferta*
Vines & climbers	n/a	2–5%	*Glycine clandestina and Einadia nutans*

*Note: *introduced species.*

Description: The community occurs on loamy soils on undulating terrain between 500 and 900 m Australian height datum (AHD) on the tablelands. Within the study area, the community occurs on loamy alluvial soils associated with Chapmans Creek and its tributaries. It occasionally also occurs in drainage depressions and drainage lines with deeper loamy soils on slopes.

The community forms woodland with a sparse shrub layer and a dense (and diverse in places) grassy groundcover. The canopy has been selectively logged throughout the study area and is either dominated by Blakely's Red Gum (*Eucalyptus blakelyi*), Yellow Box (*E. melliodora*), Apple Box (*E. bridgesiana*) and occasional Ribbon Gum (*E. viminalis*). Patches of Cabbage Gum (*E. amplifolia*) also occur in some locations. Where the community integrades with Broad-leaved Peppermint - Red Stringybark Grassy Open Forest on rocky shallow soils, Narrow-leaved Stringybark (*E. eugenioides*) increases in abundance and is a co-dominant in some locations. Where this occurs, the soils and position in the landscape were used to map the community's boundary.

The diverse groundlayer contains an array of grasses, herbs and forbs. Dominant grasses included Weeping Grass (*Microlaena stipoides var. stipoides*), Red-legged Grass (*Bothriochloa macra*), Speargrass (*Austrostipa scabra*) and Wallaby Grass (*Rytidosperma laeve*), while dominant forbs and herbs included Rock Fern (*Cheilanthes sieberi*), Yellow Buttons (*Chrysocephalum apiculatum*), Stinking Pennywort (*Hydrocotyle laxiflora*), Wattle Mat-rush (*Lomandra filiformis subsp. coriacea*), Climbing Saltbush (*Einadia nutans*), Forest Nightshade (*Solanum prinophyllum*), Kidney Weed (*Dichondra repens*), Creeping Cudweed (*Euchiton japonicus*), Common Woodfruff (*Asperula conferta*), Austral Bears-ear (*Cymbonotus lawsonianus*), *Dysphania pumilio* and Native Geranium (*Geranium solanderi*).

In some locations, few forbs remain and the groundlayer is dominated by native, and introduced grasses including Serrated Tussock (*Nassella trichotoma*) with some weeds present, particularly Catsear (*Hypochaeris radicata*) but also including Whitetip Nightshade (*Solanum chenopodioides*), Brazilian Whitlow (*Paronychia brasiliana*) and Sheep Sorrel (*Acetosella vulgaris*).

The derived grassland form of the community is dominated by native grasses, with some native forbs and herbs present. In most areas however, there are also a number of pasture weeds with patches of Serrated Tussock.

Photograph 3.1 **Yellow Box - Blakely's Red Gum Grassy Woodland (top left) and derived native grassland (top right), along Chapmans Creek (bottom left and right)**

ii Broad-leaved Peppermint - Red Stringybark Grassy Open Forest and Derived Native Grassland

Vegetation formation: Grassy Woodlands

Vegetation class: Southern Tableland Grassy Woodlands

BVT: HN514 Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands

PCT: 734

Tozer et al (2010): GW p23 Tableland Hills Grassy Woodland

Condition classes: This community occurs in two condition classes at the site: a woodland form and derived native grassland form

Conservation status: None

Estimate of percent cleared: 80%

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	12–25 m	10–42%	*E. eugenioides*, *E. cinerea, E. bridgesiana*
Small trees	2–10 m	0–10%	*E. eugenioides*
Shrubs	0.3–0.5 m	0–20%	*Daviesia ulicifolia, Acacia mearnsii and Leptospermum parvifolium*
Ground covers	0–0.3 m	60–80%	*Aristida ramose, Panicum effusum, Hibbertia obtusifolia, Gonocarpus tetragynus, Phyllanthus hirtellus, Goodenia hederacea, Fimbristylis dichotoma, Melichrus urceolatus and Veronica plebeia*
Vines & climbers	n/a	0–5%	*Glycine microphylla*

Description: This community is an open forest with a sparse shrub layer and grassy groundcover. It is known to occur on undulating hills between 550 and 1,100 m AHD from the western Blue Mountains to near Braidwood. Within the study area, the community is typically found on the mid-slopes on skeletal soils on granite, with rock outcropping present.

Narrow-leaved Stringybark (*E. eugenioides*) is the dominant canopy species in this community within the study area. Argyle Apple (*E. cinerea*) and Apple Box co-dominates in some locations, generally along drainage depressions on higher slopes. The community can also contain the occasional Yellow Box (but not a dominant canopy species), particularly where it integrades with Yellow Box - Blakely's Red Gum Grassy Woodland on lower slopes.

Surrounding the study area, such as along Brayton Road to the south of the quarry entrance, the community is co-dominated by Brittle Gum (*Eucalyptus mannifera*) and Narrow-leaved Stringybark. Some Broad-leaved Peppermint (*Eucalyptus dives*) was also recorded in the north of the study area in this community. Previous surveys in the area (Ecotone 2008a and Biosis 2015) identified Red Stringybark (*E. macrohyncha*) in this community, however this species was not recorded during the most recent EMM surveys.

The community is generally shrubby, however grazing appears to have removed the shrub layer in some areas. Typical shrub species include *Leptospermum parvifolium*, Gorse Bitter Pea (*Daviesia ulicifolia*), Prickly Moses (*Acacia ulicifolia*) and Black Wattle (*Acacia mearnsii*). The understorey is diverse with grasses including Purple Wiregrass (*Aristida ramosa*), Wallaby Grass (*Rytidosperma fulvum*), Shorthair Plumegrass (*Dichelachne micrantha*), Hairy Panic (*Panicum effusum*), Red-leg Grass and *Austrostipa rudis subsp. rudis,* and forbs and herbs including Hoary Guinea Flower (*Hibbertia obtusifolia*), *Gonocarpus tetragynus*, Thyme Spurge (*Phyllanthus hirtellus*), Wattle Mat-rush, Forest Goodenia (*Goodenia hederacea*), Common Fringe-sedge (*Fimbristylis dichotoma*), Tufted Bluebell (*Wahlenbergia communis*), Star Cudweed (*Euchiton japonicus*), Slender Wire Lily (*Laxmannia gracilis*), Rock Fern, Urn Heath (*Melichrus urceolatus*), Native Cranberry (*Astroloma humifusum*), Stinking Pennywort and Trailing Speedwell (*Veronica plebeia*).

Common exotic species recorded in this community include Catsear, Serrated Tussock, Fleabane (*Conyza sp.*), Sheep Sorrel, Whitetip Nightshade, Blackberry (*Rubus fruticosis sp.agg*), White Clover (*Trifolium repens*), Sowthistle (*Sonchus asper*) and Plantain (*Plantago lanceolata*).

The derived grassland of this community lacks the canopy and shrub layers and generally contains larger quantities of weeds. Dominant grasses in such areas include Purple Wiregrass, Hairy Panic and Red-leg Grass.

Photograph 3.2 **Broad-leaved Peppermint - Red Stringybark Grassy Open Forest: Argyle Apple dominated in deeper soils (left), Narrow-leaved Ironbark dominated on shallow soils with granite outcropping (right)**

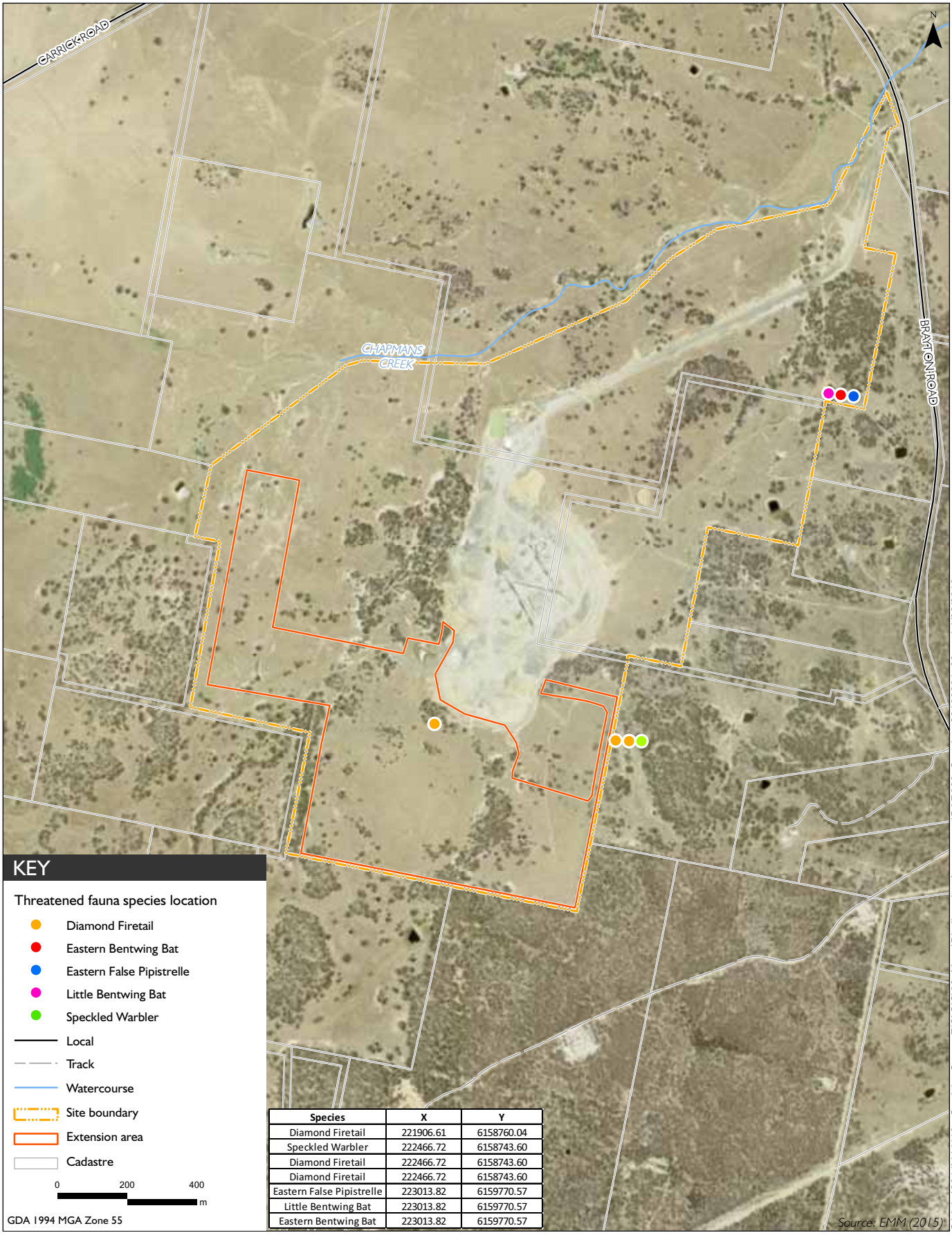
Photograph 3.3 **Derived native grassland with embedded rocks (left) and Narrow-leaved Ironbark on lower slopes with rock outcropping (right)**

3.2.3 Vegetation zones

Four vegetation zones occur in the study area. A summary of these is provided in Table 3.1 and shown in Figure 3.4. The site value score is based on the transect data which is compared with benchmark values for each vegetation type. Transect data is included in Appendix C.

Table 3.2 **Vegetation zone summary**

Vegetation zone	PCT	Condition class	Site value	Plots/transects required	Plots/transects completed	Area (ha)
1	Yellow Box - Blakely's Red Gum Grassy Woodland (PCT1330)	Moderate/Good	64.49	3	4	8.40
2	Yellow Box - Blakely's Red Gum Grassy Woodland (PCT1330)	Moderate/Good _Derived native grassland	31.88	3	4	7.00
3	Broad-leaved Peppermint - Red Stringybark Grassy Open Forest (PCT734)	Moderate/Good	67.39	1	4	3.80
4	Broad-leaved Peppermint - Red Stringybark Grassy Open Forest (PCT734)	Moderate/Good _Derived native grassland	26.09	4	4	34.90



Species	X	Y
Diamond Firetail	221906.61	6158760.04
Speckled Warbler	222466.72	6158743.60
Diamond Firetail	222466.72	6158743.60
Diamond Firetail	222466.72	6158743.60
Eastern False Pipistrelle	223013.82	6159770.57
Little Bentwing Bat	223013.82	6159770.57
Eastern Bentwing Bat	223013.82	6159770.57

Recorded threatened fauna species

Gunlake Quarry
Biodiversity Assessment Report

Figure 3.4

3.2.4 Endangered ecological communities

The quarry is within the Bungonia sub-catchment of the Hawkesbury Nepean Catchment Management Authority (CMA). There are four EECs listed under the TSC Act that have the potential to occur within the whole of the Bungonia sub-catchment (OEH 2015b). Only one of these communities, White Box Yellow Box Blakely's Red Gum Woodland, hereafter referred to as Box Gum Woodland, has the potential to occur within the study area, where it was previously recorded by Ecotone (2008a).

The Yellow Box – Blakely's Red Gum Grassy Woodland PCT recorded in the study area was assessed against the NSW Scientific Committee final determination for the Box Gum Woodland EEC listed under the TSC Act. The Yellow Box – Blakely's Red Gum Grassy Woodland and associated derived native grasslands community is considered to constitute Box Gum Woodland EEC as it:

- occurs on relatively fertile soils on the tablelands at an altitude of 170 to 1200 m AHD, within the Sydney Basin Bioregion;
- contains at least one of the characteristic tree species (Yellow Box or Blakely's Red Gum) as a dominant;
- contains a native grassy and herbaceous ground layer;
- would respond to assisted natural regeneration (natural soil and associated seed bank are still at least partially intact); and
- contains a number of characteristic species from the final determination.

White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grasslands is listed as a CEEC under the EPBC Act (hereafter referred to as Box Gum Woodland CEEC). The community as listed under the EPBC Act is slightly different to the community listed under the TSC Act.

Under the EPBC Act, the Box Gum Woodland CEEC is characterised by an understorey of tussock grasses, herbs and shrubs and dominated by White Box, Yellow Box or Blakely's Red Gum. The tree-cover is generally discontinuous and consists of trees of medium height with clearly separated canopies (TSSC 2006). The listed community occurs in areas where rainfall is between 400 and 1,200 mm per annum, on moderate to highly fertile soils at altitudes of 170 m to 1,200 m (TSSC 2006).

To qualify as the community under the EPBC Act, patches of woodland must fulfil certain criteria. The criteria include:

1. the most common overstorey species is either White Box, Yellow Box or Blakely's Red Gum currently or previously;
2. a predominantly native understorey;
3. patch size greater than 0.1 ha; and
4. 12 or more native understorey species present (excluding grasses) with at least one important species, or a patch size greater than 2 ha (TSSC 2006).

The woodland form of the Yellow Box - Blakely's Red Gum Grassy Woodland community within the study area meets the above description of the Commonwealth-listed Box Gum Woodland CEEC.

The derived native grassland form of the community does not meet criteria 1 as it does not contain any canopy species. The derived native grassland meets criteria 2 and 3 listed above as the understorey is predominantly native and the patch size exceeds 0.1 ha. However, they do not meet criteria 4 as the derived native grasslands do not contain 12 or more native understorey species (excluding grasses) or one important species. Therefore, the derived native grassland does not meet the TSSC (2006) description of the listed community. However, as these derived native grasslands are listed under the TSC Act, they have been included in the BioBanking calculations as part of the NSW-listed species and appropriate offsets will be identified to compensate for impacts to these areas.

The derived native grasslands of both vegetation communities were also compared to the Commonwealth listing advice for Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT (ESSS 2000) and the description of the community in the National Recovery Plan (Environment ACT 2005). To meet the listing criteria for the community, it must be/contain:

- located at altitudes between 560 and 1200 metres in valleys influenced by cold air drainage and in broad plains and within the area southwards from the Abercrombie River to the Victorian Border, from Boorowa and Jindabyne to the west and Goulburn to Braidwood and Bombala to the east;
- dominated by moderately tall (25-50 cm) to tall (50 cm-1.0 m), dense to open tussock grasses with up to 70% of the species being forbs;
- dominated by native grasses and/or native forbs (ie more than 50% total vegetative cover, excluding introduced annuals);
- a diversity of native herbaceous plants (forbs), which may comprise up to 70% of species; and
- the dominant grasses are Kangaroo Grass (*Themeda australis*), Wallaby Grasses (*Rytidosperma* spp), Speargrasses (*Austrostipa* spp), Red-leg Grass (*Bothriochloa macra*) and Snowgrasses (*Poa* spp).

Although the study area occurs within the altitude range of the community (approximately 700 m elevation), it occurs outside the known range of the community, ie it is north-east of Goulburn, Braidwood and Bombala. Although more than 50% of the total vegetative cover is dominated by native grasses, native forbs only comprise between 10–26% of the species in the community. Additionally, the dominant native grass in the community is Weeping Meadow Grass (*Microlaena stipoides* var. *stipoides*). For these reasons, derived native grasslands in the study area do not meet the listing criteria for Natural Tem Temperate Grassland of the Southern Tablelands of NSW and the ACT (ESSS 2000).

3.2.5 Noxious weeds

The following exotic species recorded within the study area are listed as noxious weeds in the local control area:

- Serrated Tussock (*Nassella trichotoma*);
- African Lovegrass (*Eragrostis curvula*);
- Fireweed (*Senecio madagascariensis*); and
- Blackberry (*Rubus fruticosus* spp. aggregate).

All of the above are Class 4 weeds within the Goulburn Mulwaree local control area. Under the NSW *Noxious Weeds Act 1993* landowners have a legal obligation to manage the growth of a Class 4 weed in a manner that reduces its numbers, spread and incidence, and continuously inhibits its reproduction.

Blackberry, Fireweed and Serrated Tussock are also listed as weeds of national significance (WoNS) due to their invasiveness, impacts on primary production and the environment, potential for spread and socio-economic impacts. Individual landowners and managers are ultimately responsible for managing WoNS, while state and territory governments are responsible for overall legislation and administration.

3.3 Threatened species

3.3.1 Fauna and fauna habitat

Fauna diversity in the extension area is considered to be representative of an agricultural area, with the majority of species recorded being highly mobile such as birds and microbats. The vegetated drainage lines and remnant vegetation adjoining surrounding properties provides significant fauna habitat for a range of common and threatened fauna species. A total of 103 native fauna species have been recorded in the study area during previous surveys and the survey for the current assessment.

i Broad habitat types

The fauna habitats within the study area were identified within each of the three broad vegetation types present:

- Broad-leaved Peppermint - Red Stringybark Grassy Open Forest on slopes;
- Box Gum Woodlands; and
- Native Grasslands.

The following sections describe the fauna habitat resources that each of these vegetation types provides, and the fauna species predicted to use these areas.

a. Broad-leaved Peppermint - Red Stringybark Grassy Open Forest

Broad-leaved Peppermint - Red Stringybark Grassy Open Forest is the dominant community in the study area and surrounds. This habitat occurs on gentle midslopes to steep upper slopes. Canopy species include Narrow-leaved Ironbark, Argyle Apple and Apple Box, which flower in spring/summer. Habitat also includes shrubs and abundant herbs, forbs and grasses. These provide abundant food resources for insectivorous birds such as the Yellow Thornbill (*Acanthiza nana*), Striated Pardolote (*Pardalotus striatus*) and the threatened Speckled Warbler (*Pyrrholaemus sagittatus*).

Broad-leaved Peppermint - Red Stringybark Grassy Open Forest generally contain embedded rocks and rock piles which provide shelter habitat for common reptile species such as the Garden Skink (*Lampropholis guichenoti*). These areas also provide potential habitat for threatened reptile species such as the Pink-tailed Worm-lizard (*Aprasia parapulchella*) and Striped Legless Lizard (*Delma impar*), however these were not recorded at the site during targeted surveys and are not known to occur in the locality.

The Stringybark Open Forest areas contain few hollow-bearing trees and fallen timber. The absence of these resources limits the habitat value of the Stringybark Open Forest in the local landscape.

b. Box Gum Wodlands

The Box Gum Woodlands habitat occurs in the lower lying parts of the study area, usually in association with creeks or drainage lines on deeper alluvial soils. Given the loamy soils, these areas contain numerous Wombat (*Vombatus ursinus*) burrows. The canopy species of this habitat type include Yellow Box, Blakely's Red Gum, Apple Box and occasional Ribbon Gum and Cabbage Gum.

The Box Gum Woodlands contain some large hollow-bearing trees which provide shelter and breeding opportunities for hollow dependent mammals, reptiles, amphibians and birds. Fallen timber is also a more dominant feature of this habitat type, compared with the Broad-leaved Peppermint - Red Stringybark Grassy Open Forest. Fallen timber provides potential foraging habitat for insectivorous birds and shelter opportunities for reptiles such as the Red-bellied Black Snake (*Pseudechis porphyriacus*).

Water resources within the Box Gum Woodlands include Chapmans Creek which contains deeper pools that retain water, as well as a number of dams throughout the study area. Such features provide water resources to fauna in the locality. In particular, significant microbat activity was recorded around one of the dams within the study area.

c. Native Grasslands

Native grasslands occur in areas that have been cleared of canopy species and used for grazing in the study area. This habitat type is characterised by tussock grasses and forbs, which provide habitat opportunities for granivorous and ground-feeding birds including the Red Rumped Parrot (*Psephotus haematonotus)* and threatened Diamond Firetail (*Stagonopleura guttata*).

Isolated dead stags in grassland areas often contain hollows and fissures providing roosting and breeding habitat for a range of bird and bat species such as the Chocolate Wattled Bat (*Chalinolobus morio),* Lesser Long-eared Bat (*Nyctophilus geoffroyi)* and Eastern Rosella (*Platycercus eximius).*

3.3.2 Pest species

Several pest fauna species were recorded during the surveys, including the European Red Fox (*Vulpes vulpes*, with individuals sighted at a number of locations throughout the study area, and the Rabbit (*Oryctolagus cuniculus*), which appeared to be common throughout the study area. Previous surveys also recorded the Brown Hare (*Lepus capensis*) and small flocks of Common Starlings (*Sturnus vulgaris*).

Livestock grazing over much of the extension area are considered to be a greater impediment to improving biodiversity values than any of the pest species identified.

3.3.3 Habitat linkages

No identified biodiversity links have been mapped in proximity to the study area.

There are large patches of remnant vegetation south, north-west and north-east of the study area. However, none of these areas are protected and may be subject to grazing and other agricultural activities. The vegetation in the study area is connected to the vegetation to the south by the riparian zones, forming a narrow (100–200 m) corridor. The study is not connected to vegetation to the north-east or north-west as it is separated by agricultural areas which have been cleared.

The main local habitat corridors surrounding the study area run north to south and west of the Quarry along Chapmans Creek and to the east of the Quarry where remnant Broad-leaved Peppermint - Red Stringybark Grassy Open Forest occurs. These links are not entirely vegetated, with agricultural paddocks and fences for fauna to negotiate over the length of the corridors.

3.3.4 Previously recorded threatened species

A list of threatened species likely to occur in the extension area was compiled based on the results of the literature review, database searches and consultation. This was used to develop the field methods for threatened flora and fauna (Appendix A).

A total of 51 threatened species have been recorded, or are predicted to occur, within 10 km of the extension area, including:

- thirteen plant species;
- two fish species;
- one amphibian species;
- three reptile species;
- seventeen bird species; and
- fifteen mammal species.

The Ecotone (2008a) surveys at the quarry site identified two threatened birds (Speckled Warbler (*Chthonicola saggittata*) and Little Lorikeet (*Glossopsitta pusilla*)) and two threatened microbats (Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)). The surveys also recorded threatened species in the locality, along the Bypass Road/Red Hills Road (which is outside the study area, about 3 to 6 km from it), including the Southern Myotis (*Myotis macropus*), Scarlet Robin (*Petroica multicolor*), Little Eagle (*Hieraeetus morphnoides*) and Varied Sittella (*Daphoenositta chrysoptera*) (Ecotone 2008a).

3.3.5 Species predicted to occur

Predictive modelling from the Protected Matters Search Tool (DoE 2015) indicates that 13 flora, 18 fauna, 12 migratory and five EECs listed under the EPBC Act as Matters of National Environmental Significance (MNES) have the potential to occur within 10 km of the extension area (refer Appendix A).

3.3.6 Ecosystem credit species

Six ecosystem credit species were identified during the EMM 2015 surveys of the extension area. A description of these is provided in the following sections and the locations of records are provided in Figure 3.3.

A Square-tailed Kite (*Lophoictinia isura*) was recorded flying over the site looking for prey. It roughly followed the drainage lines of the site and was only identified on one occasion over the survey period. No nests indicative of the species were identified in the study area, potential offset areas or surrounding vegetation. As such, it is likely to be hunting at the site as part of a large home range.

A pair of Speckled Warblers was identified in a small gully adjacent to the extension area. The species nests in a slight hollow in the ground or at the base of a low dense plant, often among fallen branches and other litter. No nests were identified, however given their sedentary behaviour (occupying a breeding territory of about 10 ha, with a slightly larger home-range when not breeding), it is likely that the species uses the study area for breeding as well as foraging habitat. Speckled Warblers are insectivorous and require large undisturbed remnants.

A pair of Diamond Firetails (*Stagonopleura guttata*) was recorded in the same area of habitat as the Speckled Warblers. The species was also recorded in the riparian corridor near the extension area. This species is considered to be sedentary and is therefore likely to be breeding and foraging in the study area and its surrounds. Diamond Firetails forage on seeds in grassy woodlands, building nests in shrubs or high in the canopy of trees.

The bat detector recorded three threatened microbat species: the Eastern Bentwing Bat, Eastern False Pipistrelle and Little Bentwing Bat (*Miniopterus australis*). The Eastern False Pipistrelle is a hollow-roosting species and is likely to use the area as foraging habitat, as they prefer tall, moist forest for breeding and forage in more open country in autumn when it was recorded. The Eastern Bentwing Bat and Little Bentwing Bat are cave-roosting species and are known to roost and breed nearby in karst systems in Bungonia and (in the case of the Little Bentwing Bat) in the nearby sandstone cliffs of Cookbundoon Nature Reserve. The extension area would only represent foraging habitat for these species.

In addition to the species recorded during the recent surveys, previous surveys recorded the Little Lorikeet in the study area. This species travels in feeding flocks (10 were recorded in the study area previously), sometimes over large distances in search of flowering trees. Given the species absence during the recent surveys, it is likely that the site is only used as part of a much larger foraging area, when eucalypts are flowering.

Previous surveys also recorded several species along the Bypass Road/Red Hills Road, about 3 to 6 km from the study area. These were the Southern Myotis, Scarlet Robin, Little Eagle and Varied Sittella. The extension area provides potential foraging habitat for all of these species.

Potential habitat also occurs within the extension area for other woodland bird species not recorded during the surveys, such as the Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*).

3.3.7 Species credit species

No species credit species were recorded in the study area or were considered likely to occur in the extension area.

However, potential habitat occurs in the extension area and elsewhere within the study area for the Striped Legless Lizard. Despite targeted surveys, the Striped Legless Lizard was not recorded in the study area, although they are known to be cryptic and difficult to detect. A precautionary approach was taken for this species, and species credits were generated to compensate for any impact on potential habitat.

i Koala Habitat Assessment

State Environmental Planning Policy 44 - Koala Habitat Protection (SEPP 44) defines Koala habitat as:

- potential Koala habitat: areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component; and

- core Koala habitat: an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

One feed tree species listed in Schedule 2 of SEPP 44, Ribbon Gum (*E. viminalis*), occurs as an occasional tree in the Box Gum Woodland areas along the creek lines in the extension area and elsewhere within the study area. Ribbon Gums in the study area would not provide potential Koala habitat under the SEPP definition, as less than 15% of the canopy is dominated by the species.

The study area is within both the Southern and Central Coast Koala Management Areas. The following species are listed as important species for the Koala in these Management Areas:

- primary feed trees: Cabbage Gum (*Eucalyptus amplifolia*) and Ribbon Gum;
- secondary feed trees: Yellow Box (*E. melliodora*), Apple-topped Box (*E. bridgesiana*) and Bundy (*E. goniocalyx*); and
- supplementary feed trees: Thin-leaved Stringybark (*E. eugenioides*).

There are few of the above potential Koala feed trees in the extension area, and no Koalas were recorded in the study area during the surveys. In addition, there are no Koala records within a 5 km radius of the extension area or broader study area; however there are records nearby in the Tarlo River NP, along the Wollondilly River and in Marulan. Dedicated Koala faecal pellet plots (using the spot assessment technique (SAT) methodology) were undertaken throughout the study area in suitable habitat, however no pellets were observed. In addition, nocturnal call playback and spotlighting failed to identify any individuals within the study area. For assessment purposes, and due to the presence of suitable habitat for this species, it is considered likely that Koalas occur in low numbers, possibly using the extension area as a movement corridor during the breeding period.

An assessment against the Koala EPBC Act Referral Guidelines identified that the extension area is not considered to comprise habitat critical to the survival of the Koala (Appendix D).

4 Impact avoidance and mitigation

4.1 Impact avoidance and minimisation

Impacts on native vegetation and fauna habitats will result from the construction and operation of the quarry extension.

Quarrying cannot readily avoid impacts without sterilising the resource, as the hard rock resource is in a fixed location. However, potential impacts of the extension project have been avoided, where possible, as part of the quarry design process, particularly in the positioning of infrastructure and emplacements.

It is proposed that the currently approved pit footprint is extended to the south (Figure 3). This extension will result in the clearance of an area of approximately 15.4 ha of the Box Gum Woodland EEC (TSC Act listing), comprising 8.4 ha of woodland vegetation and 7 ha of derived native grassland. Avoiding this area of Box Gum Woodland EEC by adopting a dual pit layout for the southern extension area was considered during the design process and was discounted for the following reasons:

- a dual pit layout with batter heights of approximately 13 m would result in considerably reduced bench areas and, as a result, the sterilisation of approximately 39 Mt of hard rock resource; and
- it is unlikely that the remaining 'finger' of vegetation between the two pits would continue to be ecologically viable, as water in the soils would flow away from vegetation and into the dual pits.

Therefore, a single pit extension is proposed.

The extension project will increase in the amount of overburden material that needs to be stored. Unlike the location of the resource, which is fixed, the location of overburden emplacements has greater flexibility. The approved overburden emplacement bund north-east of the infrastructure area will not be able to accommodate all of the overburden from the extended pit area because it is already at its maximum height and there is vegetation to the north and the south. Further, it will be uneconomic to haul overburden from the south of the quarry to the emplacement north of the pits. An overburden emplacement to the south-west of the current pit is proposed in an area that is predominantly pasture. Access to this area would be by a corridor, of the minimum required width, through existing vegetation.

The proposed design avoids potential impacts on threatened flora and fauna species and communities as far as possible.

4.2 Impact mitigation

The environmental safeguards proposed for the extension are detailed in Table 4.1. These will be incorporated into the updated Rehabilitation and Biodiversity Offset Management Plan (RBOMP) for the extension project.

Table 4.1 Biodiversity mitigation and management measures

Impact	Mitigation and/or management measure	Responsibility	Timing
Direct impacts			
Loss or degradation of habitat	Work areas will be stabilised through progressive revegetation.	Gunlake	Progressive
Indirect impacts			
Erosion and sedimentation	The Gunlake Quarry Erosion and Sediment Control Plan (see Surface Water Assessment (RHDHV 2015)) will be updated and implemented.	Gunlake	Within six months of project approval
Weed introduction and spread	Measures to prevent the spread of weeds will be documented in the updated RBOMP, such as cleaning machinery prior to use on site if coming from a weedy area.	Gunlake	Immediately prior to works commencing
Feral animal invasion and spread into retained vegetation during clearing works	Measures to minimise the invasion and spread of feral animals will be described in the updated RBOMP.	Gunlake	Prior to and during works
Disturbance of vegetation outside impact areas	Rehabilitation areas and areas not disturbed by quarry activities will be managed for weeds, pest animals and access will be restricted. Designated exclusion zones where works are not required will be flagged and highlighted in contractor inductions.	Gunlake	Prior to works commencing
Removal of identified threatened fauna habitat	Habitat features important to threatened fauna species will be retained for reinstatement within offset or rehabilitation areas where possible.	Gunlake	Prior to and during works
Removal of hollow-bearing trees	The updated RBOMP will outline measures to minimise the impacts on fauna from the loss of hollow-bearing trees (eg relocation of hollows).	Gunlake	Prior to and during works

i Management plans

The proposed mitigation measures will be incorporated into management plans for construction and operation of the quarry extension.

a. Rehabilitation and Biodiversity Offset Management Plan

The existing RBOMP for the quarry site will be updated to incorporate the mitigation measures. It will include methods to manage, protect and enhance vegetation and fauna habitat within the extension area and broader study area (including the offsets areas). It will include:

- an overview of the important ecological values of the extension area and their location;
- roles and responsibilities for implementation of the RBOMP;
- procedures for pre-clearing surveys;
- methods to demarcate clearing boundaries during staged quarry works;
- fauna rescue and relocation protocols;

- methods for the management of noxious weeds and pest animals;
- methods to mitigate the loss of hollow bearing trees (eg nest box installation or hollow relocation);
- methods to monitor mitigation measures; and
- management of rehabilitation of areas disturbed by quarrying and of offset areas, including seed collection methods; topsoil management techniques to preserve soil seed banks; planting guides including species and recommended planting densities; watering regimes; methods to minimise potential introduction and spread of soil pathogens and disease; key thresholds for survival of planted tube stock/broadcast seed; and measures to determine success of revegetation and rehabilitation activities and contingencies with triggers for failed rehabilitation.

b. Aquatic habitat management

A surface water management plan will be prepared. This plan will detail surface water management and monitoring protocols for water quality, aquatic and riparian environments in and downstream of Chapmans Creek.

5 Impact assessment

5.1 Impacts requiring offset

Approximately 12.2 ha of remnant woodland vegetation and 41.9 ha of native grasslands will be removed for the extension project. There will be progressive rehabilitation of some areas, such as the emplacements.

Nineteen hollow-bearing trees will be removed for the extension. Hollow sizes vary, but are generally small to medium size, suitable for small parrots or woodland birds.

The vegetation and habitat loss for threatened biodiversity that will result from the extension project is summarised in Table 5.1. The area to be cleared represents a loss of approximately 2% of Box Gum Woodland EEC, 0.8% of habitat for woodland birds, microbats and the Striped Legless Lizard, and 2.2% for raptors within the locality (a 5 km radius of the study area).

Table 5.1 Summary of vegetation and habitat loss for threatened biodiversity

Threatened biodiversity	Vegetation community impacted	Impact area	Area within the locality[1]	Percent cleared in locality
Box Gum Woodland EEC	Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grasslands	15.4 ha	756.6 ha[2]	2.0%
Woodland birds (Speckled Warbler, Diamond Firetail, Brown Treecreeper, Little Lorikeet, Flame and Scarlet Robins)	Yellow Box - Blakely's Red Gum Grassy Woodland Broad-leaved Peppermint - Red Stringybark Grassy Open Forest	12.2 ha	1,451.6 ha[3]	0.8%
Microbats	Yellow Box - Blakely's Red Gum Grassy Woodland Broad-leaved Peppermint - Red Stringybark Grassy Open Forest	12.2 ha	1,451.6 ha[3]	0.8%
Raptors	All vegetation communities	54.1 ha	2,430 ha[4]	2.2%
Striped Legless Lizard	Yellow Box - Blakely's Red Gum Grassy Woodland	8.4 ha	1,451.6 ha[3]	0.6%

Note: *1.The locality is defined as a 5 km radius surrounding the study area.*

2. Areas mapped as containing GW p24 Tableland Grassy Box-Gum Woodland (Tozer et al 2010). Does not include derived native grassland as these have not been mapped.

3. All mapped native woodland vegetation in the locality (Tozer et al 2010).

4. All mapped vegetation in the locality (Tozer et al 2010).

Direct impacts to fauna species include loss of habitat, habitat fragmentation, edge and barrier effects, injury and mortality and changed hydrology. Given the small reductions in vegetation and habitat in the locality (see Table 5.1) and reduced habitat values from past clearing and grazing, the extension project is not expected to have a significant impact on biodiversity at the local or regional level.

Remnant vegetation in the extension area is already highly fragmented and in degraded condition from weed invasion. The extension project would not significantly isolate or further fragment any habitat in the locality. However, development of the pit will require the removal of tributaries of Chapmans Creek which currently provide a vegetative corridor to the habitat to the south. Offset areas will be enhanced, improving their connectivity values over time.

Measures will be implemented to minimise the risk of any direct injury or mortality to fauna during clearing works.

5.2 Matters for further consideration under the Framework for Biodiversity Assessment

The Secretary's Environmental Assessment Requirement's (SEARs) for the extension project require further consideration of matters identified by the OEH, in accordance with Section 9.2 of the FBA (OEH 2014). Matters for further consideration are often associated with impacts that will be complicated or severe and require more detailed assessment and consideration by the consent authority. Impacts to biodiversity values that require further consideration may include:

- impacts on landscape features that will reduce the width of vegetation in riparian buffers bordering significant rivers, important wetlands or estuarine areas;
- impacts on landscape features that will prevent species movement along corridors that have been identified as significant biodiversity linkages;
- impacts on native vegetation that are likely to cause the extinction of a EEC/CEEC from an IBRA subregion or significant reduce its viability; and
- impacts on critical habitat or on threatened species or populations that are likely to cause the extinction from an IBRA subregion or significantly reduce its viability.

The SEARs identify several biodiversity values requiring further consideration (Table 5.2). Of these, only the Box Gum Woodland EEC is considered to require further assessment.

Table 5.2 Matters for further consideration

Biodiversity value	Likelihood of occurrence and impacts from the extension project	Further assessment required?
White Box Yellow Box Blakely's Red Gum Grassy Woodland 'Box Gum Woodland' EEC (TSC Act listing)	Recorded in the extension area. 15.4 ha of the EEC will be removed for the project.	Yes
Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland EEC	The vegetation types recorded within the study area are not consistent with the EEC description as detailed in the scientific determination. Most of the indicative canopy species are absent, with the exception of an occasional Ribbon Gum and Candlebark along the creek line in areas indicative of Box Gum Woodland EEC which was dominated by Yellow Box, Blakely's Red Gum and Apple Box. The community does not occur in the study area. The extension project will not impact this EEC.	No

Table 5.2 Matters for further consideration

Biodiversity value	Likelihood of occurrence and impacts from the extension project	Further assessment required?
Tablelands Basalt Forest EEC	This EEC is found on plateaus and tablelands with loam or clay soils derived primarily from basalt, but may also be derived from mudstones, granites, alluvium and other substrates. The study area does not contain any areas of basalt, but does contain areas of granites and alluvium. Vegetation types recorded within the study area are not consistent with the EEC description as detailed in the scientific determination. Most of the indicative canopy species are absent, with the exception of an occasional Ribbon Gum along the creek line in areas indicative of Box Gum Woodland EEC which are dominated by Yellow Box, Blakely's Red Gum and Apple Box. The community does not occur in the study area. The extension project will not impact this EEC.	No
Regent Honeyeater	The species inhabits dry open forest and woodland, particularly Box-Ironbark Woodland, and riparian forests of River She-oak. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. It also utilises: *Eucalyptus microcarpa, E. punctata, E. polyanthemos, E. moluccana, Corymbia robusta, E. crebra, E. caleyi, C. maculata, E.mckieana, E. macrorhyncha, E. laevopinea*, and *Angophora floribunda*. Nectar and fruit from the mistletoes (*Amyema miquelii, A. pendula* and *A. cambagei)* are also eaten during the breeding season. This species was not recorded despite targeted surveys. Some potential habitat occurs, but the study area generally lacks mature trees, high canopy cover or mistletoes. Unlikely to occur or be impacted by the extension project.	No
Bynoe's Wattle (*Acacia byoneana*)	Found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. The species is currently known from about 30 locations, with the size of the populations at most locations being very small (1–5 plants). Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple. This species was not recorded despite targeted surveys. Limited habitat is present in the study area and it is therefore unlikely to occur or be impacted by the extension project.	No
Camden Woollybutt (*Euclayptus macarthurii*)	Currently recorded from the Moss Vale District to Kanangra Boyd NP. 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. Occurs on grassy woodland on relatively fertile soils on broad cold flats. This species was not recorded despite targeted surveys. Limited habitat is present in the study area and it is therefore unlikely to occur or be impacted by the extension project.	No

Table 5.2 Matters for further consideration

Biodiversity value	Likelihood of occurrence and impacts from the extension project	Further assessment required?
Kowmung Hakea (*Hakea dohertyi*)	Kowmung Hakea is confined to a small area (18 km^2) in the Kowmung Valley in Kanangra Boyd NP. Population varies, but up to 7,000 plants have been counted. Additional small populations occur in Bindook area and at Tonalli Cove on Lake Burragorang. Kowmung Hakea grows in dry sclerophyll forest, usually dominated by Grey Gum or Silvertop Ash, with a sparse groundcover and midstorey. This species was not recorded despite targeted surveys. The study area is outside the known distribution of the species. No habitat is present. It is therefore unlikely to occur or be impacted by the extension project.	No
Cotoneater Pomaderris (*Pomaderris cotoneaster*)	Cotoneaster Pomaderris has a very disjunct distribution, being known from the Nungatta area, northern Kosciuszko NP (near Tumut), the Tantawangalo area in South-East Forests NP and adjoining freehold land, Badgery's Lookout near Tallong, Bungonia State Conservation Area, the Yerranderie area, Kanangra-Boyd NP, the Canyonleigh area, and Ettrema Gorge in Morton NP. 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. This species was not recorded despite targeted surveys. Limited habitat present within the study area and it is therefore unlikely to occur or be impacted by the extension project.	No
Solanum amourense	Confined to a relatively small area south-west of Sydney, from Mt Armour within Blue Mountains NP south to the Wombeyan area. Known from four locations, three of which occur within Blue Mountains NP. Occurs in eucalypt woodland, in shallow soil on steep rocky hillsides. Flowers from August to December. This species was not recorded despite targeted surveys. The study area is outside the known distribution of the species. No habitat is present within the study area. It is therefore unlikely to occur or be impacted by the extension project.	No

5.2.1 Box Gum Woodland EEC

The study area contains a patch of Box Gum Woodland EEC. An area of the community (15.4 ha of which meets the TSC Act listing criteria) will be removed for the proposed works.

Box Gum Woodland EEC currently occurs as remnant vegetation along the drainage lines and depressions in the extension area. There are some patches of higher quality woodland but these are interspersed with areas of derived native grassland indicative of the community. These run in a north-south corridor along two drainage lines in the extension area. The extension project has the potential to isolate the stands of the Box Gum Woodland EEC north of the extension area (and west of the emplacement area) that will not be removed. However, connectivity of remaining stands of the Box Gum Woodland EEC north and west of the infrastructure area will be maintained. This area forms part of the potential offsets that will enhance the overall quality of the Box Gum Woodland EEC within the study area.

Historic photography shows that most of the extension area and broader study area has been cleared in the past (see Section 3.2). Therefore the current woodland is largely regrowth, and as the Box Gum Woodland EEC to be cleared has also been degraded from grazing and weed infestations, it is not considered important to the survival of the community in the locality.

No data are available on the Vegetation Information System (VIS) database for the Yellow Box – Blakely's Red Gum Grassy Woodland PCT (Box Gum Woodland) regarding its distribution and extent in the IBRA subregion. Approximately 756.6 ha of Box Gum Woodland has been mapped in the locality (ie within a 5 km radius of the study area), based on areas mapped as GW p24 Tableland Grassy Box-Gum Woodland according to Tozer et al (2010). The extension project will result in the removal of approximately 2.0% of the community in the locality. It is therefore unlikely that the removal of the Box Gum Woodland on an edge of the extension area could have an adverse effect on the extent of the community, or potentially place it at risk of extinction in the locality.

The extension project could cause indirect impacts through increased edge effects and introduction or spread of weeds. Weed control and monitoring will continue to be implemented in the quarry site as described in the updated RBOMP as part of the offset package for the project.

The impacts to the Box Gum Woodland EEC are therefore unlikely to cause the local extinction or decrease the EEC in the locality. The proposed offset package will protect and enhance areas of the Box Gum Woodland EEC that are currently degraded and unprotected.

5.3 Impacts not assessed under the FBA

5.3.1 Indirect impacts

Indirect impacts to fauna could result from erosion and sedimentation, the introduction of weeds, and increased noise and vibration.

Without management, erosion and sedimentation could occur during operation of the extension. This may cause adverse impacts on the riparian habitat downstream on Chapmans Creek as well as vegetated remnants in depressions throughout the extension area and surrounds. The Gunlake *Quarry Erosion and Sediment Control Plan* will be updated and continue to be implemented to minimise this potential impact.

Soil disturbance may encourage weed growth. Given the majority of the extension area already contains invasive weed species, additional weed growth would not be expected to degrade habitat beyond existing levels. However there is potential for increased spread into adjacent remnant vegetation through edge effects. Measures to prevent the spread of weeds will be documented in the updated RBOMP, such as cleaning machinery prior to use on site if coming from a weedy area.

Noise and vibration levels would be increased during the expansion of the quarry, potentially resulting in behavioural changes of fauna including movement away from the study area. However, the increase in these levels is unlikely to be significant in relation to the existing noise and vibration from current quarry operations, and given the current operations, the species present in the study area are likely to be tolerant of this type of disturbance.

i Key threatening processes

Key threatening processes (KTPs) are the events and processes that threaten, or could threaten, the survival or evolutionary development of species, populations or ecological communities. Thirty six KTPs are currently listed in NSW under the TSC Act and nineteen KTPs are listed under the EPBC Act. Table 5.2 lists the KTPs with the potential to be exacerbated as a consequence of the extension project. The table also summarises the likely impacts of the extension project on these KTPs.

Table 5.3 Key threatening processes and significance of threat

Key threatening process	Relevance to extension project
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	The project is not expected to increase the operation of this KTP. Refer to Section 5.3.3 on groundwater dependent ecosystems.
Bush rock removal	The extension project requires the removal of embedded rock in some areas. Relocation of such material into the offset areas will be described in the updated RBOMP.
Clearing of native vegetation	54.1 ha of native vegetation of variable condition will be cleared within the extension area. Vegetation of conservation significance has been avoided where possible through footprint realignments. The emplacement areas and the upper sections of the pit walls will be rehabilitated.
Competition and grazing by the Rabbit	While Rabbits occur within the extension area, their current impact appears to be minor. The proposed works will not significantly increase the level of this threat. Feral animal control will be undertaken in the quarry site (including rehabilitation areas), and offset areas.
Loss of hollow-bearing trees	Hollow-bearing trees are currently a limiting habitat feature within the extension area. The loss of any hollow-bearing trees therefore represents a substantial threat to local hollow-dependent fauna. Hollow replacement measures will be implemented as described in the updated RBOMP.
Removal of dead wood and dead trees	The proposed works will remove dead wood and dead trees from the extension area. Such habitat features will be collected during clearing works and reinstated as described in the updated RBOMP.
Predation by Foxes	Foxes have direct impacts on a range of native animal species. They prey particularly on small to medium-sized, ground-dwelling and semi-arboreal mammals, and ground-nesting birds. The Speckled Warbler is known to nest low, in dense shrubs or in basal hollows. This species is considered to particularly susceptible to predation by the Fox. Foxes and other pest fauna species will be controlled in the quarry site and offset areas as described in the updated RBOMP.

ii Critical habitat

The *National Recovery Plan for White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (DECCW 2010) identifies all areas that meet the Commonwealth listing advice (TSSC 2006) criteria as habitat critical to the survival of the community. The extension project will remove 8.4 ha of habitat critical to the survival of the community.

The Regent Honeyeater Recovery Plan (Menkhorst, Schedvin and Geering 1999) states that stands of Yellow Box (a species present in the extenion area) growing at high quality sites where nectar production is copious and relatively predictable appear to be critical to the survival of the Regent Honeyeater. These stands include small, isolated patches growing in agricultural areas, as well as patches in extensive state forests or conservation reserves.

Two surveys (December 2014 and January 2015) were completed during the Yellow Box flowering period (September to March). Yellow Box trees in the extension area were in poor condition, and no flowering (ie nectar production) of the species was observed. In addition, Regent Honeyeaters have not been recorded in the extension area or wider study area. Therefore, the extension area is not considered to contain habitat critical to the survival of the Regent Honeyeater.

iii Cumulative impacts

The Gunlake Quarry occurs in an agricultural setting. As such, most of the native vegetation at the quarry site, including the extension area, has been cleared and modified for agricultural purposes.

On a local scale, the extension project will remove approximately 2.2% of native vegetation (see Table 5.1) and approximately 2.0% of the Box Gum Woodland EEC. This will be in addition to clearance of a larger area of approximately 72.4 ha of native vegetation including approximately 58.1 ha of the Box Gum Woodland EEC (approximately 7.7% of its extent in the locality) as a result of the proposed Modification 4 of the nearby Lynwood Quarry, located south of the study area (Umwelt 2014). This vegetation is described as being in a similarly disturbed state to that within the extension area (Umwelt 2014). Apart from ongoing agricultural land use, the Box Gum Woodland EEC is not under threat by any other significant major proposals in the locality, and as a result of the offset requirements that apply to both the extension project and Lynwood Quarry project, it is anticipated that cumulative impacts to threatened biodiversity are overall likely to be positive.

While the project will unavoidable remove vegetation, it will conserve and protect a larger area of vegetation in the local area as part of the biodiversity offset package (see Section 7.6). This will have positive outcome for threatened biodiversity and a cumulative benefit with the offsets associated with the Lynwood Quarry.

5.3.2 Impacts on aquatic biodiversity

i Existing environment

The study area is in the upper reaches of the Chapmans Creek sub-catchment within the greater Hawkesbury-Nepean Catchment. The headwaters of Chapmans Creek (the creek) traverse the extension area. The creek is ephemeral and flows in a north-easterly direction into Jaorimin Creek, approximately 3 km downstream of the extension area. The condition of Chapmans Creek sub-catchment is highly influenced by agricultural practices, namely land clearing and livestock grazing. This is evident in the riparian condition of the waterways with little to no riparian vegetation, moderate to severe bank erosion, bed lowering and soil sodicity in most reaches inspected during the site visit by Royal Haskoning DHV (RHDHV 2015).

Five unnamed tributaries of Chapmans Creek headwaters traverse the extension area (see Figure 5.1):

- a 55 m stretch flowing north in the south-eastern corner of the extension area (T1);
- a 240 m stretch flowing north-west in the south-eastern corner and a 170 m stretch flowing north-east in the western part of the extension area (T2);
- a 740 m stretch flowing north traversing through the centre of the extension area (T3);
- a 380 m stretch flowing north-east in the western part of the extension area (T4); and
- a 90 m stretch flowing north in the far north-western part of the extension area (T5).

The confluence of T1 and T2 lies on the boundary of the extension area, approximately 0.17 km north of the south-western corner. T3 flows through a series of artificial dams on the southern boundary of the current quarry footprint (see Photograph 5.1). Only the most southern dam lies within the extension area. All tributaries ultimately flow and converge in a north to north-easterly directly discharging into Chapmans Creek. The T2 and T4 confluence lies within the extension area, in the western wing. T5 lies to the far north-west of the extension area. Similar to Chapmans Creek, these waterways are ephemeral and heavily degraded with little to no riparian vegetation and actively eroding banks and undercutting. Water depth in these waterways would vary with rainfall and at the time of the site inspection it ranged from 0–10 cm. The creek bed is dominated by exotic flora including Blackberry (*Rubus fruticosus* aggregate) and Serrated Tussock (*Nassella trichotoma*) or eroded materials in dry reaches and stagnant pools of water in wet reaches (see Photograph 5.1 to 5.5).

Photograph 5.1 **Artificial dam on the northern boundary of the extension area**

Photograph 5.2 **Riparian condition looking upstream to T1**

Photograph 5.3 **In-stream and riparian condition looking upstream along T3**

Photograph 5.4 **In-stream and riparian condition along T3 looking downstream**

Photograph 5.5 **Characteristic of wet areas along the tributaries**

Gunlake Quarries has conducted a surface water monitoring program over 49 monitoring events between February 2007 and May 2015. The monitoring program found that water quality along T3 when compared to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ 2000) for the protection of ecosystems is characterised by:

- elevated pH;
- elevated nutrients (total nitrogen (TN) and total phosphorous (TP)); and
- high electrical conductivity (EC) in certain reaches (RHDHV 2015).

These conditions are similar to water quality along Chapmans Creek (RHDHV 2015). Poor water quality conditions in the sub-catchment are reflective of land use practices and poor riparian conditions. Nutrient enrichment is a common result of contaminated runoff from agricultural land and erosion. The subsequent increase in photosynthetic activities and decomposition from elevated nutrients usually increases pH.

The creek and its tributaries are mapped as key fish habitat (KFH). From the visual inspection of the tributaries, these waterways are Type 3 KFH and Class 3 waterways for fish passage. The riparian buffer zone required for these waterways are 10–50 m as recommended in the *Policy and Guidelines for Fish Habitat Conservation and Management* (Fisheries NSW 2013).

The Protected Matters Search Tool (PMST) predicted two threatened fish species listed under the EPBC Act and the *Fisheries Management Act 1994* (FM Act) to occur within 10 km of the extension area:

- Macquarie Perch (*Macquaria australasica*) – listed as endangered under the EPBC Act and the FM Act; and
- Australian Grayling (*Prototroctes maraena*) – listed as vulnerable under the EPBC Act and endangered under the FM Act.

No records for these species exist within the Goulburn Mulwaree LGA. The Macquarie Perch is known in a number of locations in the adjacent Upper Lachlan Shire LGA. The closest location for this species is approximately 45 km north-west of the extension area (DPI 2015).

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Waterways and waterbodies to be impacted by the Proposal

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Figure 5.1

ii Potential impacts and mitigation

The following project activities have the potential to impact on aquatic ecology:

- extension of the quarry pit directly in-stream and in adjacent areas; and
- development of fixed or temporary infrastructure including haul roads and water storage and management dams.

Potential impacts of these activities and mitigation measures are presented in Table 5.4.

Table 5.4 Potential aquatic impacts and mitigation measures

Potential impacts	Mitigation measures
Loss of catchment area	Controlled discharges from the site (where water quality meets the release criteria) will be timed to coincide with natural flows. This will mitigate the loss of catchment area and creek sections. Impacts will also be mitigated through long-term management and remediation of the catchment immediately downstream of the extension project as part of the offset package.
Decreased habitat	The updated Water Management Plan (see the Surface Water Assessment (RHDHV 2015)) will incorporate the monitoring and management of water quality and aquatic and riparian environments.
Changes to flow regimes	The project will alter surface flow regimes in the area and all practical mitigation measures will be in place to protect downstream water quality and flows including stream flow reduction offsets by water releases from onsite dams (RHDHV 2015), (see also Section 5.3.3 and the Groundwater Assessment (EMM 2015c).
Contamination downstream through spills and untreated runoff	Risks associated with the spillage of fuels and other contaminants will be avoided by: • undertaking vehicle maintenance, refuelling and storage of fuels, oils and batteries within bunded areas; • storage and handling of flammable and combustible liquids in bunded areas away from waterways and water bodies; • reporting all spills of contaminants are reported to the Quarry Manager (or delegated person); and • making appropriate spill containment kits available for the cleanup of spills. The kits will contain equipment for cleanup of both spill on land or in dry creek beds, and spills to water (such as floating booms).
Increased turbidity from erosion and sedimentation from vegetation clearing and earthworks	Mitigation measures to maintain water quality include runoff diversion and sediment treatment by the Pit Dewatering Dam. The water management system has been developed to ensure the impact to water quality is avoided or minimised (see Surface Water Assessment (RHDHV 2015) for details).
Nutrient mobilisation downstream	As above.
Water quality issues within onsite dams	As above.

5.3.3 Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems that have species composition and natural ecological processes dependent on groundwater (DLWC 2004). Four main types of GDEs are recognised in NSW:

- terrestrial vegetation;
- base flows in streams;
- aquifer and cave ecosystems; and
- wetlands.

Murray et al (2003) define GDEs as requiring the input of groundwater to maintain their current composition and functioning. Removal of groundwater from these ecosystems or a change in the timing, quantity, quality or distribution of groundwater may influence GDEs. Such changes could include altering the availability of water for transpiration by vegetation and the recruitment of seedlings into the adult population.

Two ecosystems types potentially reliant on groundwater have been identified within and surrounding the extension area:

- ecosystems potentially reliant on the surface expression of groundwater (ie creeks and springs); and
- ecosystems potentially reliant on the subsurface presence of groundwater.

The following surface water ecosystems identified by the *Atlas of Groundwater Dependent Ecosystems* (BOM 2015) potentially rely on the surface expression of groundwater:

- Chapmans Creek, within and directly north of the extension area has a moderate potential for groundwater interaction;
- Jaormin River, south of the extension area has a high potential for groundwater interaction;
- Lockyersleigh River, west of the extension area has a high potential for groundwater interaction; and
- Wollondilly River, north of the extension area has a high potential for groundwater interaction.

These rivers and creeks may support native macroinvertebrates, fish and reptiles.

In addition to the surface water features, nine springs were identified around the extension area in the Groundwater Assessment (EMM 2015b). These springs are found at the base of changes in slope (ie depression springs) and where groundwater has been forced upwards in local fractures (ie fracture springs). The surrounding vegetation is unlikely to be dependent on these springs as no swamps or swamp forests that would depend on the surface expression of groundwater from these springs occur.

The *Groundwater Dependent Ecosystems Atlas* (BOM 2015) identifies patches of Box Gum Woodland adjacent to the extension area as potentially reliant on the subsurface presence of groundwater. Figure 6.1 shows the distribution of this vegetation community, which was identified during field investigations for this ecological assessment.

The Box Gum Woodland in and adjacent to the extension area may have some reliance on the subsurface presence of groundwater, where the community grows on alluvium and shallow groundwater is present (Figure 7.1).

Box Gum Woodland and alluvium have been mapped as occurring along Chapmans Creek (Thomas *et al* 2013). Groundwater is inferred to sit approximately five metres below the ground level in this area, which is within the root zone of trees in the Box Gum Woodland. The alluvium overlies a fractured rock porphyry. Following rainfall, water infiltrates the alluvium, with enhanced recharge along Chapmans Creek. Groundwater flow in the alluvium is predominantly to the north-east mirroring surface drainage. Vertical leakage from the alluvium to the fractured rock porphyry comprises a minor component of this flow.

Drawdown of the fractured rock porphyry has been modelled for Years 5, 10, 20 and 30. Minor drawdown of 2–5 m at Chapmans Creek is predicted by Year 10. This drawdown is also predicted to occur in Years 20 and 30 (Figure 8.2 in Gunlake Quarry Groundwater Impact Assessment (EMM 2015)). Aside from the areas immediately adjacent to the pit, drawdown in the fractured rock porphyry is not predicted to increase the component of vertical leakage from the overlying alluvium along Chapmans Creek. Therefore drawdown is not predicted to significantly decrease water availability in the perched system to the overlying Box Gum Woodland.

There are no high priority GDEs listed in the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources, Goulburn Fractured Groundwater Source 2011* (NOW 2011), which is applicable to the quarry.

5.4 Matters of National Environmental Significance

5.4.1 Threatened species, populations and communities

No threatened species listed under the EPBC Act have been recorded in the study area. Two matters of MNES listed under the EPBC Act have been identified within the extension area or with the potential to occur: the Striped Legless Lizard and the Box Gum Woodland CEEC (8.4 ha).

Assessments of significance have been prepared for these matters. A significant impact on the Box Gum Woodland CEEC is likely, but impacts on the Striped Legless Lizard are unlikely to be significant. A referral to the Commonwealth has been prepared for the project. The Commonwealth has requested further information on the following matters (Table 5.5).

Table 5.5 Further information requested by the Commonwealth

Issue	Section addressed in this report
Area of EPBC Act listed White Box Yellow Box Blakely's Red Gum Woodland and Derived Native Grasslands in the extension area	Section 3.2.3
The presence/absence of Natural Temperate Grassland	Section 3.2.3
Critical habitat for the Regent Honeyeater	Section 5.3.1 (ii)
Survey effort for the Striped Legless Lizard and Pink-tailed Worm Lizard	Table 2.3

Impacts to threatened species habitat listed under the EPBC Act will be offset in accordance with the FBA, with 'like for like' offsets provided in accordance with the EPBC Act Environmental Offsets Policy (SEWPaC 2012).

6 Biodiversity credit report

6.1 Quantification of impacts

The impacts of the extension project have been assessed according to the FBA and associated major projects calculator. This method allows for impacts on native vegetation and threatened flora and fauna to be quantified, so that suitable and proportionate offsets can be identified. The method details the offset requirements in terms of ecosystem credits and species credits. Both ecosystem and species credits are required to compensate for the project's impacts on biodiversity.

Areas that do not require offsets include all areas that do not contain native vegetation or have a site value below 17, in accordance with Section 9.5 of the FBA. This includes the active quarry site. However, all four vegetation zones identified within the extension area have site value scores >17. Offset requirements have therefore been calculated for these vegetation zones.

Several ecosystem credit species were recorded or were identified as having a moderate–high potential to occur in the extension area and have therefore been assumed to be present. The calculations assume that the vegetation to be impacted contains suitable habitat for the Square-tailed Kite, Speckled Warbler, Diamond Firetail, Striped Legless Lizard, Eastern Bentwing Bat, Eastern False Pipistrelle, Little Bentwing Bat, Little Eagle, Little Lorikeet, Southern Myotis, Scarlet Robin, Brown Treecreeper and Varied Sittella. The threatened species with the highest multipliers were the Speckled Warbler and Eastern False Pipistrelle (Table 6.1).

A total of 1,521 ecosystem credits are required to compensate for the project's impacts on threatened species habitat (Table 6.1). The assumed presence of the Striped Legless Lizard has generated an additional 210 species credits (refer Section 7.3).

Table 6.1 Ecosystem credits

Vegetation zone	PCT	Area (ha)	EEC?	Site value score	Ecosystem credit species with the highest multiplier	Credits required to offset impact
1	Yellow Box - Blakely's Red Gum Grassy Woodland (PCT1330)	8.40	Yes	64.49	Speckled Warbler	454
2	Yellow Box - Blakely's Red Gum Grassy Woodland DNG (PCT1330)	7.00	Yes	31.88	Speckled Warbler	207
3	Broad-leaved Peppermint - Red Stringybark grassy open forest (PCT734)	3.80	No	67.39	Eastern False Pipistrelle	162
4	Broad-leaved Peppermint - Red Stringybark grassy open forest DNG (PCT734)	34.90	No	26.09	Eastern False Pipistrelle	698
Total						1,521

7 Biodiversity offset strategy

7.1 Strategy

The biodiversity offset strategy aims to identify suitable compensation for the extension project's unavoidable impacts on biodiversity using NSW and Commonwealth offset policies. The offsets strategy to involves the following steps:

1. identifying if suitable credits are available on the market to meet offset requirements;

2. finding potential offset sites with the biodiversity values required to compensate for the project's impacts; and

3. in the absence of suitable offset credits or properties, applying the variation criteria rules of the FBA and finding suitable offsets to meet the requirements.

The existing offset package will be extended to compensate for the additional impacts of the extension project. The potential offset areas are immediately north and east of the extension project on land owned by Gunlake.

7.2 Potential offset credits

Credit calculations for the potential offset areas have been completed using the FBA and Biobanking calculator (Table 7.1). The Diamond Firetail and Speckled Warbler and the ultrasonic calls of the Eastern Bentwing Bat, Little Bentwing Bat and the Eastern False Pipistrelle were recorded within the potential offset areas. Given that it has been assumed that the Striped Legless Lizard occurs in the impacted areas, it has also been assumed that the Striped Legless Lizard occurs in the adjacent potential offset areas that are generally in better condition. Credits have been calculated for this species credit species.

Table 7.1 Credits generated by potential offsets

Vegetation type name	BVT/PCT	Condition	Offset area (ha)[1]	Total credits created by offset
Yellow Box - Blakely's Red Gum Grassy Woodland on the tablelands, South Eastern Highlands Bioregion	HN614/ PCT1330	Moderate/Good	9.73	62
Yellow Box - Blakely's Red Gum Grassy Woodland on the tablelands, South Eastern Highlands Bioregion	HN614/ PCT1330	Moderate/Good Derived grassland	31.00	580
Yellow Box - Blakely's Red Gum Grassy Woodland on the tablelands, South Eastern Highlands Bioregion	HN614/ PCT1330	Low	17.35	167
Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	HN514/ PCT734	Moderate/Good	40.42	610
Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	HN514/ PCT734	Moderate/Good Derived grassland	87.82	1,802
			186.32	3,221

Note: 1. Does not include areas already conserved as offset as part of the previous approvals.

The potential offset areas generate a total of 3,221 ecosystem credits (Table 7.1). As described in Section 6.1, a total of 1,521 ecosystem credits are required to compensate for the project's impacts on threatened species habitat and 210 species credits are required to compensate for the assumed presence of the Striped Legless Lizard in the impacted areas.

7.3 Available offsets

There are sufficient potential offset areas to meet the credits required to compensate for the project's impacts on the Box Gum Woodland EEC and threatened species habitat (Table 7.2).

Table 7.2 Credits generated by offsets for threatened species and ecological communities

Vegetation type name	Credits required to compensate for impact	Total credit created generated by potential offset areas	Have credit requirements been met?
Yellow Box - Blakely's Red Gum Grassy Woodland on the tablelands, South Eastern Highlands Bioregion	661[1]	809[3]	Yes
Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	860[2]	2,412[4]	Yes
Striped Legless Lizard	210	287	Yes

Notes: *1. Box Gum Woodland (454 credits) plus Box Gum Woodland DNG (207 credits), see Table 6.1.*

2. Stringybark open forest (162 credits) plus Stringybark open forest DNG (698 credits), see Table 6.1.

3. Box Gum Woodland in Moderate/Good condition (62 credits) plus Box Gum Woodland DNG in Moderate/Good condition (580 credits) plus Box Gum Woodland in Low condition (167 credits), see Table 7.1.

4. Stringybark open forest (610 credits) plus Stringybark open forest DNG (1,802 credits), see Table 7.1.

7.4 Existing offset areas

The current Gunlake Quarry offset package (see Project Approval Schedule 3 Condition 27) will protect and enhance additional remnant vegetation and fauna habitat close to the quarry site. The existing Gunlake Quarry offset package is summarised in Table 7.3.

Table 7.3 Existing Gunlake Quarry offset package

Offset area	Offset type	Minimum size (hectares)
Biodiversity Offset Area - existing vegetation to be enhanced and maintained	Existing vegetation to be enhanced and maintained as well as assisted regeneration of Box Gum Woodland EEC and Speckled Warbler habitat, including a minimum of 30.38 hectares of Box Gum Woodland EEC.	30.38
Biodiversity Offset Area - vegetation regeneration	A minimum of 46.16 hectares of cleared pasture to be regenerated and/or replanted using species representative of pre-clearing vegetation, including Box Gum Woodland EEC.	46.16
Additional Biodiversity Offset Area	Box Gum Woodland EEC to be enhanced and maintained.	2.28
Total		78.82

Source: *Project Approval 07-0074 Schedule 3 Condition 27, as amended in April 2015.*

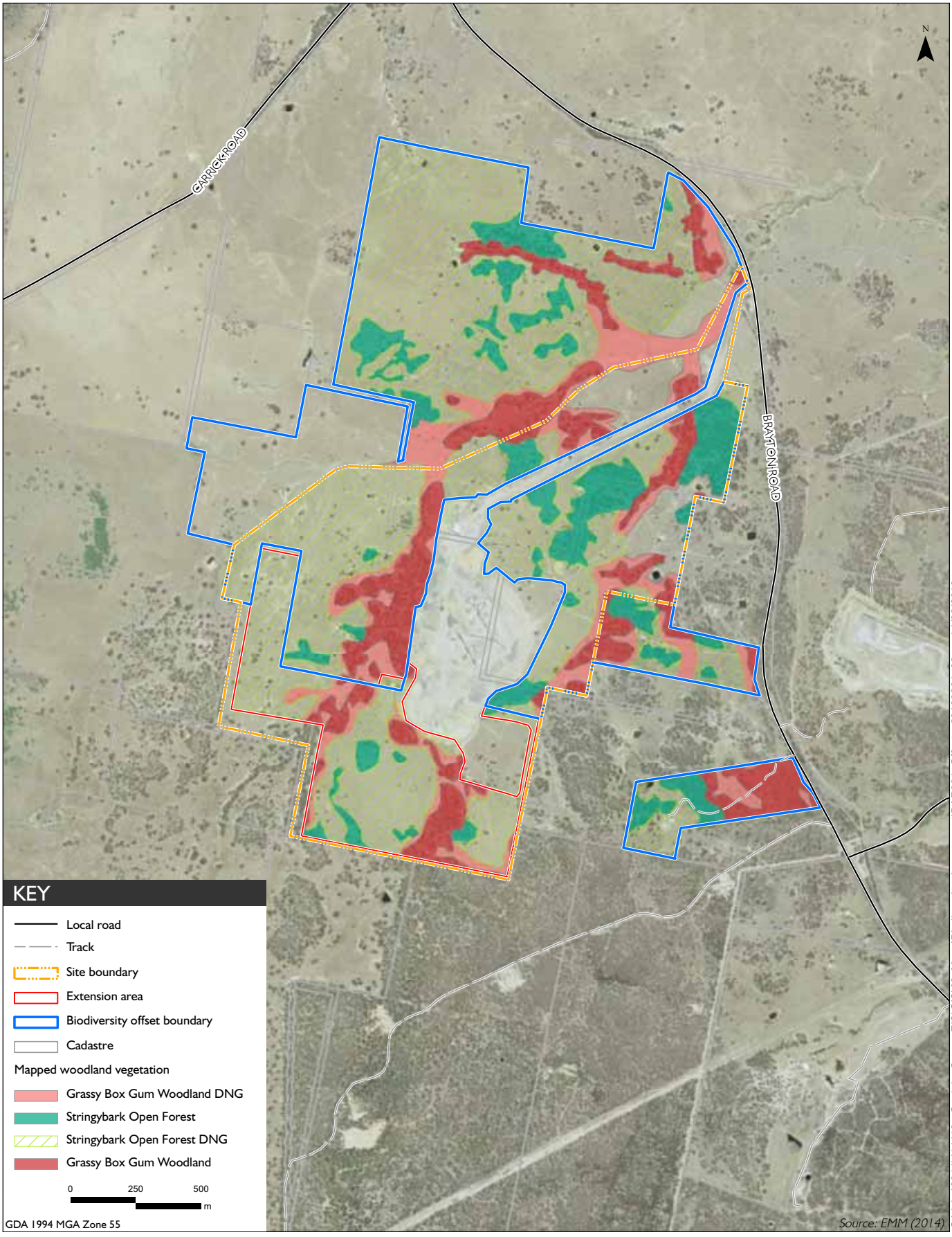
During the vegetation mapping undertaken for Modification 2, it became apparent that the extent of Box Gum Woodland was over-estimated in the previous (2008 to 2014) vegetation mapping due to an assumption that all grassland was Box Gum Woodland DNG. However, as described in the Modification 2 application (C Thompson, EMM, pers comm, letter to P Duncan, DPE, 17 February 2015, and S Rose, Biosis, pers comm, letter to C Thompson, EMM (as provided to DPE)), the DNG did not meet the description of the listed community. The area of Box Gum Woodland removed as part of the original application was actually 7.8 ha and the area removed as part of the MOD2 application was 0.6 ha (ie a total of 8.4 ha).

Based on the original offset ratio of 3.8:1 used by Biosis (2014), 31.9 ha of Box Gum Woodland was actually required to offset the 8.4 ha removed as part of the original and Modification 2 project. The Modification 2 Project Approval requires 78.82 ha of Box Gum Woodland offsets (Table 7.3). Therefore, an excess of 46.9 ha of Box Gum Woodland is included in the approved offset package.

A total of 661 credits are required (see Table 7.2) to offset the unavoidable impacts of removing 8.4 ha of Box Gum Woodland for the extension project[1]. Using an approximate area:credits ratio of 1:8.5, this equates to 71.1 ha of Box Gum Woodland as being required to offset the unavoidable impacts of the extension project on this EEC.

It is proposed that the excess Box Gum Woodland in the current offset package (46.9 ha) is used to meet part of the offsets required for this EEC the extension project (71.1 ha). This leaves 24.2 ha of Box Gum Woodland to be offset in additional offset areas to meet the FBA requirements. However as described in below, a greater area of Box Gum Woodland is required to meet Commonwealth offsetting requirements.

1. To avoid confusion, it is noted that it is a coincidence that 8.4 ha of Box Gum Woodland was removed as part of the original and Modification 2 project and that it is proposed to remove 8.4 ha of Box Gum Woodland as part of the extension project.



Biodiversity offsets

Gunlake Quarry
Biodiversity Assessment Report

Figure 7.1

7.4.1 Consideration of NSW offset principles

The potential offsets have been assessed against the OEH principles for offsetting in NSW (Table 7.4).

Table 7.4 Compliance with NSW offset principles

	Principle	Compliance
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.	The extension project has aimed to avoid potential impacts where possible. Offsets have only been recommended for those residual impacts that remain after avoidance and mitigation.
2	Offset requirements should be based on a reliable and transparent assessment of losses and gains.	This assessment uses the FBA, Major Proposal Calculator and the BioBanking calculator for the offset areas.
3	Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.	Offset areas have targeted the vegetation communities, TECs and threatened species habitats to be impacted by the extension project. The offsets contain similar vegetation to the extension area and provide similar habitat values as those in the extension area. The offsets also contain known populations of and/or suitable habitat for most of the threatened species identified in the extension area.
4	Offsets must be additional to other legal requirements.	Existing offset requirements for previous approvals have been taken into account for the extension project. The proposed offset lands proposed are not subject to any other legal requirements.
5	Offsets must be enduring, enforceable and auditable.	Offset areas will be protected into the future through secure land tenure for ongoing conservation management through a BioBanking agreement or a suitable mechanism that meets the requirements of the NSW Major Proposal Offset Policy. Offset areas will be conserved in perpetuity.
6	Supplementary measures can be used in lieu of offsets.	Supplementary measures are not proposed as part of the offset package.

7.5 Commonwealth offset calculations

Calculations have been completed (Appendix F) in accordance with the EPBC offset calculator, under the *EPBC Act Environmental Offset Policy* (the EPBC Act Policy).

A total of 8.4 ha of Box Gum Woodland CEEC will be removed as part of the extension project. Using the EPBC Offset Calculator, 44.2 ha offset is required to compensate for the unavoidable removal of this CEEC. The potential offset areas contain 58.1 ha of Box Gum Woodland and the approved offset areas contain an excess of 46.9 ha of Box Gum Woodland (see above). Therefore, there is sufficient Box Gum Woodland in the potential offset areas to meet Commonwealth requirements.

The EPBC Act Policy requires that a minimum 90% direct offset is met using the calculator for all MNES that may be impacted by the extension project, with the remaining 10% which can comprise indirect offsets (eg contribution to research programs). Gunlake propose to provide a 100% direct offset for the extension project.

The reasoning behind the calculated offset area for the MNES is provided in Table 7.6.

Table 7.5 Impact site calculations - Box Gum Woodland

Attribute	Maximum score	Reasoning	Score
Quality of the impact areas			
Condition	5	This community is associated with the low-lying creek lines where remnant vegetation occurs. The canopy is largely immature with some areas of dense regrowth, regenerating from the seedbank from past clearing. Generally, the understorey is diverse with a range of forb and herb species present. However, Serrated Tussock occurs throughout most patches of the community and areas of bare ground and erosion associated with grazing occur.	4
Context	3	As the patches occur along drainage depressions, there is a degree of connectivity of the community across the extension area. However, most patches are small and only connected with derived native grassland, which would not meet the Commonwealth description of the community due to the lack of diversity and forbs. The areas of CEEC are connected to surrounding areas along drainage lines to the south and north of the extension area. A large patch of bushland occurs to the south-east of the extension area which is likely to contain a larger, more intact remnant of the community.	2
Species stocking rate	2	The landscape and soils where Box Gum Woodland occurs is in a degraded condition from agricultural practices. The areas between patches of the community now provide limited habitat for the ecological community, which is fragmented in the landscape. Box Gum Woodland occurs in similar habitats throughout the study area and locality. Therefore, the removal of Box Gum Woodland will not substantially reduce the extent of the ecological community in the locality and wider region.	1
Total	**10**		**7**
Quality of the offset areas			
Condition	5	Most of the Box Gum Woodland remnants surround the extension area and are in a similar condition. However, the majority of the community in the proposed offset area exists as derived native grassland, which will regenerate to woodland under management. The large patch of Box Gum Woodland to the west of the existing quarry is in good condition with an array of forb, herb and native grass species present. In areas, more mature trees occur with hollows. However, these areas have been subject to grazing and other agricultural influences. Overall, the combined existing condition of the Box Gum Woodland patches is comparable to those in the extension area, but incorporating the areas of derived native grassland, the condition score is lower.	2
Context	3	As with the extension area, patches of Box Gum Woodland are fragmented in the offset areas, mainly being confined to drainage lines and interspersed with areas of derived native grassland.	2
Species stocking rate	2	As with the extension area, the extent of Box Gum Woodland in the offsets will not substantially reduce the extent of the community in the locality and the region.	1
Total	**10**		**5**

Table 7.5 Impact site calculations - Box Gum Woodland

Attribute	Maximum score	Reasoning	Score
Future quality of the offset areas			
Without offset	n/a	The majority of the patches of Box Gum Woodland in the offset areas are subject to agricultural disturbance, mainly grazing by livestock and pest species. These disturbances are likely to continue in the absence of conservation management at these sites. The quality of Box Gum Woodland is decreased with such activities, with lower species diversity observed in areas which have been heavily grazed in the locality.	4
With offset	n/a	The management of the offsets for conservation will reduce the current impacts on this community from agricultural disturbances. This is likely to improve the condition and habitat value of the areas identified as Box Gum Woodland and also the areas adjacent which have been identified as derived native grasslands, but which do not currently meet the Commonwealth's description of the listed community. As a result, the species diversity and habitat complexity of the patches is likely to increase significantly to match, if not exceed, those in the extension area.	7
Risk of loss in 20 yrs in the offset areas			
Without offset	n/a	The risk of loss in 20 years has been determined if no management actions were undertaken and considering the existing land use, zoning and management of the offset sites. It is possible that future quarrying activities could be considered in some of the offset sites. There is also the potential for clearing for agricultural practices, particularly the areas in which Box Gum Woodlands have been identified as these contain the more fertile soils of the locality. Therefore, there is a chance that areas of Box Gum Woodland may be lost from the proposed offset sites without protection from offsetting.	35%
With offset	n/a	The offsets will be protected from future clearing through conversion in perpetuity. These communities may still be subject to impacts, which could lead to their loss in the long-term despite these protection measures. With protection from offsetting, this remains relatively low but not zero.	10%
Confidence in result			
Risk of loss	n/a	Agricultural practices in the area have led to the degradation and loss of areas of Box Gum Woodland in the locality historically. If the offsets are not conserved through protection mechanisms, they may be lost in the long-term given their position in the landscape adjacent to cleared areas and on better agricultural soils. Several mechanisms are in place to prevent further degradation of these communities and therefore the risk of loss without the offsets is uncertain. The risk of loss for offsets that are conserved in perpetuity are much lower, particularly as these will be under active management for improvement. Overall, the risk of loss is considered moderate.	70%
Habitat quality change	n/a	Scientific data shows that Box Gum Woodland has the ability to regenerate over a relatively short timeframe, particularly when grazing is removed (Maguire & Mulvaney 2011). It is likely that Box Gum Woodland will respond quickly to the removal of grazing and assisted and natural regeneration. It has been demonstrated on other sites that such management activities provide a positive outcome and improvement in condition for the community.	70%

7.5.1 Commonwealth offset principles

The Commonwealth offset principles have been considered in the formulation of the offset package. Table 3.3 details the consideration of these principles for the offset package.

Table 7.6 Compliance with Commonwealth offset principles

	Principle	Compliance
1	Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action	The proposed offsets will protect and restore woodland habitat in a fragmented agricultural landscape. The offsets will connect through to the east to a large area of bushland to the south of the study area. Over time, lower condition areas of Box Gum Woodland derived native grassland will regenerate between patches of woodland forming a connected link through the landscape. This will increase the amount and quality of Box Gum Woodland CEEC in the locality in the long term. The offsets would also protect these areas in perpetuity and reduce the current risks from key threatening processes.
2	Be built around direct offsets but may include other compensatory measures	The offset package is based on direct, land-based offsets that meet the minimum 90% requirement under the EPBC Act Environmental Offset Policy. Other compensatory measures are not proposed.
3	Be in proportion to the level of statutory protection that applies to the protected matter	The EPBC Act Environmental Offset Policy and offset calculator have been used to determine if adequate offsets have been provided for matters of NES. The calculator accounts for the various levels of statutory protection for each matter of NES and therefore the offset package.
4	Be of a size and scale proportionate to the residual impacts on the protected matter	The EPBC Act Environmental Offset Policy and offset calculator determine if the offset proposed is proportionate to the residual impacts to each MNES. The offset package meets the requirements of the policy for all MNES and is considered to be suitable to compensate for the residual impacts of the extension project.
5	Effectively account for and manage the risks of the offset not succeeding	The EPBC Act Environmental Offset Policy accounts for uncertainty with the offsets within the calculations. This includes assessing the risk of the offset not succeeding. Gunlake is committed to implementing the proposed offset package, to ensure that the policy is met for all MNES. The biodiversity values discussed in this offset package will be managed for conservation in the long-term to compensate for the impacts of the extension project. The offset management plans will be included in the RBOMP, and will detail the monitoring and an adaptive management framework to ensure that additional measures are implemented, should this be required.
6	Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action)	The proposed offset package provides for the protection of biodiversity values for each of the MNES identified within the extension area. The offset properties are privately owned and are currently unprotected from threatening processes, which have the potential to impact on MNES. The majority of the offset package is additional to any other requirements, but includes values, which will be used to offset impacts on those MNES which are also listed in NSW under the TSC Act.
7	Be efficient, effective, timely, transparent, scientifically robust and reasonable	The offsets will be delivered following project approval. The adequacy of the offset package proposed has been assessed against NSW and Commonwealth requirements and is considered to adequately compensate for the impacts of the extension project on MNES.
8	Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	Offset sites will be protected into the future through secure land tenure for ongoing conservation management through a biobanking agreement or a suitable mechanism that meets the requirements of the NSW Major Proposal Offset Policy. Offset areas will be conserved in perpetuity.

7.6 Offset package

Gunlake propose to provide a total offset package of approximately 155.6 ha that will compensate for the unavoidable impacts on biodiversity. It will comprise of:

- approved Box Gum Woodland offset (woodland and DNG): 78.8 ha (31.9 ha of Box Gum Woodland to meet offset requirements of the original approval/MOD2 and 46.9 ha of Box Gum Woodland to meet 46.9 ha of the FBA offset requirements and 20 ha of the Commonwealth offset requirements for the extension project);
- additional Box Gum Woodland offset (woodland and DNG) to meet the remaining FBA and Commonwealth offset requirements: 24.2 ha;
- additional Stringybark community offset to meet the FBA requirement of 860 credits (assuming that woodland is used as an offset followed by DNG):
    - Stringybark community woodland: 40.4 ha (610 credits); and
    - Stringybark community DNG: 12.2 ha (250 credits).

Only the credits required to compensate for the impact will be included in the final offset package. The final configuration of the offset areas and the balance of woodland versus DNG will selected from the potential offset areas and will be finalised as part of the biodiversity package.

The offset areas will be reconfigured to ensure that previous offset commitments and new offset requirements will be met.

7.7 Offset security

In accordance with the transitional arrangements under the NSW Major Proposal Offset Policy, offset areas will be secured where possible using a BioBanking agreement. Where this cannot be achieved, a suitable mechanism will be identified that follows the criteria specified by the Policy. The criteria set out the required elements of an offset site that ensure that actual gains to biodiversity will be achieved, which include:

- the principal objective of ongoing site management is biodiversity conservation;
- management actions are undertaken in accordance with a plan of management;
- there is reasonable likelihood that sufficient resources will be available to implement the plan of management over time;
- there are appropriate accountability mechanisms in place to secure the outcomes, and these mechanisms cannot be altered without alternative and comparable offsetting arrangements being put in place; and
- the arrangements are in perpetuity and conservation obligations are transparently transferred and disclosed to any new owners of the land through appropriate administrative procedures.

7.8 Offset management and monitoring

The offset areas will be managed in accordance with the updated RBOMP. The plan will be completed and implemented within six months of approval of the extension project. It will include procedures to be applied for the management of the offset areas, the arrangements for conservation in perpetuity and regeneration works to be undertaken. This will include the procedures for:

- assisting the revegetation and regeneration in the offset areas, including establishment of canopy, understorey and groundcover in areas of native pasture where required;
- controlling weeds and feral pests;
- fencing and access arrangements;
- erosion control; and
- bushfire management.

An offset monitoring program will be included within the RBOMP. The purpose of the program will be to monitor any changes to the condition of these areas to:

- assess any indirect impacts from the extension project; and
- determine the success of the management actions implemented.

8 Conclusion

The study area consists of the approved disturbance area that has previously been assessed and has largely been cleared, and the extension area that contains exotic and native vegetation that was the focus of this biodiversity assessment. The extension area has limited habitat due to the widespread removal of native vegetation for agriculture. However, some remnant vegetation occurs in the extension area, particularly along Chapmans Creek and its tributaries. This vegetation is considered to meet the description of Box Gum Woodland, an EEC listed under the TSC Act. The woodland form of this community within the extension area meets the criteria for the CEEC listed under the EPBC Act.

Remnant vegetation provides habitat for the threatened Speckled Warbler, Diamond Firetail, Square-tailed Kite, Eastern Bentwing Bat, Eastern False Pipistrelle and Little Bentwing Bat, which were recorded during the surveys. It also contains potential habitat for the Little Lorikeet, Striped Legless Lizard, Little Eagle, Southern Myotis, Scarlet Robin, Brown Treecreeper and Varied Sittella.

During the project planning phase, Gunlake investigated a range of options to avoid and minimise impacts on remnant vegetation. The proposed emplacement will be located in an area which is predominantly pasture to minimise impacts on woodland vegetation.

The extension project will require the removal of a total of 12.2 ha of woodland and 41.9 ha of grassland vegetation. This includes 8.4 ha of Box Gum Woodland (listed under the TSC Act and EPBC Act) and 7 ha of Box Gum Woodland derived native grassland (listed under the TSC Act only). Quarrying also has the potential to result in indirect impacts on biodiversity, including erosion and sedimentation, weed invasion and changes in hydrology, if not managed appropriately. Biodiversity mitigation and management measures will minimise and/or mitigate these potential impacts of the extension project.

The impacts of the extension project have been quantified using the FBA and Major Proposals Calculator. A total of 1,521 ecosystem credits are required to compensate for the unavoidable impacts of the extension project. There are sufficient offset areas available for addition to the existing Gunlake offset package to compensate for these impacts. The offset areas will be reconfigured to ensure that previous offset commitments and new offset requirements will be met. The resulting offset package will provide long-term protection and enhancement of habitat for threatened species and ecological communities.

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Appendix A

Habitat assessment table

Table A.1 Threatened species previously recorded or predicted to occur in the locality

Species/community	Conservation status[1]		Habitat[2]	Likelihood of occurrence and potential for impacts from the proposed activity
	TSC Act	EPBC Act		
Flora				
Austral Toadflax *Thesium australe*	V	V	Not known from the extension area or surrounds. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass.	Not recorded despite targeted surveys. Potential habitat present. Not identified despite targeted surveys in areas of potential habitat to be impacted. Considered unlikely to occur or be impacted.
Basalt Peppercress *Lepidium hyssopifolium*	E	E	Not known from the extension area or surrounds. Currently, the species is known from near Bathurst and Bungendore, in the South Eastern Highlands Bioregion. Known to establish on open, bare ground with limited competition from other plants.	Not recorded despite targeted surveys. Limited habitat present. Unlikely to occur or be impacted.
Black Gum *Eucalyptus aggregata*	V	-	Occurs in the South Eastern Highlands Bioregion and on the western fringe of the Sydney Basin Bioregion. Has a moderately narrow distribution, occurring mainly in the wetter, cooler and higher parts of the tablelands. 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.	Not recorded despite targeted surveys. Limited habitat present. Unlikely to occur or be impacted.
Bynoe's Wattle *Acacia byoneana*	E	V	Found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. The species is currently known from about 30 locations, with the size of the populations at most locations being very small (1–5 plants). Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed, sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple.	Not recorded despite targeted surveys. Limited habitat present. Unlikely to occur or be impacted.
Camden Woollybutt *Eucalyptus macarthurii*	V	-	Recorded from the Moss Vale District to Kanangra Boyd NP. 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. Occurs on grassy woodland on relatively fertile soils on broad cold flats.	Not recorded despite targeted surveys. Limited habitat present. Unlikely to occur or be impacted.

Table A.1 Threatened species previously recorded or predicted to occur in the locality

Species/community	Conservation status[1]		Habitat[2]	Likelihood of occurrence and potential for impacts from the proposed activity
	TSC Act	EPBC Act		
Cotoneaster Pomaderris *Pomaderris cotoneaster*	E	E	Cotoneaster Pomaderris has a very disjunct distribution, being known from the Nungatta area, northern Kosciuszko NP (near Tumut), the Tantawangalo area in South-East Forests NP and adjoining freehold land, Badgery's Lookout near Tallong, Bungonia State Conservation Area, the Yerranderie area, Kanangra-Boyd NP, the Canyonleigh area and Ettrema Gorge in Morton NP. 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.	Not recorded despite targeted surveys. No habitat present. Unlikely to occur or be impacted.
Hoary Sunray *Leucochrysum albicans var. tricolor*	-	E	Recorded in the bypass area to the south-east of the extension area. In NSW it currently occurs on the Southern Tablelands adjacent areas in an area roughly bounded by Albury, Bega and Goulburn, with a few scattered localities know from beyond this region. Occurs in a wide variety of grassland, woodland and forest habitats, generally on relatively heavy soils. Can occur in modified habitats such as semi-urban areas and roadsides. Highly dependent on the presence of bare ground for germination.	Potential habitat present. Not identified despite targeted surveys in areas of potential habitat to be impacted during the flowering period. Unlikely to occur or be impacted.
Kangaloon Sun Orchid *Thelymitra kangaloonica*	CE	CE	Not known from the extension area or surrounds. The Kangaloon Sun-orchid is found in swamps in sedgelands over grey silty grey loam soils. It is thought to be a short-lived perennial, flowering in late October and early November.	Not recorded despite targeted surveys. No habitat present. Unlikely to occur or be impacted.
Kowmung Hakea *Hakea dohertyi*	E	E	Kowmung Hakea is confined to a small area (18 km^2) in the Kowmung Valley in Kanangra Boyd NP. Population varies, but up to 7000 plants have been counted. Additional small populations occur in Bindook area and at Tonalli Cove on Lake Burragorang. Kowmung Hakea grows in dry sclerophyll forest, usually dominated by grey gum or silvertop ash, with a sparse groundcover and midstorey.	Not recorded despite targeted surveys. The study area is outside the known distribution of the species. No habitat present. Unlikely to occur or be impacted.
Kunzea cambagei	V	V	Not known from the extension area or surrounds. Mainly occurs in the western and southern parts of the Blue Mountains, NSW, namely the Yerranderie/Mt Werong area. Populations are also located west of Berrima, along the Wingecarribee River; Loombah Plateau east of Mount Werong; the Oberon-Colong Stock Route within Kanangra-Boyd NP; and Wangaderry Plateau within the Nattai NP. It is restricted to damp, sandy soils in wet heath or mallee open scrub at higher altitudes on sandstone outcrops or Silurian group sediments.	Not recorded despite targeted surveys. No habitat present as it requires sandstone. Unlikely to occur or be impacted.
Omea Storksbill *Pelargonium sp. Striatellum*	E	E	Not known from the extension area or surrounds. The Omeo Storksbill is known from only three locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst.	Not recorded despite targeted surveys. No habitat present as it requires basalt. Unlikely to occur or be impacted.

Table A.1 Threatened species previously recorded or predicted to occur in the locality

Species/community	Conservation status[1]		Habitat[2]	Likelihood of occurrence and potential for impacts from the proposed activity
	TSC Act	EPBC Act		
Solanum amourense	E	-	Confined to a relatively small area south-west of Sydney, from Mt Armour within Blue Mountains NP south to the Wombeyan area. Known from four locations, three of which are within Blue Mountains NP. Occurs in eucalypt woodland, in shallow soil on steep rocky hillsides. Flowers August to December.	Not recorded despite targeted surveys. The study area is outside the known distribution of the species. No habitat present. Unlikely to occur or be impacted.
Solanum celatum	E	-	Not known from the extension area or surrounds. Restricted to an area from Wollongong to just south of Nowra, and west to Bungonia. Grows in rainforest clearings, or in wet sclerophyll forests. Flowers August to October and produces fruit December to January.	Not recorded despite targeted surveys. No habitat present due to the lack of rainforest or wet sclerophyll forest. Unlikely to occur or be impacted.
Square Raspwort *Haloragis exalata* subsp. *exalata*	-	V	Populations are known from the areas of western Sydney, Kosciuszko NP, the Bega Valley, Bungonia Gorge east of Goulburn on the Central Tablelands, the Shoalhaven River and Lake Illawarra on the Central Coast, the North Coast and the Northern Tablelands. It appears to be a post-disturbance coloniser, based on observations of large numbers of plants on disturbed roadsides, cleared power-line easements, and recently burnt or flooded areas.	Not recorded despite targeted surveys. Potential habitat present. Not identified despite targeted surveys in areas of potential habitat to be impacted. Unlikely to occur or be impacted.
Tallong Midge Orchid *Genoplesium plumosum*	CE	E	Not known from the extension area or surrounds. Only known from two areas – the village of Tallong and its immediate environs, and a site in Morton NP 8.5 km south-east of the town of Wingello. Occurs exclusively in heathland, generally dominated by Violet Kunzea (*Kunzea parvifolia*), Common Fringe-myrtle (*Calytrix tetragona*) and parrot-peas (*Dillwynia spp*.).	Not recorded despite targeted surveys. No habitat present as no heathland occurs. Unlikely to occur or be impacted.
Thick-lipped Spider-orchid *Caladenia tessellata*	E	V	Not known from the extension area or surrounds. The Thick Lip Spider Orchid is generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. The single leaf regrows each year.	No habitat present as no clay loams or sandy soils occur. Although surveys were completed outside the flowering time, due to lack of habitat and recent nearby records, it is considered unlikely to occur or be impacted.
Yellow Gnat Orchid *Genoplesium baueri*	E	E	Not known from the extension area or surrounds. The Yellow Gnat-orchid has been recorded from locations between Ulladulla and Port Stephens. Grows in dry sclerophyll forest and moss gardens over sandstone.	Not recorded despite targeted surveys. No habitat present as it requires sandstone. Unlikely to occur or be impacted.

Table A.1 Threatened species previously recorded or predicted to occur in the locality

Species/community	Conservation status[1]		Habitat[2]	Likelihood of occurrence and potential for impacts from the proposed activity
	TSC Act	EPBC Act		
Fauna				
Fish				
Macquarie Perch *Macquaria australasica*	E	E	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/Nepean and Shoalhaven catchments. Found in both river and lake habitats, especially the upper reaches of rivers and their tributaries.	Not known from the rivers of the locality. Unlikely to occur or be impacted.
Australian Grayling *Protroctes maraena*	-	V	Occurs in streams and rivers on the eastern and southern flanks of the Great Dividing Range, from Sydney, southwards to the Otway Ranges of Victoria and in Tasmania. The species is found in fresh and brackish waters of coastal lagoons and is diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas.	Not known from the rivers of the locality. Unlikely to occur or be impacted.
Frogs				
Littlejohn's Tree Frog *Litoria littlejohni*	V	V	Not recorded in the extension area or nearby surrounds. Littlejohn's Tree Frog has a distribution that includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.	Not recorded despite targeted surveys. No suitable habitat occurs as it requires heath and running rocky streams. Unlikely to occur or be impacted.
Reptiles				
Broad-headed Snake *Holocephalus bungaroides*	E	V	Not known from extension area or surrounds. The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.	Not recorded despite targeted surveys. No suitable habitat occurs as it requires heath and running rocky streams. Unlikely to occur or be impacted.
Pink-tailed Worm-lizard *Aprasia parapulchella*	V	V	Not known from the extension area or surrounds. 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. Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks. These burrows have been constructed by and are often still inhabited by small black ants and termites.	Not recorded despite targeted surveys. Some potential habitat occurs. Closest records are over 100 km away, therefore unlikely to occur or be impacted.

Table A.1 Threatened species previously recorded or predicted to occur in the locality

Species/community	Conservation status[1]		Habitat[2]	Likelihood of occurrence and potential for impacts from the proposed activity
	TSC Act	EPBC Act		
Striped Legless Lizard *Delma impar*	V	V	Not known from the extension area or surrounds. This species is mainly found in natural temperate grassland but has also been captured in exotic grasslands. Its optimal habitat is grassland dominated by perennial, tussock grasses including Kangaroo Grass (*Themeda australis*), Speargrasses (*Austrostipa* spp.), *Poa* spp. and Wallaby Grasses (*Rytidosperma* spp.). It is occasionally found in Box Gum Woodland.	Not recorded despite targeted surveys. Some potential habitat occurs. May occur or be impacted. An assessment of significance has been completed for this species.
Birds				
Australasian Bittern *Botaurus poiciloptilus*	E	E	Widespread but uncommon over south-eastern Australia. In NSW they are found over most of the state except for the far north-west. They favour permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.). They hide during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails.	Not recorded despite targeted surveys. Some potential habitat occurs, but no vegetated wetlands occur. Unlikely to occur or be impacted.
Australian Painted Snipe *Rostratula australis*	E	E	Usually found in shallow inland wetlands, either freshwater or brackish, that are either permanently or temporarily filled. It nests on the ground amongst tall reed-like vegetation near water, and feeds near the water's edge and on mudflats, taking invertebrates, such as insects and worms, and seeds.	Not recorded despite targeted surveys. Some potential habitat occurs, but no vegetated wetlands occur. Unlikely to occur or be impacted.
Brown Treecreeper (eastern subspecies) *Climacteris picumnus victoriae*	V	-	The eastern subspecies lives in eastern NSW in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands such as the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond and Clarence Valleys. 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. This species is also found in mallee and River Red Gum (*Eucalyptus camaldulensis*). Usually not found in woodlands with a dense shrub layer. Fallen timber is an important habitat component for foraging.	Not recorded despite targeted surveys. Some potential habitat occurs. May occur or be impacted. An assessment of significance has been completed for this species.
Diamond Firetail *Stagnopleura guttata*	V	-	Endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia. It is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (*Eucalyptus pauciflora*) woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities.	Recorded. Impacts likely. An assessment of significance has been completed for this species.

Table A.1 Threatened species previously recorded or predicted to occur in the locality

Species/community	Conservation status[1]		Habitat[2]	Likelihood of occurrence and potential for impacts from the proposed activity
	TSC Act	EPBC Act		
Flame Robin *Petroica phoenicea*	V	-	Endemic to south-eastern Australia, and ranges from near the Queensland border to south-east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. It prefers clearings or areas with open understoreys. It often occurs in recently burnt areas; however, habitat becomes unsuitable as vegetation closes up following regeneration.	Not recorded despite targeted surveys. Some potential habitat occurs. May occur or be impacted. An assessment of significance has been completed for this species.
Gang-gang Cockatoo *Callocephalon fimbriatum*	V	-	Distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas.	Not recorded despite targeted surveys. Some potential habitat occurs. Unlikely to occur or be impacted.
Glossy Black-Cockatoo *Calyptorhynchus lathami*	V	-	Uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1,000 m AHD in which stands of She-oak species, particularly Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur.	Not recorded despite targeted surveys. Some potential habitat occurs, but no key feed trees are present. Unlikely to occur or be impacted.
Hooded Robin (south-eastern form) *Melanodryas cucullata cucullata*	V	-	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Often perches on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey.	Not recorded despite targeted surveys. Some potential habitat occurs, but shrubs are generally absent and woodland is not structurally diverse. Unlikely to occur or be impacted.
Little Eagle *Hieraaetus morphnoides*	V	-	Found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	Not recorded despite targeted surveys. Some potential habitat occurs. May occur or be impacted. An assessment of significance has been completed for this species.
Little Lorikeet *Glossopsitta pusilla*	V	-	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, eg paddocks, roadside remnants and urban trees also help sustain viable populations of the species. Feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe, and only rarely in orchards.	Not recorded despite targeted surveys. Some potential habitat occurs. May occur or be impacted. An assessment of significance has been completed for this species.

Table A.1 Threatened species previously recorded or predicted to occur in the locality

Species/community	Conservation status[1]		Habitat[2]	Likelihood of occurrence and potential for impacts from the proposed activity
	TSC Act	EPBC Act		
Powerful Owl *Ninox strenua*	V	-	Endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains. Now uncommon throughout its range where it occurs at low densities. Roosts by day in dense vegetation comprising species such as Turpentine (*Syncarpia glomulifera)*, Black She-oak (*Allocasuarina littoralis)*, Blackwood (*Acacia melanoxylon)*, Rough-barked Apple (*Angophora floribunda)*, Cherry Ballart (*Exocarpus cupressiformis*) and a number of eucalypt species.	Not recorded despite targeted surveys. Some potential habitat occurs, but the site generally lacks mature trees with large hollows. Unlikely to occur or be impacted.
Regent Honeyeater *Anthochaera phrygia*	CE	CE	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Also utilises: *Eucalyptus microcarpa, E. punctata, E. polyanthemos, E. moluccana, Corymbia robusta, E. crebra, E. caleyi, C. maculata, E.mckieana, E. macrorhyncha, E. laevopinea*, and *Angophora floribunda*. Nectar and fruit from the mistletoes (*Amyema miquelii, A. pendula* and *A. cambagei)* are also eaten during the breeding season.	Not recorded despite targeted surveys. Some potential habitat occurs, but the site generally lacks mature trees, high canopy cover or mistletoes. Unlikely to occur or be impacted.
Scarlet Robin *Petroica boodang*	V	-	Lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. Habitat usually contains abundant logs and fallen timber; that are important components of its habitat.	Not recorded despite targeted surveys. Some potential habitat occurs. May occur or be impacted. An assessment of significance has been completed for this species.
Speckled Warbler *Chthonicola sagittata*	V	-	Recorded during Ecotone surveys in 2008. Lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	Recorded. Impacts likely. An assessment of significance has been completed for this species.
Swift Parrot *Lathamus discolor*	E	E	Migrates to the Australian south-east mainland between March and October. Occur in areas where eucalypts are flowering profusely or where there are abundant lerp infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta)*, Spotted Gum (*Corymbia maculate)*, Red Bloodwood (*C. gummifera)*, Mugga Ironbark (*E. sideroxylon)* and White Box (*E. albens)*.	Not recorded despite targeted surveys. Some potential habitat occurs, but no key feed trees are present. Unlikely to occur or be impacted.

Table A.1 Threatened species previously recorded or predicted to occur in the locality

Species/community	Conservation status[1]		Habitat[2]	Likelihood of occurrence and potential for impacts from the proposed activity
	TSC Act	EPBC Act		
Square-tailed Kite *Lophoictinia isura*	V	-	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage. Appears to occupy large hunting ranges of more than 100 km^2. Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	Recorded. Impacts likely. An assessment of significance has been completed for this species.
Varied Sittella *Daphoenositta chrysoptera*	V	-	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Not recorded despite targeted surveys. Some potential habitat occurs. Unlikely to occur or be impacted.
Bats				
Eastern Freetail Bat *Mormopterus norfolkensis*	V	-	Dry sclerophyll forest and woodland. Roosts in hollows and under bark or man-made structures.	Not recorded despite targeted surveys. Some potential habitat occurs. May occur or be impacted. An assessment of significance has been completed for this species.
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	V	-	Prefers moist habitats with trees >20 m tall. Roosts in hollow-bearing trees, under bark or in buildings. Probable calls recorded during the Ecotone (2008a) survey.	Recorded. Impacts likely on roosting and foraging habitat. An assessment of significance has been completed for this species.
Little Bentwing Bat *Miniopterus australis*	V	-	Moist Eucalypt forests whilst roosting in caves and man-made structures.	Recorded. Impacts likely on foraging habitat. An assessment of significance has been completed for this species.
Eastern Bentwing Bat *Miniopterus schreibersii oceanensis*	V	-	Roosts in caves, derelict mines, storm-water tunnels, buildings. Forages in forested areas. Positive calls recorded during the Ecotone (2008a) survey.	Recorded. Impacts likely on foraging habitat. An assessment of significance has been completed for this species.

Table A.1 Threatened species previously recorded or predicted to occur in the locality

Species/community	Conservation status[1]		Habitat[2]	Likelihood of occurrence and potential for impacts from the proposed activity
	TSC Act	EPBC Act		
Southern Myotis *Myotis macropus*	V	-	Forages over streams and pools catching insects and small fish by raking their feet across the water surface. Possible calls recorded during the Ecotone (2008a) survey at the nearby bypass road.	Not recorded despite targeted surveys. Some potential habitat occurs. May occur or be impacted. An assessment of significance has been completed for this species.
Greater Broad-nosed Bat *Scoteanax rueppellii*	V	-	Woodland, moist and dry eucalypt forest, and rainforest but prefers tall wet forest.	Not recorded despite targeted surveys. Some potential habitat occurs. Unlikely to occur or be impacted.
Grey-headed Flying-fox *Pteropus poliocephalus*	V	V	Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths & swamps.	Not recorded despite targeted surveys. Some potential habitat occurs, but no key feed trees are present. Unlikely to occur or be impacted.
Large-eared Pied Bat *Chalinolobus dwyeri*	V	V	Roosts in caves, derelict mines frequenting low to mid elevation dry open forests and woodland close to these features.	Not recorded despite targeted surveys. Some potential habitat occurs. Unlikely to occur or be impacted.
Mammals				
Spotted-tailed Quoll *Dasyurus maculatus maculatus*	V	E	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. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	Potential habitat present, however more suitable habitat in remnant woodland nearby. Unlikely to occur or be impacted.
Koala *Phascolarctos cinereus*	V	-	Eucalypt forests and woodlands. Ribbon gum (*E. viminalis*) is a known feed tree for the Koala in the area, also Bundy (*E. goniocalyx*) and Coast Grey Box (*E. bosistoana*) are secondary feed species, with Narrow-leaved stringybark (*E. eugenioides*) a supplementary species.	Not recorded despite targeted surveys. Potential habitat occurs, however no evidence was observed of habitat use. Unlikely to occur or be impacted.
Yellow-bellied Glider *Petaurus australis*	V	-	Occur in tall mature eucalypt forest generally in areas with high rainfall. Inhabits tall wet eucalypt forest and requires tree hollows for nesting.	Not recorded despite targeted surveys. No suitable habitat occurs as it requires tall, productive woodlands. Unlikely to occur or be impacted.

Table A.1 Threatened species previously recorded or predicted to occur in the locality

Species/community	Conservation status[1]		Habitat[2]	Likelihood of occurrence and potential for impacts from the proposed activity
	TSC Act	EPBC Act		
Squirrel Glider *Petaurus norfolcensis*	V	-	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest with heath understorey in coastal areas. It inhabits mature dry woodlands, preferring mixed species stands and a diverse shrub understorey, including *Acacia spp*.	Not recorded despite targeted surveys. Potential habitat is present.
Brush-tailed Rock-wallaby *Petrogale penicillata*	E	V	Rocky escarpments, outcrops, steep slopes or cliffs - especially those with caves, ledges or overhangs and shrub cover.	No suitable habitat occurs as it requires rocky escarpments and cliffs. Unlikely to occur or be impacted.
New Holland Mouse *Pseudomys novaehollandiae*	-	V	Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. It is a social animal, living predominantly in burrows shared with other individuals.	No suitable habitat occurs as it requires heathlands or heathy understorey. Unlikely to occur or be impacted.

Note: 1. TSC Act - Threatened Species Conservation Act 1995; EPBC Act - Environment Protection and Biodiversity Conservation Act 1999; V - vulnerable; E - endangered; pop - population.

2. Information source: Threatened species information database online http://www.environment.nsw.gov.au/threatenedSpeciesApp or Species Profile and Threats Database online http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

Appendix B

Assessments of significance

B.1 Significant impact criteria in accordance with the TSC Act

Section 5A of the *Environment Planning and Assessment Act 1979* (EP&A Act) provides the criteria that must be considered in the assessment of the significance of potential impacts on all threatened species listed under the TSC Act. Assessment of Significance (known as the seven-part test) is made up of the following seven questions:

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

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

3. In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

    a) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

    b) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

4. In relation to the habitat of a threatened species, population or ecological community:

    a) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

    b) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action;

    c) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

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

6. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

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

Assessments of significance are undertaken in accordance with *Threatened Species Assessment Guidelines: The Assessment of Significance* (DEC 2007b).

B.1.1 Assessments of significance

Communities and species as identified in Appendix A requiring additional assessment and which are listed as threatened under the TSC Act were assessed using the seven-part test. Seven-part tests have been prepared in accordance with the criteria presented in Section B.1. Assessments have been undertaken for guilds of species or communities which have similar habitat requirements. The results of tests have been tabulated for ease of reading and are presented in the following sections. Assessments in accordance with the EPBC Act are provided in Section B.2.1.

i Box Gum Woodland EEC

White Box Yellow Box Blakely's Red Gum Woodland (Box Gum Woodland) is listed as an endangered ecological community (EEC) under the NSW TSC Act.

The extension project would impact up to 15.4 ha of Box Gum Woodland EEC (including derived native grassland). This represents approximately 2.0% of the existing community within the locality (756.6 ha). Of this, 8.4 ha occurs as higher quality woodland and 7 ha occurs as derived native grassland in the extension area.

An assessment of impact criteria has been completed to assess potential impacts of the extension project on this EEC (Table B.1).

Table B.1 Assessment of impact criteria for Box Gum Woodland EEC

Criteria	Discussion
1: life cycle of threatened species	N/A
2: life cycle of endangered population	N/A
3: EEC extent of removal and modification	The study area contains patches of Box Gum Woodland EEC. An area of the community (15.4 ha) will be removed for the proposed works. Substantial areas outside the study area have been mapped as containing Box Gum Woodland EEC (Tozer et al 2010). It is therefore unlikely that the removal of these discrete areas on an existing edge around the quarry could have an adverse effect on the extent of the community, or potentially place it at risk of extinction in the locality. Potential indirect impacts of the extension project that could cause modification of this community include increased edge effects and introduction or spread of weeds. To minimise these potential impacts, weed control and monitoring will continue to be implemented in the area as described in the RBOMP and as part of the offset package for the project.
4: habitat removal, fragmentation, isolation and importance	The extension project will remove 15.4 ha of Box Gum Woodland EEC. Box Gum Woodland EEC currently occurs as remnant vegetation along the drainage lines and depressions in the extension area. Some patches of higher quality woodland occur in the extension area but these are interspersed with areas of derived native grassland indicative of the community. These run in a north-south corridor along two drainage lines in the extension area. The extension project may isolate the area of Box Gum Woodland EEC to the north of the extention area, however as this area is connected to the north of the study area to similar vegetation and that these areas will become part of the offsets which will enhance the quality and amount of Box Gum Woodland EEC present, this impact is not considered to be significant for the patch. Historical aerial photography shows that most of these areas have been cleared in the past for agricultural practices. Therefore the current extent is largely regrowth, which have been degraded from grazing and weed infestations. Therefore the areas to be removed are not considered important to the survival of the community in the locality.

Table B.1 Assessment of impact criteria for Box Gum Woodland EEC

Criteria	Discussion
5: critical habitat	Critical habitat under the TSC Act has not been declared for Box Gum Woodland EEC.
6: consistency with recovery or threat abatement plans	A recovery or threat abatement plan has not been prepared for Box Gum Woodland EEC. However, a number of management actions have been identified to aid in its recovery. The actions focus on research and conservation management at priority sites. The study area has not been identified as a priority site and is not inconsistent with these objectives.
7: key threatening processes	The proposed quarry extension works constitute and increase 'clearing of native vegetation', 'removal of dead wood and dead trees', 'loss of hollow-bearing trees' and 'predation by European Red Fox'. The RBOMP will detail measures to minimise these impacts on remnant stands of the community in the proposed offsets.
Conclusion	The extension project is unlikely to result in significant impacts to Box Gum Woodland EEC as: • it only removes 15.4 ha or 2.0% of the community within the locality; • it will not significantly fragment or isolate the community in the locality; and • it is not inconsistent with management actions for recovery of the community.

ii Raptors: Little Eagle (*Hieraaetus morphnoides*) and Square-tailed Kite (*Lophoictinia isura*)

The **Little Eagle** is listed as a vulnerable species under the TSC Act. The species occupies open eucalypt forest, woodland or open woodland and nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. It preys on birds, reptiles and mammals, occasionally feeding on large insects and carrion (OEH 2015b). The species was not recorded during the site surveys but there are previous records from the locality.

The **Square-tailed Kite** is listed as a vulnerable species under the TSC Act. It is found in a variety of timbered habitats including dry woodlands and open forests, showing a particular preference for timbered watercourses. It is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage. The species occupies large hunting ranges of more than 100 km^2 (OEH 2015b). The Square-tailed Kite was recorded flying over the extension area.

The extension project will result in the removal of up to 54.1 ha of potential habitat for these raptors. This equates to 2.2% of the habitats available within the locality.

An assessment of impact criteria under Part 5a of the EP&A Act has been completed to assess potential impacts of the extension project to threatened raptors (Table B.2).

Table B.2 Seven part test for the threatened raptors

Criteria	Discussion
1: Life cycle of threatened species	The extension project will result in the removal of potential breeding and foraging habitat for these raptor species in the form of tall trees providing suitable nesting locations adjacent to foraging grounds. No large stick nests were identified during the field investigations. The Little Eagle has been recorded during 2007 near Jaormin Creek adjacent to the extension area, while the Square-tailed Kite was recorded within the study area during the field investigations. Given no nests were observed during the field investigations it is unlikely that these raptors are breeding near the extension area. However, there is the potential that these birds may establish nests or forage during the breeding season within the study area. The removal of up to 54.1 ha of habitat for these raptors has the potential to affect breeding success, limit recruitment and decrease the local population size in the long-term. However, given the availability of such resources throughout the locality, these impacts are considered minor for the species in the long-term for these highly mobile species (approximately 2.2% of available habitats within the locality will be impacted). Indirect impacts such as night light may also interrupt these species and affect breeding success in the study area, though such impacts are only likely to be minor.
2 : Life cycle of endangered population	N/A
3: EEC extent and modification	N/A
4: Habitat removal, fragmentation, isolation and importance	Foraging habitat is widely distributed within the study area and surrounds. Up to 54.1 ha of vegetation representing potential breeding and foraging habitat for these bird species will be removed for the extension project. The works will not fragment habitat for threatened raptors as they are a highly mobile species and continuous vegetation in surrounding areas will be retained.
5: Critical habitat	Critical habitat has not been declared for any of these threatened raptors.
6: Consistency with recovery or threat abatement plans	No recovery plan, or threat abatement plan exists for these birds or prey. These species have been assigned to the landscape management species under the Saving Our Species program. The study area does not occur within any identified management sites for the recovery of Little Eagle or Square-tailed Kite. Identified recovery actions (OEH 2015b) include the protection of open forest, woodland including paddock trees, preserving a mosaic of habitats, restoring degraded remnants and riparian corridors. The extension project is not consistent with these recovery actions, but the proposed offsets will restore potential habitat in the area.
7: Key threatening processes	The proposed quarry extension works constitute and increase 'clearing of native vegetation', 'removal of dead wood and dead trees', 'loss of hollow-bearing trees' and 'predation by European Red Fox'. The RBOMP will detail measures to minimise these impacts.
Conclusion	The proposed quarry extension works are not expected to result in significant impacts to threatened raptors as: • there will only be a minor reduction in available foraging habitat; • no known breeding sites will be removed; and • foraging and breeding resources are abundant in the wider locality.

iii Woodland birds: Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*), Diamond Firetail (*Stagonopleura guttata*), Little Lorikeet (Glossopsitta pusilla), Scarlet Robin (*Petroica boodang*), Flame Robin (*Petroica phoenicea*) and Speckled Warbler (*Chthonicola sagittata*)

The **Brown Treecreeper** is listed as vulnerable under the TSC Act. It is found in eucalypt woodlands (including Box-Gum Woodland) where it mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, with an open grassy understorey, sometimes with one or more shrub species. It is a sedentary species that uses hollows in standing dead or live trees and tree stumps for nesting (OEH 2015b). This species was not recorded in the extension area or broader study area despite targeted surveys.

The **Diamond Firetail** is listed as a vulnerable species under the TSC Act. It is found in grassy eucalypt woodlands, including Box-Gum Woodlands and in secondary grassland. The species is sedentary and 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) (OEH 2015b). A pair of Diamond Firetails was recorded in a small gully adjacent to the extension area. It is likely that the extension area and its surrounds forms part of the home range for the pair.

The **Little Lorikeet** is listed as vulnerable under the TSC Act. The species forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Hollow openings are very small, approximately 3 cm in diameter (OEH 2015b). It has high site fidelity with nesting areas, which are usually in proximity to feeding areas. However, nomadic movements, following food availability are common (OEH 2015b). This species was not recorded in the extension area or broader study area during the surveys.

The **Scarlet Robin** is listed as vulnerable under the TSC Act. It lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs and usually contains abundant logs and fallen timber as these are important components of its habitat. Breeding habitat may also be present as the Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions (OEH 2015b). This species was not recorded in the extension area or broader study area during the surveys.

The **Flame Robin** is listed as vulnerable under the TSC Act. It breeds in upland areas moving into drier inland slopes and plains during winter. It prefers clear areas with open understoreys, often occurring in recently burnt areas (OEH 2015b). This species was not recorded in the extension area or broader study area during the surveys.

The **Speckled Warbler** is listed as vulnerable under the TSC Act. It lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Large, relatively undisturbed remnants are required for the species to persist in an area. Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding (OEH 2015b). A pair of Speckled Warblers was recorded adjacent to the extension area in a small gully. It is likely that the pair is breeding in the locality.

The extension project will result in the removal of up to 12.2 ha of potential habitat for these woodland birds including 19 hollow bearing trees. This equates to 0.8% of the habitats available within the locality.

An assessment of impact criteria under Part 5a of the EP&A Act has been completed to assess potential impacts of the extension project to threatened woodland birds (Table B.3).

Table B.3 Seven part test for the threatened woodland birds

Criteria	Discussion
1: Life cycle of threatened species	The extension project will result in the removal of potential breeding habitat (in the form of nineteen hollow bearing trees, or foraging resources in proximity to potential breeding areas) for all species. Pairs of Speckled Warblers and Diamond Firetails were observed during the field investigations and are likely to occupy breeding territories within the study area, but outside the extension area. Although the remaining woodland birds were not observed during the field investigations these species may use tree hollows for breeding (Brown Treecreeper and Little Lorikeet) or nest within the extension area or surrounds on occasion. The extension project would impact on up to 12.2 ha of potential breeding and foraging habitat for these woodland bird species. Impacts on these habitat resources have the potential to affect breeding success, limit recruitment and decrease the local population size in the long-term. However, given that potential breeding resources within the extension area are few (including hollow bearing trees), and given the availability of such resources throughout the locality, these impacts are considered minor for these species in the long-term. Indirect impacts such as increased vehicle movements may also interrupt these species and affect breeding success in the study area, though such impacts are only likely to be minor.
2 : Life cycle of endangered population	N/A
3: EEC extent and modification	N/A
4: Habitat removal, fragmentation, isolation and importance	Foraging habitat is widely distributed within the study area and surrounds. Up to 12.2 ha of woodland representing foraging habitat for these woodland bird species and up to 19 hollow-bearing trees will be removed for the proposed quarry extension works. The works will not fragment habitat for threatened woodland birds as they are a highly mobile species and continuous vegetation in surrounding areas will be retained.
5: Critical habitat	Critical habitat has not been declared for any of these threatened woodland birds.
6: Consistency with recovery or threat abatement plans	No recovery plans, or threat abatement plan exists for these threatened woodland birds. These species have been assigned to the landscape management species under the Saving Our Species program. The study area does not occur within any identified management sites for the recovery of Brown Treecreeper, Diamond Firetail, Speckled Warbler, Little Lorikeet, Flame Robin or Scarlet Robin. Identified recovery actions (OEH 2015b) include the protection of open forest, woodland including paddock trees (and tree hollows for the Little Lorikeet and Brown Treecreeper), preserving a mosaic of habitats, encouraging the regeneration of native grassy understoreys, restoring degraded remnants and riparian corridors. The extension project is not consistent with these recovery actions.
7: Key threatening processes	The extension project constitutes and increases 'clearing of native vegetation', 'removal of dead wood and dead trees', 'loss of hollow-bearing trees' and 'predation by European Red Fox'. The updated RBOMP will detail measures to minimise these impacts.
Conclusion	The proposed quarry extension works are not expected to result in significant impacts to threatened woodland birds as: • there will only be a minor reduction in available foraging habitat; • only a small amount of potential breeding habitat will be removed; and • foraging and breeding resources are abundant in the wider locality.

iv Striped Legless Lizard (*Delma impar*)

The **Striped Legless Lizard** is listed as vulnerable under the TSC Act. The species is often found in Natural Temperate Grassland, secondary grassland near Natural Temperate Grassland and occasionally in open Box-Gum Woodland. Habitat occurs where grassland is dominated by perennial, tussock-forming grasses such as Kangaroo Grass (*Themeda australis)*, spear-grasses (*Austrostipa* spp.) and poa tussocks (*Poa* spp.), and occasionally wallaby grasses (*Austrodanthonia* spp). It is sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter (OEH 2015b). The species was not identified in the extension area or broader study area during the site surveys.

An assessment of impact criteria under Part 5a of the EP&A Act has been completed to assess potential impacts of the extension project to threatened reptiles (Table B.4).

Table B.4 Seven part test for the Striped Legless Lizard

Criteria	Discussion
1: Life cycle of threatened species	The extension project will result in the removal of potential breeding habitat in the form of native temperate grassland and surface rocks, particularly in the areas occupied by remnant Box Gum Woodland EEC which contains an abundance of native grass species. Given the lack of records for this species in the locality and that no individuals were found during the targeted surveys it is unlikely that a large population exists within the study area. If a population is present, the impacts on these habitat resources have the potential to affect breeding success, limit recruitment and decrease the local population size in the long-term. However, given that only limited habitat will be removed, and given the availability of suitable habitats throughout the locality, these impacts are considered minor for the species in the long-term. Indirect impacts such as increased vehicle movements may interrupt these species and affect breeding success in the study area, though such impacts are only likely to be minor.
2 : Life cycle of endangered population	N/A
3: EEC extent and modification	N/A
4: Habitat removal, fragmentation, isolation and importance	Foraging habitat is widely distributed within the study area and surrounds. Up to 8.4 ha of Box Gum Woodland (ie excluding Box Gum Woodland derived native grassland), which provides potential habitat for this species is proposed to be removed as part of the works, representing 0.6 % of potential habitat in the locality. The works will not fragment habitat for the Striped Legless Lizard given the continuous vegetation in surrounding areas will be retained.
5: Critical habitat	Critical habitat has not been declared for any of the Striped Legless Lizard.
6: Consistency with recovery or threat abatement plans	A recovery plan has been prepared for the Striped Legless Lizard. Relevant to the extension project, the plan focuses on obtaining a better understanding of the species distribution, establishing a reserve network to protect important populations, further research into the species ecological requirements, identifying key threatening processes, monitoring and increasing community awareness. The extension project does not interfere with these objectives.
7: Key threatening processes	The extension project constitutes and increases 'clearing of native vegetation', 'removal of dead wood and dead trees', 'loss of hollow-bearing trees' and 'predation by European Red Fox'. The updated RBOMP will detail measures to minimise these impacts.
Conclusion	The proposed quarry extension works are not expected to result in significant impacts to the Striped Legless Lizard as: • the study area does not contain any known populations of the species; • the extension project would not interfere with the species recovery; and • foraging and breeding resources are abundant in the wider locality.

v Microbats: Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*), Eastern Freetail Bat (*Mormopterus norfolkensis*) Southern Myotis (*Myotis macropus*) and Little Bentwing Bat (*Miniopterus australis*)

The **Eastern False Pipistrelle** is listed as vulnerable under the TSC Act. This species prefers moist habitats with tall trees. The Eastern False Pipistrelle typically roosts in tree hollows but may shelter under loose bark or in the rooves of buildings (OEH 2015b). This species requires tree hollows in which to breed. Habitat is present for this species in eucalypt woodlands. This species was recorded during the recent field investigations.

The **Eastern Bentwing Bat** is listed as vulnerable under the TSC Act. Habitat (non-breeding) is present for this species in eucalypt woodland and open grasslands (Churchill, 2008). This species migrates to maternity roosts in limestone caves in October and gives birth from December to January. Females leave maternity sites in March to seek out cold caves for winter hibernation. Eastern Bentwing Bats roost in other caves and road culverts for the remainder of the year. Within the study area, roosting habitat is available in crevices and cracks of rocky outcrops on the faces of cliffs (OEH 2015b).

The **Eastern Freetail Bat** is listed as vulnerable under the TSC Act. The species occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures (OEH 2015b). This species has potential habitat within the study area.

The **Southern Myotis** is listed as vulnerable under the TSC Act. This species is closely associated with water courses foraging along rivers and streams. It may roost in a variety of locations including tree hollows, mine shafts, storm-water channels, under bridges and amongst dense aquatic vegetation (OEH 2015b). Habitat is present for this species in eucalypt woodlands and along riparian vegetation in proximity to water bodies. This species was recorded nearby to the study area in recent surveys.

The **Little Bentwing Bat** is listed as vulnerable under the TSC Act. It occurs in moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. It is generally found in well-timbered areas. The species roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats (OEH 2015b). This species was recorded during the recent field investigations.

The study area provides potential foraging habitat for these microbat species. Breeding and roosting habitat is also potentially present for these microbats with the exception of the Little Bentwing Bat and Eastern Bentwing Bat which breed exclusively in maternity caves.

An assessment of impact criteria under Part 5a of the EP&A Act has been completed to assess potential impacts of the extension project to threatened microbats (Table B.5).

Table B.5 Assessment of impact criteria for the threatened microbats

Criteria	Discussion
1: Life cycle of threatened species	The Little Bentwing Bat and Eastern Bentwing Bat breed exclusively in maternity caves which do not occur in proximity to the extension area. These species will roost in culverts, caves and buildings outside the breeding season. The extension project will not impact breeding or roosting resources for these microbat species. The extension area provides potential breeding habitat for the Eastern Freetail Bat, Eastern False Pipistrelle and Southern Myotis within hollow-bearing trees. Impacts on these habitat resources have the potential to affect breeding success, limit recruitment and decrease the local population size in the long-term. However, given that only up to 19 hollow-bearing trees will be removed, and given the availability of such resources throughout the locality, these impacts are considered minor for the species in the long-term. Indirect impacts such as night light may also interrupt these species and affect breeding success in the extension area, though such impacts are only likely to be minor.
2: Life cycle of endangered population	N/A
3: EEC extent and modification	N/A
4: Habitat removal, fragmentation, isolation and importance	Foraging habitat is widely distributed within the extension area, with only sheltering habitat and potential breeding habitat in hollow-bearing trees. Up to 12.2 ha of woodland representing foraging habitat for these species and up to 19 hollow-bearing trees will be removed for the proposed quarry extension works. This represents up to 0.8% of available habitats within the broader locality. The works will not fragment habitat for threatened microbats as they are a highly mobile species and continuous vegetation in surrounding areas will be retained.
5: Critical habitat	Critical habitat has not been declared for any of these threatened microbats.
6: Consistency with recovery or threat abatement plans	No recovery plan, threat abatement plan or priority action statement exists for these threatened microbats. Identified recovery actions (OEH 2015b) include the protection of roosting sites from damage or disturbance. The extension project is not consistent with these recovery actions for Eastern False Pipistrelle, Eastern Freetail Bat and Southern Myotis.
7: Key threatening processes	The proposed quarry extension works constitute and increase 'clearing of native vegetation', 'removal of dead wood and dead trees', 'loss of hollow-bearing trees' and 'predation by European Red Fox'. The updated RBOMP will detail measures to minimise these impacts.
Conclusion	The extension project is not expected to result in significant impacts to threatened microbats as: • there will only be a minor reduction in available foraging habitat; • foraging resources are abundant in the wider locality; and • only a small amount of potential breeding or roosting habitat for the Eastern Freetail Bat, Eastern False Pipistrelle and Southern Myotis will be removed.

B.2 Significant impact criteria in accordance with the EPBC Act

The following sections provide the criteria that must be considered in the assessment of all threatened species listed under the EPBC Act. There are separate criteria for each listing category under the EPBC Act, in accordance with *'EPBC Act Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance'* (DoE 2013).

B.2.1 Significant impact criteria for critically endangered and endangered ecological communities

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:

- reduce the extent of an ecological community;
- fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;
- adversely affect habitat critical to the survival of an ecological community;
- 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;
- 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;
- cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
    - assisting invasive species, that are harmful to the listed ecological community, to become established; or
    - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or
- interfere with the recovery of an ecological community.

B.2.2 Significant impact criteria for critically endangered and endangered species

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of a population;
- reduce the area of occupancy of the species;
- fragment an existing population into two or more populations;
- adversely affect habitat critical to the survival of a species;

- disrupt the breeding cycle of a population;
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
- introduce disease that may cause the species to decline; or
- interfere with the recovery of the species.

B.2.3 Significant impact criteria for vulnerable species

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species;
- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat;
- introduce disease that may cause the species to decline; or
- interfere substantially with the recovery of the species.

B.2.4 Significant impact criteria for listed migratory species

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- 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
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

B.2.5 Assessments of significance

Assessments of significance have been prepared for species listed under the EPBC Act, in accordance with the criteria above.

i Critically endangered ecological communities: Box Gum Woodland

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland is listed as a Critically Endangered ecological community (Box Gum Woodland CEEC) under the EPBC Act. See Section B.1.1 (i) for a description of Box Gum Woodland.

The extension project will impact up to 8.4 ha of Box Gum Woodland CEEC.

An assessment of significance has been completed to assess potential impacts on this CEEC (Table B.6).

Table B.6 Assessment of impact criteria for Box Gum Woodland CEEC

Criteria	Discussion
1: reduce extent of EEC	This TEC has been heavily cleared in the locality. The extension project will result in the removal of up to 8.4 ha of Box Gum Woodland from the extension area.
2: fragment an EEC	Box Gum Woodland EEC currently occurs as remnant vegetation along the drainage lines and depressions in the extension area. Some patches of higher quality woodland occur in the extension area but these are interspersed with areas of derived native grassland that does not meet the descriptions of the EPBC Act listing criteria. These run in a north-south corridor along two drainage lines in the extension area. The extension project may isolate the area of Box Gum Woodland EEC to the north of the extension area, however as this area is connected to the north of the study area to similar vegetation and that these areas will become part of the offsets which will enhance the quality and amount of Box Gum Woodland EEC present, this impact is not considered to be significant.
3: adversely affect critical habitat for an EEC	Habitat critical to the survival of Box Gum Woodland has been identified by DECCW (2010) as wherever it occurs. The extension project will result in the removal of 8.4 ha of such habitat.
4: modify or destroy abiotic factors	The extension project will remove the soils and seedbank of the areas to be impacted which will affect the abiotic factors associated with the community in the area. An assessment has been completed of potential impacts to the community outside the extension area, with respect to changes in groundwater availability. Aside from the areas immediately adjacent to the pit, drawdown of the fractured rock porphyry for the extension project is not predicted to increase the component of vertical leakage (ie available water to the community) of the overlying Chapmans Creek alluvium. Therefore, it is unlikely that the extension project would affect any abiotic factors outside the extension area which would impact on remnants of the community in the wider study area.
5: substantial change in composition of an EEC	Potential changes to composition of the TEC could occur through weed invasion or dust deposition (where species assemblages change to favour dust tolerant species). In order to reduce the potential for these impacts, management and mitigation measures will be implemented as part of the RBOMP and management of the proposed offsets.
6: substantial reduction in quality or integrity of EEC	Historical aerial photography shows that most of these areas have been cleared in the past for agricultural practices. Therefore the current extent is largely regrowth, which have been degraded from grazing and weed infestations. Therefore the areas to be removed are not considered important to the survival of the community in the locality. Measures will be employed in retained areas containing the community as part of the RBOMP and offsets to ensure that the quality and integrity of remnant patches is enhanced.

Table B.6 Assessment of impact criteria for Box Gum Woodland CEEC

Criteria	Discussion
7: interfere with recovery	Recovery objectives for Box Gum Woodland focus on the achievement of 'no net loss', increasing connectivity and restoring sites (DECCW 2010). The RBOMP will incorporate these objectives, with species characteristic of these communities to be planted within rehabilitated areas. However, as the extension project removes vegetation consistent with the community, it is not considered to be consistent with recovery of these community types.
Conclusion	The extension project is expected to result in significant impacts to Box Gum Woodland because it: • removes up to 8.4 ha of TEC from the extension area; • impacts critical habitat for Box Gum Woodland; and • is not consistent with the recovery plan for this community. Offsets will be provided to compensate for residual impacts to the Box Gum Woodland CEEC.

ii Vulnerable reptiles: Striped Legless Lizard (*Delma impar*)

See Section B.1.1 (iv) for a description of the vulnerable reptiles. An assessment of significance has been completed to assess potential impacts of future development on these threatened species (Table B.7).

Table B.7 Assessment of significance for the Striped Legless Lizard

Criteria	Discussion
1: Long-term decrease of an important population	The *National Recovery Plan for the Striped Legless Lizard* (Smith and Robertson 1999) does not identify important populations of the species, and states that additional research is required before this is determined. Three important populations are known from Victoria (Iramoo Wildife Reserve and Keilor Plains in Melbourne and Dashwood). These populations contain large numbers of the species (up to 600 individuals) and are considered important for the species' long-term survival and recovery (DoE 2015). The extension area is not located near these areas, therefore it will not lead to the long-term decrease of an important population. Given the lack of individuals recorded in the study area, it is not considered likely to contain an important population of the Striped Legless Lizard.
2: Reduce area of occupancy of an important population	The study area does not contain an important population of the Striped Legless Lizard.
3: Fragment an existing population	The study area does not contain an important population of the Striped Legless Lizard.
4: Adversely affect critical habitat	Critical habitat has not been declared for the Striped Legless Lizard. However, given that the species is usually only recorded in small numbers, the areas in which the important populations are located in Victoria could be considered to contain habitat critical to the survival of the species. The extension project will not affect these areas, and therefore will not adversely affect habitat critical to the survival of the species.
5: Disrupt the breeding cycle of an important population	The study area does not provide breeding habitat for an important population of this species.

Table B.7 Assessment of significance for the Striped Legless Lizard

Criteria	Discussion
6: Decrease availability or quality of habitat	Potential habitat to be removed for the Striped Legless Lizard is approximately 0.6% of available habitat in the locality. This small reduction in habitat availability is not expected to cause the species to decline, if present in the extension area. Potential reduction in habitat quality of habitat surrounding the extension area could occur, primarily through weed invasion. Management of weeds will be implemented as part of the RBOMP, which will be updated prior to commencement of the extension project.
7: Result in invasive species	The extension project is not expected to increase the threat of invasive species to the Striped Legless Lizard.
8: Introduce disease	The extension project is not likely to increase the likelihood, introduction, or spread of any disease that would affect this species.
9: Interfere with the recovery of the species	Recovery objectives in the *National Recovery Plan for the Striped Legless Lizard* (Smith and Robertson 1999) focus on obtaining a better understanding of the species distribution, establishing a reserve network to protect important populations, further research into the species ecological requirements, identifying key threatening processes, monitoring and increasing community awareness. The proposed modification does not interfere with these objectives.
Conclusion	The extension project is unlikely to result in significant impacts to the Striped Legless Lizard as: • the extension area does not contain an important population of the species; • habitat availability will only by reduced by 0.6% in the locality; and • the extension project does not interfere with the species recovery.

Appendix C

Species recorded

Table C.1 EMM BioBanking plots data

Family	Exotic	Scientific name	Common name	Cover abundance score												
				Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13
Acanthaceae		*Brunoniella australis*	Blue Trumpet								1	1				
Adiantaceae		*Cheilanthes sieberi*	Rock Fern	2	1			3	4		3	4			2	4
Amaranthaceae		*Amaranthus macrocarpus* subsp. Pallidus				1	1									
		Amaranthus spp.				1										
Anthericaceae		*Laxmannia gracilis*	Slender Wire Lily												2	
		Tricoryne elatior	Yellow Autumn-lily	2	1											
Apiaceae		*Daucus glochidiatus*	Native Carrot								1					
		Hydrocotyle laxiflora	Stinking Pennywort			3		3			3	2				
Asteraceae		*Cassinia arcuata*	Sifton Bush		1				1							
		Chrysocephalum apiculatum	Common Everlasting					2		1						2
	*	*Cirsium vulgare*	Spear Thistle	2	1	1		1		2				2		2
	*	*Conyza spp.*	A Fleabane		1	2					2					
		Cymbonotus lawsonianus	Bears-ear	1	1					1	1					3
		Euchiton japonicus	Creeping Cudweed			3			1		2	3		1	2	2
		Euchiton spp.	Cudweed										1			
		Gnaphalium spp.	Cudweed							1						
	*	*Hypochaeris radicata*	Catsear	2		2	2	2	2	3	2	3	5	3	1	3
	*	*Senecio madagascariensis*	Fireweed		1											
		Solenogyne dominii													1	
		Solenogyne gunnii	Solengyne		1											
	*	*Sonchus asper*	Prickly Sowthistle					1			1					
		Vittadinia spp.	Fuzzweed									1				
Brassicaceae	*	*Lepidium africanum*	Common Peppercress		2	1										

Table C.1 EMM BioBanking plots data

Family	Exotic	Scientific name	Common name	Cover abundance score												
				Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13
Campanulaceae		*Wahlenbergia communis*	Tufted Bluebell				2	2	2	1	1	2	1	1	2	1
		Wahlenbergia gracilis	Sprawling Bluebell	1	1											
		Wahlenbergia multicaulis	Tadgell's Bluebell			2										
Caryophyllaceae	*	*Paronychia brasiliana*	Chilean Whitlow Wort	1	2											
	*	*Petrorhagia dubia*		1								1				
	*	*Petrorhagia prolifera*	Proliferous Pink					1								
Chenopodiaceae		*Chenopodium carinatum*	Keeled Goosefoot	2	1											
		Dysphania pumilio				1		2							2	1
		Einadia hastata	Berry Saltbush		2											
		Einadia nutans	Climbing Saltbush		2							1				
		Einadia polygonoides	Knotweed Goosefoot			1										
Clusiaceae		*Hypericum gramineum*	Small St John's Wort					2	2			3			1	
Convolvulaceae		*Dichondra repens*	Kidney Weed	1	2	3		1	1					1		
		Dichondra spp.									1					
Crassulaceae		*Crassula sieberiana*	Australian Stonecrop			1	1									
Cucurbitaceae	*	*Cucumis myriocarpus subsp. leptodermis*	Paddy Melon				1									
Cyperaceae		*Carex inversa*	Knob Sedge			1								1		
	*	*Cyperus brevifolius*		1												
		Fimbristylis dichotoma	Common Fringe-sedge	2					1	2		2				2
Dilleniaceae		*Hibbertia obtusifolia*	Hoary Guinea Flower					1	1		1	3			3	
Ericaceae		*Astroloma humifusum*	Native Cranberry					3	4	3	2	3		1	1	3
		Brachyloma daphnoides	Daphne Heath												1	
		Lissanthe strigosa	Peach Heath	3		1										
		Melichrus urceolatus	Urn Heath						2			2			1	

Table C.1 EMM BioBanking plots data

Family	Exotic	Scientific name	Common name	Cover abundance score												
				Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13
Euphorbiaceae		*Chamaesyce drummondii*	Caustic Weed	1							1					
Fabaceae (Faboideae)		*Bossiaea heterophylla*	Variable Bossiaea												1	
		Bossiaea prostrata							3							
		Daviesia ulicifolia	Gorse Bitter Pea						1			3				
		Desmodium varians	Slender Tick-trefoil	2												1
		Dillwynia sericea	Egg and Bacon Peas, Parrot Peas									2				
		Glycine clandestina	Twining glycine	1	1	2		2	2			1				1
		Glycine microphylla	Small-leaf Glycine								3					
		Hardenbergia violacea	False Sarsaparilla						1							
		Pultenaea linophylla														1
	*	*Trifolium dubium*	Yellow Suckling Clover							3			1	3		
	*	*Trifolium repens*	White Clover								1					
	*	*Trifolium tomentosum*	Woolly Clover											3		
Fabaceae (Mimosoideae)		*Acacia mearnsii*	Black Wattle		1				1							
		Acacia ulicifolia	Prickly Moses									1			1	
Geraniaceae	*	*Erodium cicutarium*	Common Crowfoot	1												
		Geranium homeanum									2					
		Geranium solanderi	Native Geranium	2		3	1			3						
Goodeniaceae		*Goodenia hederacea*	Ivy Goodenia						3			4			3	
		Goodenia macbarronii	Narrow Goodenia					2								
Haloragaceae		*Gonocarpus* spp.													4	
		Gonocarpus tetragynus	Poverty Raspwort					2				4				
		Haloragis aspera	Rough Raspwort								4					
Hypoxidaceae		*Hypoxis* spp.											1			

Table C.1 EMM BioBanking plots data

Family	Exotic	Scientific name	Common name	Cover abundance score												
				Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13
Juncaceae		*Juncus australis*	Rush							1						
	*	*Juncus capillaceus*				1										
		Juncus filicaulis				1										
		Juncus usitatus		1				1				1		1		
Lomandraceae		*Lomandra filiformis subsp. coriacea*		2		2		1	2		3	3			3	1
Myrsinaceae	*	*Anagallis arvensis*	Scarlet Pimpernel	1												
Myrtaceae		*Eucalyptus amplifolia*	Cabbage Gum			1										
		Eucalyptus blakelyi	Blakely's Red Gum		4	3		4								4
		Eucalyptus bridgesiana	Apple Box		1	1		2	2							
		Eucalyptus cinerea	Argyle Apple								4				4	
		Eucalyptus eugenioides	Thin-leaved Stringybark		1	2	2	1	3		2	3			2	
		Eucalyptus melliodora	Yellow Box		2	3										1
		Leptospermum myrtifolium						1								
		Leptospermum parvifolium							2						2	
Orchidaceae		*Microtis unifolia*	Common Onion Orchid					1								
		Prasophyllum spp.				1										
Oxalidaceae		*Oxalis perennans*		2	2	1	1	1				1	3			1
Phyllanthaceae		*Phyllanthus hirtellus*	Thyme Spurge									4				
Plantaginaceae	*	*Plantago lanceolata*	Lamb's Tongues								2					
		Plantago varia						1								
		Veronica plebeia	Trailing Speedwell					1	2						1	3

Table C.1 EMM BioBanking plots data

Family	Exotic	Scientific name	Common name	Cover abundance score												
				Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13
		Aristida ramosa	Purple Wiregrass	1				2	3			2			2	
		Austrostipa rudis subsp. *nervosa*		2	1		2									
		Austrostipa rudis subsp. *rudis*							4							
		Austrostipa scabra	Speargrass		1	2			2			1	1			
		Bothriochloa macra	Red Grass	2				2	3	4	3		4	5		3
	*	*Bromus diandrus*	Great Brome			2										
	*	*Chloris gayana*	Rhodes Grass							1						
		Dactyloctenium radulans	Button Grass	2												
		Dichelachne micrantha	Shorthair Plumegrass									2		2		3
		Dichelachne sp.	Plumegrass								2					
		Digitaria diffusa	Open Summer-grass				1							4		
Poaceae	*	*Eleusine tristachya*	Goose Grass				1			2				1		
		Eragrostis benthamii		1				1								
		Eragrostis brownii	Brown's Lovegrass												1	
	*	*Eragrostis cilianensis*	Stinkgrass							4						
	*	*Eragrostis curvula*	African Lovegrass				1						4			
		Eragrostis leptocarpa	Drooping Lovegrass	1												
	*	*Holcus lanatus*	Yorkshire Fog											1		
		Microlaena stipoides	Weeping Grass	6	2	2	5	2		2	2			2	1	
	*	*Nassella trichotoma*	Serrated Tussock	4	5	5	2	3		2	2					
		Panicum effusum	Hairy Panic				2					1	4	5		2
	*	*Poa annua*	Winter Grass							2						
		Poa sieberiana	Snowgrass	2	1											
		Rytidosperma bipartita	Wallaby Grass			1										
		Rytidosperma fulvum	Wallaby Grass						3		2	3			1	1

Table C.1 EMM BioBanking plots data

Family	Exotic	Scientific name	Common name	Cover abundance score												
				Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13
		Rytidosperma laeve				3		2		3						
		Rytidosperma racemosum	Wallaby Grass		1											
	*	*Setaria spp.*											3	2		
		Sporobolus creber	Slender Rat's Tail Grass	2			2			3						
		Themeda australis	Kangaroo Grass	1				1	1		2	2				
	*	*Urochloa spp.*								1	2					
Polygonaceae	*	*Acetosella vulgaris*	Sheep Sorrel	2		2	1			2	2		1	2	1	3
		Acaena novae-zelandiae	Bidgee-widgee			1										
Rosaceae		*Acaena ovina*	Acaena	1				2								
	*	*Rubus anglocandicans*	Blackberry	1		2					2					
		Asperula conferta	Common Woodruff	1		3		1	1		1	1				1
Rubiaceae		*Opercularia aspera*	Coarse Stinkweed		1				2							
	*	*Richardia stellaris*		1												
Santalaceae		*Exocarpos strictus*	Dwarf Cherry						2							
		Solanum chenopodinum				2		2			1					1
Solanaceae	*	*Solanum nigrum*	Black-berry Nightshade		1	1										1
		Solanum prinophyllum	Forest Nightshade		2											
		Solanum pungetium	Eastern Nightshade			1										

Notes **Denotes introduced species*

Table C.2 EMM BioBanking transect data

Plot	Native plant species richness	Native overstorey cover (%)	Native midstorey cover (%)	Native groundcover (grasses)	Native groundcover (shrubs)	Native groundcover (other)	Exotic plant cover (%)	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs
1	30	0	0	75	0	0	25	0	0	0
2	24	29	0	20	0	0	70	0	1	5
3	27	18	0	30	0	30	80	1	1	35
4	10	2	0	100	0	0	30	0	0	20
5	32	23	0	60	0	30	10	0	1	5
6	30	19	0	70	0	60	0	2	1	20
7	11	0	0	100	0	10	30	0	0	0
8	23	10	0	60	0	80	0	0	1	7
9	31	42	0	20	10	70	10	0	1	5
10	0	0	0	70	0	0	80	0	0	0
10	0	0	0	70	0	0	80	0	0	0
11	11	0	0	80	0	10	30	0	0	1
12	24	28.5	0	10	20	50	10	0	1	0
13	22	13	0	40	0	60	30	0	1	0

Table C.3 Recorded fauna species

Taxa	Common name	Scientific name	EMM survey	Ecotone survey
Amphibia	Beeping Froglet	*Crinia parinsignifera*	X	X
	Clicking Froglet	*Crinia signifera*	X	X
	Stripped Marsh Frog	*Limnodynastes peronii*		X
	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	X	X
	Striped Rocket Frog	*Litoria nasuta*	X	
	Emerald-spotted Tree Frog	*Litoria peronii*	X	X
	Dusky Toadlet	*Uperoleia fusca*		X
	Red-groined Toadlet	*Uperoleia laevigata*		X
Aves	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	X	X
	Yellow Thornbill	*Acanthiza nana*	X	
	Brown Thornbill	*Acanthiza pusilla*	X	
	Buff-rumped Thornbill	*Acanthiza reguloides*	X	
	Pacific Black Duck	*Anas superciliosa*	X	X
	Wedge-tailed Eagle	*Aquila audax*	X	
	White-necked Heron	*Ardea pacifica*	X	
	Dusky Woodswallow	*Artamus cyanopterus*	X	X
	Hardhead	*Aythya australis*	X	
	Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	X	
	Australian Wood Duck	*Chenonetta jubata*	X	X
	Speckled Warbler[1]	*Chthonicola sagittata*	X	X
	Rufous Songlark	*Cincloramphus mathewsi*	X	
	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	X	X
	White-winged Chough	*Corcorax melanorhamphos*	X	X
	White-throated Treecreeper	*Cormobates leucophaea*	X	X
	Australian Raven	*Corvus coronoides*	X	X
	Stubble Quail	*Coturnix pectoralis*	X	
	Brown Quail	*Coturnix ypsilophora*	X	
	Pied Butcherbird	*Cracticus nigrogularis*	X	X
	Australian Magpie	*Cracticus tibicen*	X	X
	White-faced Heron	*Egretta novaehollandiae*	X	X
	Black-fronted Dotterel	*Elseyornis melanops*	X	
	Galah	*Eolophus roseicapillus*	X	X
	Nankeen Kestrel	*Falco cenchroides*	X	
	Eurasian Coot	*Fulica atra*	X	
	White-throated Gerygone	*Gerygone albogularis*	X	X
	Magpie-lark	*Grallina cyanoleuca*	X	X
	Welcome Swallow	*Hirundo neoxena*	X	X
	White-plumed Honeyeater	*Lichenostomus penicillatus*	X	
	Square-tailed Kite	*Lophoictinia isura*	X	
	Pink-eared Duck	*Malacorhynchus membranaceus*	X	

Table C.3 Recorded fauna species

Taxa	Common name	Scientific name	EMM survey	Ecotone survey
	Superb Fairy-wren	*Malurus cyaneus*	X	X
	Noisy Miner	*Manorina melanocephala*	X	
	Jacky Winter	*Microeca fascinans*	X	
	Red-browed Finch	*Neochmia temporalis*	X	
	Crested Pigeon	*Ocyphaps lophotes*	X	X
	Rufous Whistler	*Pachycephala rufiventris*	X	X
	Spotted Pardalote	*Pardalotus punctatus*	X	X
	Striated Pardalote	*Pardalotus striatus*	X	X
	Fairy Martin	*Petrochelidon ariel*	X	
	Noisy Friarbird	*Philemon corniculatus*	X	
	Crimson Rosella	*Platycercus elegans*	X	X
	Eastern Rosella	*Platycercus eximius*	X	X
	Tawny Frogmouth	*Podargus strigoides*	X	X
	Red-rumped Parrot	*Psephotus haematonotus*	X	X
	Grey Fantail	*Rhipidura albiscapa*	X	X
	Willie Wagtail	*Rhipidura leucophrys*	X	X
	Diamond Firetail[1]	*Stagonopleura guttata*	X	
	Pied Currawong	*Strepera graculina*	X	X
	Common Starling[2]	*Sturnus vulgaris*	X	
	Australasian Grebe	*Tachybaptus novaehollandiae*	X	X
	Straw-neck Ibis	*Threskiornis spinicollis*		X
	Australian Hobby	*Falco longipennis*		X
	Brown Falcon	*Falco berigora*		X
	Masked Lapwing	*Vanellus miles*		X
	Common Bronzewing	*Phaps chalcoptera*		X
	Sulphur-crested Cockatoo	*Cacatua galerita*	X	X
	Musk Lorikeet	*Glossopsitta concinna*		X
	Little Lorikeet[1]	*Glossopsitta pusilla*		X
	Australian Owlet-nightjar	*Aegotheles cristus*		X
	Laughing Kookaburra	*Dacelo novaeguineae*	X	X
	Dollarbird	*Eurystomus orientalis*		X
	Variegated Fairywren	*Malurus lamberti*		X
	Weebill	*Smicrornis brevirostris*		X
	Western Gerygone	*Gerygone fusca*		X
	Striated Thornbill	*Acanthiza leneata*		X
	Southern Whiteface	*Aphelocephala leucopsis*		X
	Red Wattlebird	*Anthochaera carunculata*		X
	Noisy Minor	*Manorina melanocephala*		
	Grey Shrike-thrush	*Colluricincla harmonica*	X	X
	White-winged triller	*Lalage tricolor*		X

Table C.3 Recorded fauna species

Taxa	Common name	Scientific name	EMM survey	Ecotone survey
	White-browed Woodswallow	*Artamus superciliosus*		X
	Grey Currawong	*Strepera versicolor*		X
	Richard's Pipit	*Anthus novaeseelandiae*		X
	Fairy Martin	*Hirundo ariel*		X
Mammalia	Common Brushtail Possum	*Trichosurus vulpecula*	X	X
	White-striped Free-tailed Bat	*Austronomus australis*	X	X
	Chocolate Wattled Bat	*Chailinolbous morio*	X	X
	Gould's Wattled Bat	*Chalinolobus gouldii*	X	X
	Eastern False Pipistrelle[1]	*Falsistrellus tasmaniensis*	X	X
	Brown Hare[2]	*Lepus capensis*		X
	Common Wallaroo	*Macopus robustus*		X
	Eastern Grey Kangaroo	*Macropus giganteus*	X	
	Little Bentwing Bat[1]	*Miniopterus australis*	X	
	Eastern Bentwing Bat[1]	*Miniopterus schreibersii oceanensis*	X	X
	South-eastern Freetail Bat	*Mormopterus sp.4*	X	X
	Freetail Bat	*Mormopterus sp.5*	X	
	Lesser Long-eared Bat	*Nyctophilus geoffroyi*	X	X
	Long-eared Bat	*Nyctophilus spp.*	X	
	Rabbit[2]	*Oryctolagus cuniculus*	X	
	Sugar Glider	*Petaurus breviceps*		X
	Little Broad-nosed Bat	*Scotorepens greyii*		X
	Eastern Broad-nosed Bat	*Scotorepens orion*		X
	Short-beaked Echidna	*Tachyglossus aculeatus*		X
	Large Forest Bat	*Vespadelus darlingtoni*	X	X
	Southern Forest Bat	*Vespadelus regulus*	X	X
	Little Forest Bat	*Vespadelus vulturnus*	X	X
	Wombat	*Vombatus ursinus*	X	
	Fox[2]	*Vulpes vulpes*	X	
	Swamp Wallaby	*Wallabia bicolour*	X	X
Reptilia	Jacky Lizard	*Amphibolurus muricatus*		
	Cunninham's Skink	*Egernia cunninghami*		
	Three-toes Skink	*Hermiergis decresiensis*		
	Garden Skink	*Lampropholis guichenoti*	X	
	Red-bellied Black Snake	*Pseudechis porphyriacus*	X	
	Eastern Blue-tongue Lizard	*Tiliqua scincoides*		

Notes: *1. Listed as a threatened species under the TSC Act 1995.*

2. Introduced species.

Appendix D

Koala assessment

D.1 Assessment in accordance with the Draft Koala Referral Guidelines

Action: Extension of an existing quarry **Context:** Coastal
Associated infrastructure: n/a
Primary impacts: Habitat removal for extension of quarry pit and stockpile areas
Impact area size: 17.29 ha (woodland only)

Table D.1 Koala EPBC Act Referral Guidelines assessment for the extension project

Attribute	Score	Data source	Habitat appraisal
Koala occurrence	0	Desktop	Nine Koala records occur in the locality (10 km radius) from the 1980s to 2013, which was recorded approximately 7 km to the north of the extension area associated with vegetation in the Tarlo River NP. Important feed species occur in the NP for the Koala including those identified in the extension area, but also areas of Grey Gum (*E. punctata*), Ribbon Gum (*E. viminalis*) and Brittle Gum (*E. mannifera*). The Protected Matters Search Tool identifies that the species or its habitat is known to occur in the area. One Koala sighting has been recorded in the locality on the Australian Koala Foundation (AKF) Koala Map, from 2014 on the Tarlo River Rd, approximately 5 km to the north-west of the extension area.
		On-ground	Previous surveys in 2006/2007, 2014 and for the current study (2015) throughout the extension area and surrounds did not identify any Koalas or evidence of use (scats, scratches, etc).
Vegetation structure and composition	+2	Desktop	The extension area is within proximity to both the Southern and Central Coast Koala Management Areas. A number of feed trees are known to occur in the locality.
		On-ground	Primary food trees in the South Coast Koala Management Area have been recorded in the extension area and the broader study area including Cabbage Gum (*Eucalyptus amplifolia*) and Ribbon Gum *(E. viminalis*), secondary feed tree Yellow Box (*E. melliodora*), and Apple-topped Box (*E. bridgesiana*) also occur. Primary food trees in the Central Coast Koala Management Area have also been recorded in the extension area and its surrounds including Cabbage Gum and Ribbon Gum. Secondary species including Bundy (*E. goniocalyx*) and supplementary species including Thin-leaved Stringybark (*E. eugenioides*) were also recorded. Recorded primary feed trees do not account for >50% of the vegetation in the relevant strata. However when secondary and supplementary feed tree species are included in the assessment, then the vegetation composition is favourable for the Koala.

Table D.1 Koala EPBC Act Referral Guidelines assessment for the extension project

Attribute	Score	Data source	Habitat appraisal
Habitat connectivity	+1	Desktop	The extension area is linked to vegetation to its south along the creek lines which still contain remnant vegetation. However, this corridor is narrow (100–200 m wide in locations). With the vegetation to the south of the extension area included, the area is part of a contiguous landscape with more than 300 ha of vegetation.
Key existing threats	+1	Desktop	No sick, injured or dead Koalas have been recorded by the AKF Koala Map. Habitat is heavily fragmented in the extension area and surrounds, with large patches only present to the east in conservation areas.
		On-ground	No Koalas were recorded.
Recovery value	0	Desktop and on-ground	Vegetation to the south of the extension area, which occurs as a large, contiguous patch, is likely to be important to the Koala in the area. However, movement corridors through the landscape are also important and it is likely that the creek lines could be providing a corridor for the species, despite it not being recorded in the extension area. However, the vegetation within the extension area is not considered important to the recovery of the species in the locality due to fragmentation and lack of signs of use.
Total score	**4**	Not critical	

Appendix E

Microbat sonograms

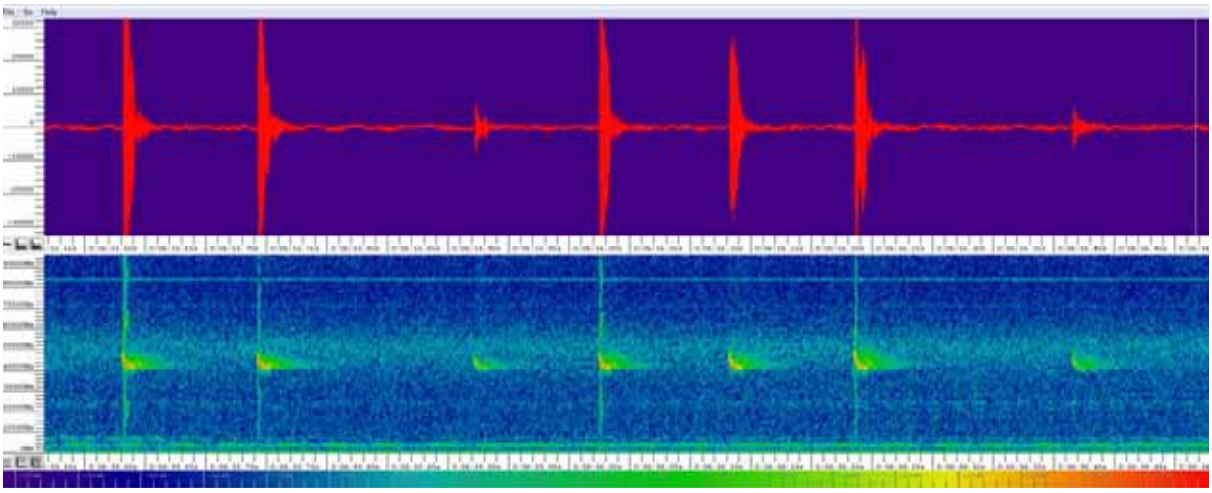

Figure E.1 Eastern False Pipistrelle

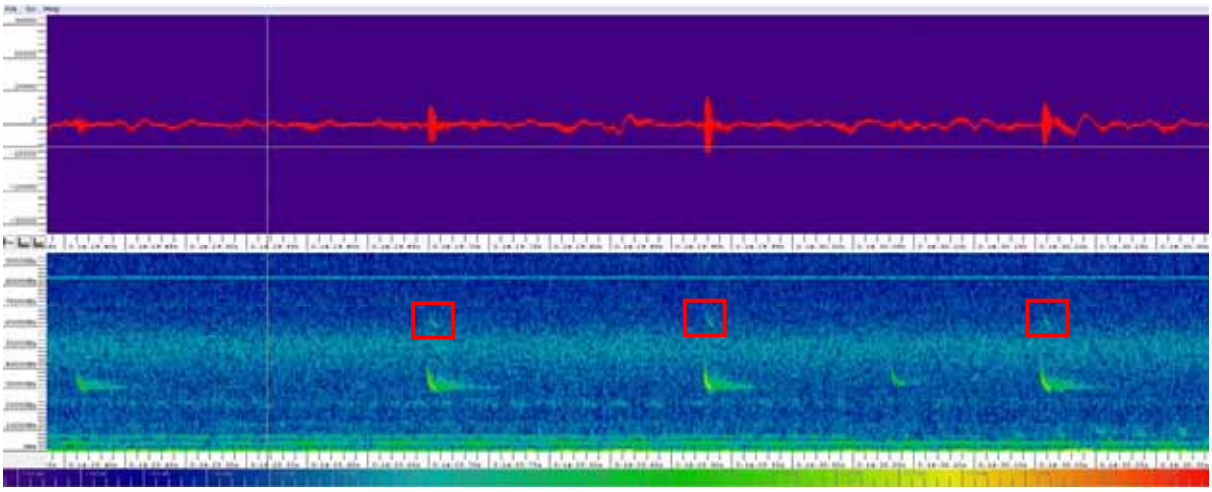

Figure E.2 Little Bentwing Bat (pulses highlighted in red squares only)

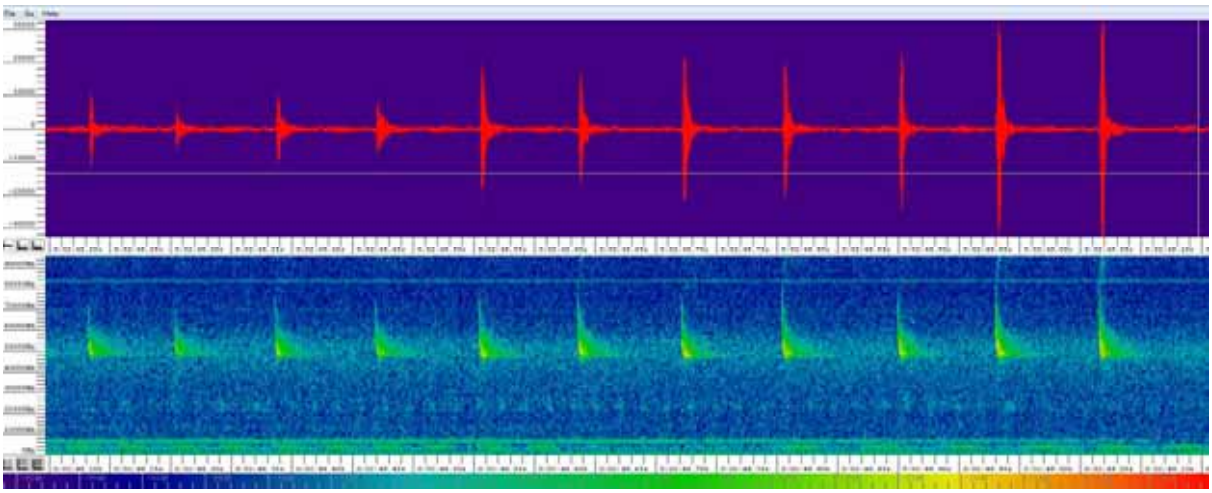

Figure E.3 Eastern Bentwing Bat

Appendix F

Offset calculator results

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Box Gum Woodland
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	**6.8%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	Yes	Box Gum Woodland	**Area**	8.4	Hectares	
			Quality	**6**	Scale 0-10	
			Total quantum of impact	5.04	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	Yes	5.04	Adjusted hectares	Unsecured and secured offsets	**Risk-related time horizon (max. 20 years)**	10	**Start area (hectares)**	44.2	**Risk of loss (%) without offset**	30%	**Risk of loss (%) with offset**	15%	6.63	70%	4.64	2.40	5.05	100.16%	Yes		
									Future area without offset (adjusted hectares)	30.9	**Future area with offset (adjusted hectares)**	37.6								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**5**	**Future quality without offset (scale of 0-10)**	**4**	**Future quality with offset (scale of 0-10)**	**7**	3.00	70%	2.10	1.09				
Threatened species habitat																				
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	0				$0.00		$0.00
Area of community	5.04	5.05	100.16%	**Yes**	$0.00	N/A	$0.00
					$0.00	**$0.00**	**$0.00**

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