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Biodiversity Assessment Report

Eagleton Rock Syndicate Pty Ltd

Eagleton Quarry

13 Barleigh Ranch Way, Eagleton NSW

17 July 2017

Biodiversity Assessment Report

Eagleton Quarry

13 Barleigh Ranch Way, Eagleton NSW

Kleinfelder Document Number: NCA16R50548
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Prepared for:

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EXECUTIVE SUMMARY

Kleinfelder were commissioned by Eagleton Rock Syndicate Pty Ltd to prepare a Biodiversity Assessment Report (BAR) and Biodiversity Offset Strategy (BOS) for a proposed hard rock quarry at Lot 2 DP1108702, 13 Barleigh Ranch Way, Eagleton NSW. This report (BAR) and the BOS (included in Appendix 2) have been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) (SSD 7332, dated 6 November 2015). The BAR provides an assessment of the biodiversity values on the proposed development site and the potential impacts of the proposal on these values in accordance with the Framework for Biodiversity Assessment. This updated version has been prepared to incorporate the results of additional fieldwork and GIS mapping that was conducted in response to submissions to the exhibited Environmental Impact Statement.

The study area is approximately 100.94 ha and consists of a single lot (Lot 2 DP 1108702). The development site (33.7 ha) is located on the northern part of the study area. The majority of the development site occurs on the north-west part of the study area where the hard rock resource is situated. The development site would also include a haul road which would extend from the north-east corner of the study area and connect to the south-east end of the main part of the development site.

Survey Results

Key findings of the field surveys conducted across the study area between 2011 and 2016 are summarised below:

- *Two plant community types (PCT) were identified in the study area: HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest and HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley. The assessment determined that these communities do not constitute any listed threatened ecological communities under the TSC Act 1995 and/or EPBC Act 1999.*
- *No threatened flora species were detected in the study area during the surveys.*
- *A total of 12 threatened fauna species listed under the TSC Act 1995 and/or EPBC Act were detected in the study area during the surveys: Spotted Harrier, Brown Treecreeper (eastern subspecies), Black Falcon, Square-tailed Kite, Grey-crowned Babbler (eastern subspecies), Large-eared Pied Bat, Eastern False Pipistrelle, Little Bentwing-bat, Eastern Freetail-bat, Southern Myotis, Eastern Cave Bat and the Koala.*
- *One EPBC Act-listed migratory bird species was also recorded in the study area during the surveys: Rufous Fantail.*
- *The study area contains a number of 1st, 2nd and 3rd order streams with associated riparian vegetation (i.e. variation within HU804).*

Avoidance and Minimisation

Measures to avoid and minimise impacts on biodiversity values within the study area were considered as part of the project design, and additional minimisation measures to be implemented during the construction and operation phases of the project are detailed in Section 2.1.3. The extent and layout of the proposed development site has been selected to avoid and retain the following biodiversity values:

- *The proposal would retain 57.2 ha of land for conservation within the study area. This retained vegetation is proposed to be secured under a biobanking agreement as part of the offset to provide in-perpetuity protection and management of this native vegetation and threatened species habitat.*

- *The proposed development has been positioned to avoid the 2nd and 3rd order streams and the associated riparian buffers in the study area, with the exception of a small area for the proposed haul road. A new bridge crossing is proposed to be constructed over Seven Mile Creek.*

- *The proposed development would avoid and retain the majority of suitable Koala and Southern Myotis habitat in the study area (approximately 78.7% and 66.7%, respectively).*

Proposed impact minimisation measures are summarised as follows:

- *Preparation and implementation of a Flora and Fauna Management Plan, which will detail measures and protocols to minimise potential impacts upon wildlife and ensure protection of vegetation immediately adjacent to the development footprint during the construction phase of the project. The plan would include the following chapters: Pre-clearing fauna surveys; Clearing protocols; Hollow-bearing tree clearing protocol; Fauna translocation protocol; and Vegetation clearing protocol. Refer to Section 2.1.3.1 for details.*

- *Preparation and implementation of a Landscape and Rehabilitation Management Plan, which will detail the short and long term measures that would be implemented during the construction and operation phases of the project to minimise impacts on native vegetation and fauna on the site, and ensure the development site is progressively rehabilitated with self-sustaining native vegetation. Refer to Section 2.1.3.2 for details.*

- *The proposed onsite offset site will include revegetation of small areas of cleared grassland on the north-east part of the site to ensure habitat connectivity is maintained and improved within the study area.*

Impact Summary

The proposed development would impact on 32.03 ha of native forest vegetation consisting of one PCT (HU804). The vegetation within the development site also represents suitable habitat for a number of threatened fauna species which would be impacted by the proposal. This includes two fauna species credit species: Koala and Southern Myotis. The proposed development would not impact on any threatened ecological communities (TECs), critical habitat, riparian areas of 4th order or higher, important wetlands, estuaries, or state significant biodiversity links.

An assessment of likelihood of occurrence of the threatened species, populations and ecological communities previously recorded and/or modelled to occur within a 10 km radius of the study area was also undertaken (Appendix 5). This assessment determined that a total of 26 threatened fauna species and eight EPBC Act-listed migratory species were likely to, or could potentially, be impacted by the proposed development.

Application of the Assessment of Significance (TSC Act) and EPBC Act Significant Impact Criteria revealed that the proposal is unlikely to have a significant impact upon any of these threatened or migratory species. The proportion of habitat that would be removed is relatively small when considering the large areas of similar habitat that are contiguous with the study area. Additionally, the proposed development would not isolate or substantially fragment areas of suitable habitat for the affected threatened species within the study area or the locality. These conclusions are contingent upon implementation of mitigation measures detailed in Section 2.1.3 of the BAR to ensure potential indirect impacts on adjacent vegetation and fauna habitats are effectively managed.

Biodiversity Offset Strategy

It is proposed that the majority of the land in the study area not subject to development would be secured as a biobank site (57.2 ha) as part of the proposed offsets. The proposed onsite offset site would satisfy a large proportion of the biodiversity credits required at the development site. At this stage, it is intended that the remaining biodiversity credits would be purchased from existing biobank sites with suitable credits (e.g. biobanking agreement [BA] no. 96). However, if the required credits are unavailable at existing biobank sites at the time, the proponent may also secure an offsite offset site under a biobanking agreement to satisfy the credit requirements. All ecosystem and species credits required for the development will be retired at the offset sites in accordance with the FBA prior to commencement of clearing and construction. A summary of the biodiversity credit requirements is provided in the table below.

Ecosystem / Species	Credits Required at Development Site	Credits Generated at Onsite Offset Site	Credit Balance
HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	1,836	533	-1,303
HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	0	63	+63
Southern Myotis (*Myotis macropus*)	362	235	-127
Koala (*Phascolarctos cinereus*)	291	294	+3

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Abbreviations

BAR	Biodiversity Assessment Report
BBAM	BioBanking Assessment Methodology (2014)
BOS	Biodiversity Offset Strategy
ECs	Ecosystem Credits
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
FBA	Framework for Biodiversity Assessment
GIS	Geographic Information System
ha	hectares
IBRA	Interim Biogeographic Regionalisation of Australia
OEH	Office of Environment and Heritage (NSW)
RDP	Rapid Point Data
SCs	Species Credits
TEC	Threatened Ecological Community (as defined under Commonwealth and NSW Legislation)
TSC Act	*Threatened Species Conservation Act* 1995 (NSW)

STAGE 1: BIODIVERSITY ASSESSMENT

1.1 INTRODUCTION

Kleinfelder were commissioned by Eagleton Rock Syndicate Pty Ltd to prepare a Biodiversity Assessment Report (BAR) and Biodiversity Offset Strategy (BOS) for a proposed hard rock quarry at Lot 2 DP1108702, 13 Barleigh Ranch Way, Eagleton NSW (hereafter referred to as the 'study area'). The BAR and BOS have been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) (SSD 7332, dated 6 November 2015). The relevant SEARs relating to these reports include:

- *"Accurate predictions of any vegetation clearing on site;*
- *A detailed assessment of the potential biodiversity impacts, paying particular attention to threatened species, populations and ecological communities, having regard to the requirements of OEH (see Attachment 2); and*
- *A detailed description of the proposed measures to maintain or improve the biodiversity values of the region in the medium to long term"* (p.2).

Points 1 and 2 are addressed in the BAR (this report), and point 3 is addressed in the BOS (included as an appendix to the BAR). This updated version has been prepared to incorporate the results of additional fieldwork and GIS mapping that was conducted in response to submissions to the exhibited Environmental Impact Statement.

This project has been assessed under the NSW Biodiversity Offsets Policy for Major Projects using the Framework for Biodiversity Assessment (FBA) (OEH 2014) in accordance with OEH's requirements in the SEARs. The assessment has been undertaken and reviewed by persons accredited in accordance with Section 142B(1)(c) of the *NSW Threatened Species Conservation Act 1995* (TSC Act) (Aaron Mulcahy and Adam Blundell), and both the BAR and BOS have been prepared to comply with the FBA requirements. This report provides an assessment of the biodiversity values on the proposed development site and the potential impacts of the proposal on these values in accordance with the FBA.

1.1.1 Report Structure

This report has been structured to comply with the reporting requirements of the FBA, as detailed in Appendix 7 of the FBA. The BOS (i.e. Stage 3 of the FBA) has been included as an appendix to this report and has also been structured in accordance with Appendix 7 of the FBA. Additionally, a number of other biodiversity assessment requirements under the SEARs and in response to submissions from the exhibited EIS have also been included as appendices

to this report, including Additional Survey Information (Appendix 4), Assessments of Significance (TSC Act) and EPBC Act Assessments of Significance (Appendix 6), Groundwater Dependent Ecosystem (GDE) Assessment (Appendix 7), Aquatic Habitat Assessment (Appendix 8) and a Brush-tailed Phascogale Habitat Assessment (Appendix 10).

1.1.2 Study Area and Project Description

The study area is approximately 100.94 ha and consists of a single lot (Lot 2 DP 1108702). The study area is located at 13 Barleigh Ranch Way, Eagleton approximately 800 m to the west of the Pacific Highway within the Port Stephens Council Local Government Area (LGA).

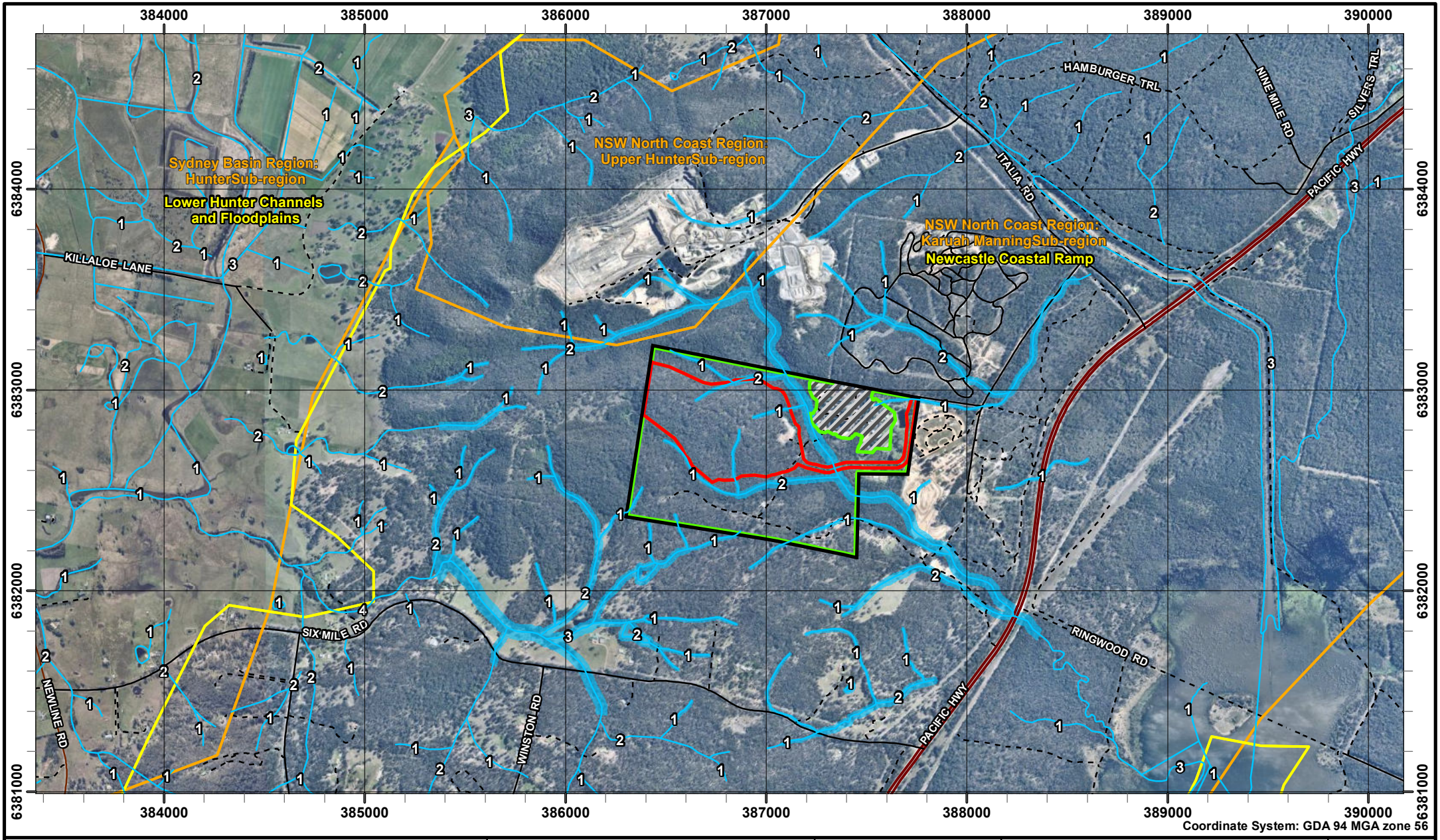
The proposed hard rock quarry (hereafter referred to as the 'development site') is located on the north-west part of the study area. The proposed development would involve the extraction and processing of up to 600,000 tonnes per year for a 30-year period. The proposed quarry meets the criteria listed in Schedule 1 clause 7(1)(a) of *State Environmental Planning Policy - State and Regional Development 2011* for assessment as 'State Significant Development' (SSD) under Section 89C of the *Environmental Planning and Assessment* (EP&A) *Act 1979*.

The proposed development site includes a hard rock reserve occurring within the study area. The hard rock proposed for extraction and processing is a mixture of igneous and sedimentary formations and is suited to local and regional construction markets. The proposed development would include construction of on-site infrastructure and facilities to support quarry activities, and transporting material off-site by truck. A detailed description and layout of the proposed development is provided in the main Response to Submissions document.

The study area is zoned RU2 Rural Landscape under Port Stephens Council Local Environmental Plan (LEP) 2013 which permits development for extractive industries. The study area is owned by Port Stephens Gardenland, which currently operates a landscape supplies business on the site. The operations and facilities associated within Port Stephens Gardenland are located on the north-east part of the study area. The remainder of the study area primarily consists of remnant native forest vegetation, with several smaller cleared and regenerating areas in the central, south-east and north-east parts of the study area as a result of past disturbance and management. Evidence of past logging activities was also observed in the study area (e.g. cut stumps).

All lands adjoining the study area are also zoned RU2 under the Port Stephens Council LEP 2013. The adjoining lands contain a mixture of land uses, including the Boral Quarry to the north, MX Central Motocross Riding Complex to the east, Hunter Valley Paintball to the south-east, and other private landholdings to the south and west. The study area has high vegetation connectivity with adjoining lands to the north, south and west, and forms part of a large expanse of remnant forest vegetation extending from north of Raymond Terrace to Wallaroo State Forest and Wallaroo National Park.

A Location Map is provided in **Figure 1**.



Coordinate System: GDA 94 MGA zone 56

- Study Area (100.94 ha)
- Development Site (33.68 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Riparian Buffers
- Mapped Rivers & Streams (labelled with stream order)
- Mitchell Landscapes Boundary (V3)
- IBRA Subregion Boundary (V7)
- PrimaryRoad
- Sub-arterial Road
- Local Road
- Track

Metres
0 100 200 400 600 800 1,000

N

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PROJECT REFERENCE:	20173040
DATE DRAWN:	20-Jun-17 12:34 Version 1
DRAWN BY:	amarshall
DATA SOURCE:	NSW Land and Property Information - 2017 Nearmap - 2017

Location Map

Eagleton Rock Syndicate Pty Ltd
Biodiversity Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:

1

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1.1.3 Development Site

The development site (33.7 ha) is located on the northern part of the study area, entirely within Lot 2 DP 1108702. The majority of the development site occurs on the north-west part of the study area where the hard rock resource is situated. This part of the development site would be subject to extraction of rock material and would include all infrastructure required for processing and stockpiling. The development site would also include a haul road which would extend from the north-east corner of the study area and connect to the south-east end of the main part of the development site. The proposed haul road would bisect Seven Mile Creek which runs north-west to south-east through the study area.

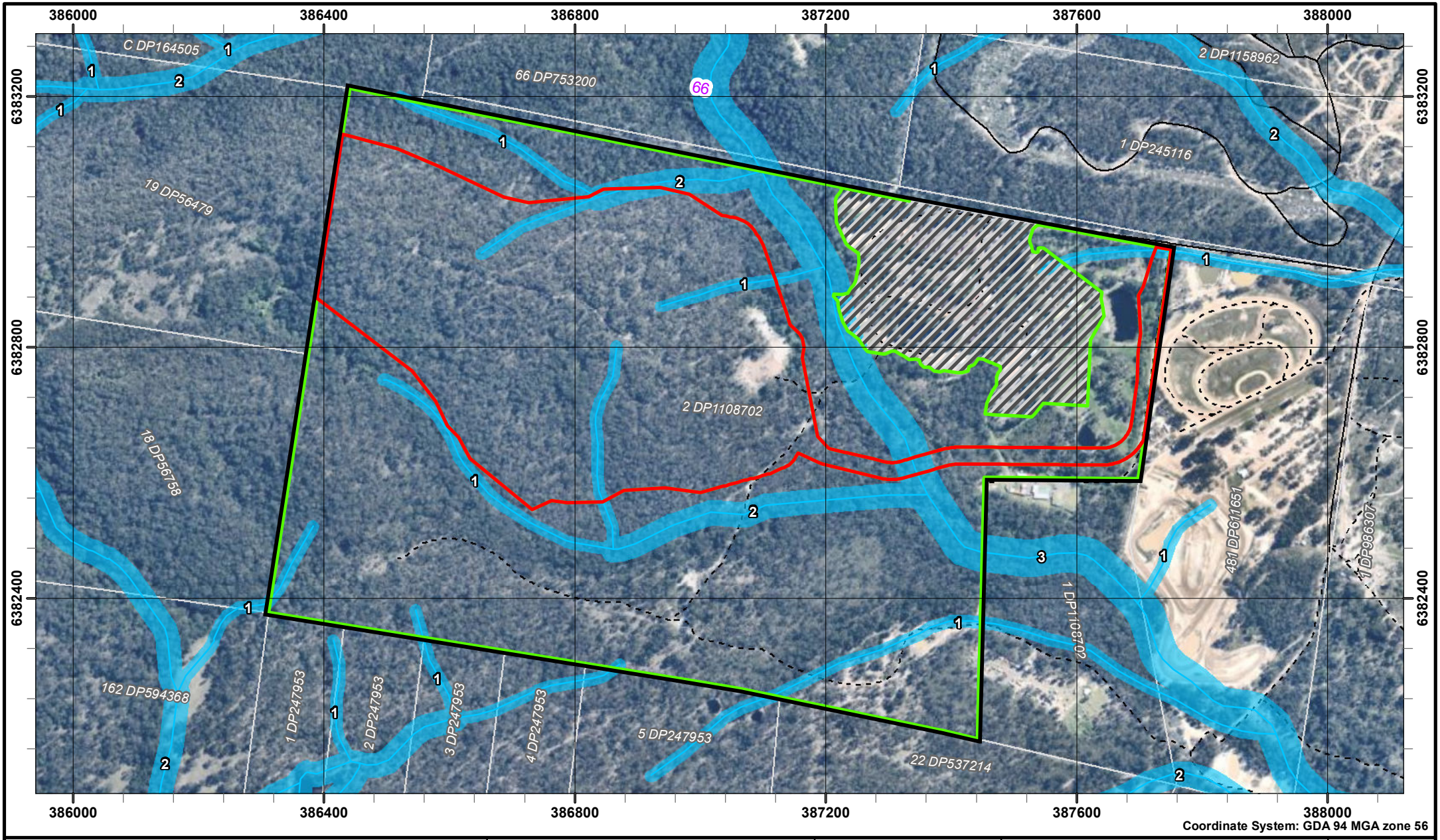
The development site is predominately vegetated with dry sclerophyll forest vegetation (32.03 ha). A small portion of the development site consists of disturbed un-vegetated areas, non-native vegetation, and access tracks (1.66 ha).

A Site Map showing the extent of the development site in accordance with Section 3.2.1.2 of the FBA is provided in **Figure 2**. The study area, proposed onsite offset site (refer to the BOS for further details), and the existing Port Stephens Gardenland facilities and operations area are also shown on **Figure 2**.

1.1.4 Assessment Guidelines

This BAR has been prepared in accordance with the FBA (as required under the SEARs), and in consideration of the following legislation, policies and assessment guidelines:

- *NSW Environmental Planning and Assessment Act 1999* (EP&A Act);
- *NSW Threatened Species Conservation Act 1995* (TSC Act);
- *NSW Biodiversity Offsets Policy for Major Projects* (OEH 2014);
- *State Environmental Planning Policy* (SEPP) *44 – Koala Habitat Protection*;
- *Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act);*
- *Commonwealth Matters of National Environmental Significance: EPBC Act Significant Impact Guidelines 1.1* (Department of the Environment 2013);
- *Fisheries Management Act 1994* (FM Act); and
- *NSW Groundwater Dependent Ecosystem Policy 2002.*



- Study Area (100.94 ha)
- Development Site (33.68 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Local Road
- Track
- Mapped Rivers & Streams (labelled with stream order)
- Lot
- Riparian Buffers

Metres
0 25 50 100 150 200 250

N

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Site Map

Eagleton Rock Syndicate Pty Ltd
Biodiversity Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
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1.1.5 Previous Studies and Data Sources

A number of ecological surveys and assessments have been undertaken within the study area since 2011 by different consultants. A list of the previous assessment reports that were reviewed in preparation of this report is provided below. The survey data and results from these reports have been included in this assessment where appropriate.

In addition to the results and data sourced from the reports listed below, Kleinfelder have undertaken additional ecological surveys in 2015 and 2016 to address relevant SEARs that were issued in 2015.

- Stephen Debus (2011). *Eagleton Quarry Biobank Assessment: Survey for Target Threatened Birds*. Report to Orogen Pty Ltd, November 2011.
- PDA Services (formerly Orogen) 2012. *Flora and Fauna Impact Assessment: Eagleton Quarries, Lot 2 on DP 1108702, Balickera*. Prepared for Eagleton Quarries Pty Ltd, October 2012.
- GHD (2012). *Environmental Assessment: Eagleton Quarry.* Prepared for Eagleton Quarry Pty Ltd, October 2012.
- Kleinfelder (2013). *Flora, Fauna and Threatened Species Assessment: Eagleton Quarry, Barleigh Ranch Way, Eagleton.* Prepared for Eagleton Rock Pty Ltd, February 2013.

1.2 LANDSCAPE FEATURES

1.2.1 Identification of Landscape Features

The landscape features detailed in Section 4.1 of the FBA including IBRA bioregion, IBRA subregion, Mitchell landscape, rivers and streams, wetlands, and the extent of native vegetation in the outer assessment circle for the development site are described in **Table 1**. These landscape features are also shown in **Figure 1, Section 1.1.1**.

Table 1: Landscape features of the development site

Landscape Feature	Development Site
IBRA bioregion	NSW North Coast
IBRA subregion	Karuah Manning
Mitchell landscape	Newcastle Coastal Ramp
River, streams and estuaries	Three 1st order streams occur within the development site. The proposed haul road would also bisect one 3rd order stream (i.e. Seven Mile Creek).
Wetlands	No important or local wetlands occur within the development site.
Native vegetation extent	See Section 1.2.2
State or regionally significant biodiversity links	None identified

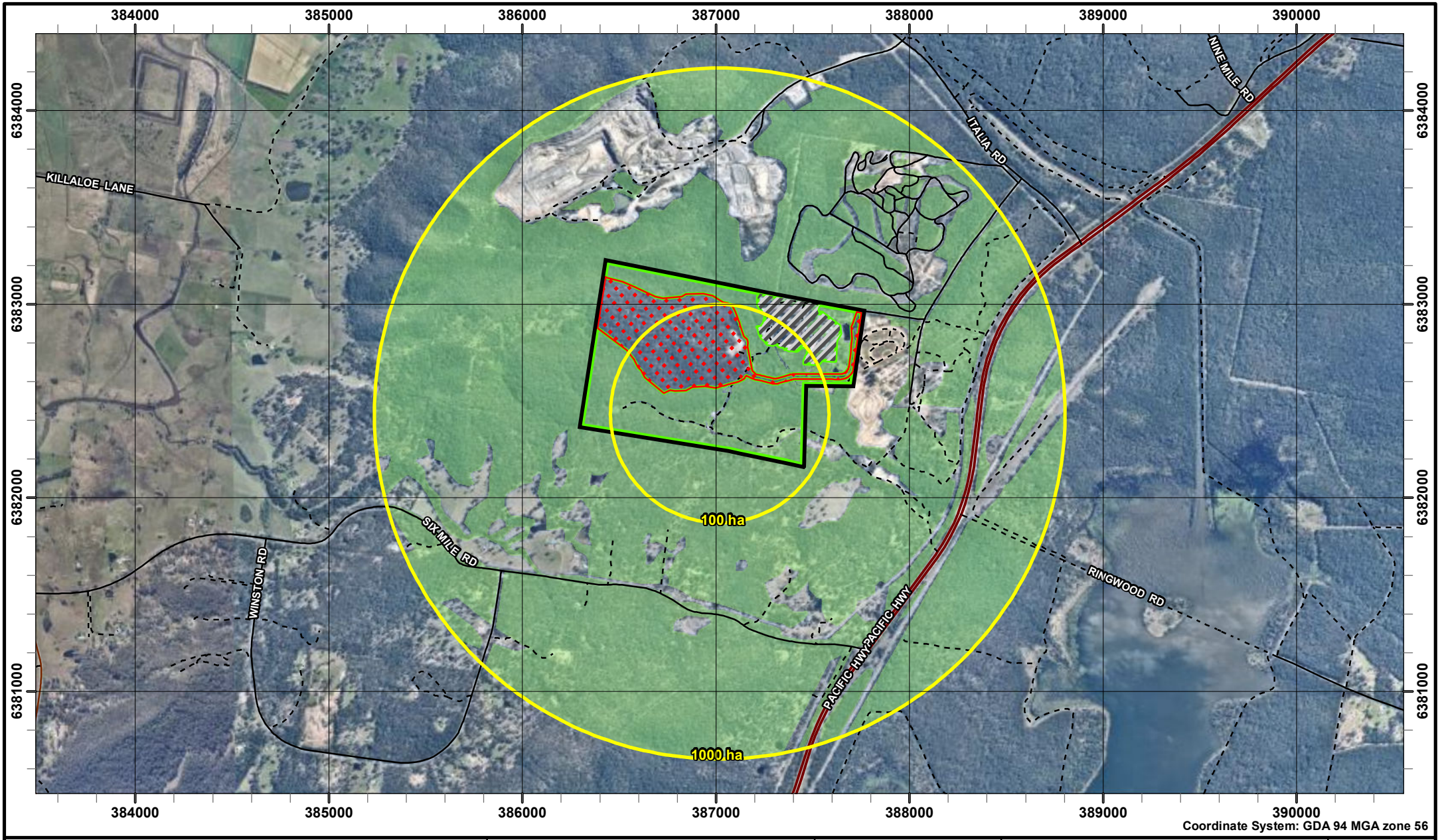
1.2.2 Determining Landscape Values

The landscape assessment for the development site was undertaken in accordance with Section 4.2 and Appendix 4 of the FBA through a combination of GIS analysis and ground-truthing. The current and future linkage width classes for the development site were determined to be between >100 m – 500 m through aerial photo analysis; the narrowest point of the corridor was assessed between Port Stephens Gardenland and the Boral Quarry to the north (185 m). The current and future linkage condition classes for overstorey and midstorey/ground cover were determined to be within benchmark through a combination of aerial photo analysis and ground-truthing. The patch size was determined to be >1,000 ha through aerial photo analysis.

Details of the landscape assessment are provided in **Table 2** and **Figure 3**.

Table 2: Development site landscape assessment

Assessment Circle	Vegetation cover before development	Vegetation cover after development
100 ha circle	92% (91-95)	64% (61-65)
1000 ha circle	78% (76-80)	76% (76-80)
Patch Size	**Landscape Value Score**	
>1000 ha	13.60	



Coordinate System: GDA 94 MGA zone 56

- Study Area (100.94 ha)
- Development Site (33.68 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Assessment Circles
- Native Vegetation
- Primary Road
- Sub-arterial Road
- Local Road
- Track

Metres
0 100 200 400 600 800 1,000

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Nearmap - 2017

Landscape Assessment

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FIGURE:
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1.3 NATIVE VEGETATION

1.3.1 Methodology

Native vegetation within the study area was assessed in accordance with Section 5 of the FBA. Further detail on the specific methods used to undertake the assessment of the native vegetation is provided in the following subsections.

1.3.1.1 Review of Existing Vegetation Studies

In addition to the site-specific ecological assessments undertaken within the study area (refer to Section 1.1.4), regional vegetation mapping studies that encompass and/or adjoin the study area were also reviewed prior to undertaking the vegetation assessment:

- *Vegetation Survey Classification and Mapping Lower Hunter and Central Coast Region* (LHCCREMS; NPWS 2000); and
- *Hunter, Central and Lower North Coast Vegetation Classification and Mapping Project* (Somerville, 2009).

1.3.1.2 Vegetation Survey and Mapping

Vegetation surveys and mapping of the study area was conducted by Kleinfelder in 2013. It is noted that these vegetation surveys (and previous surveys undertaken by PDA Services [2012]) were undertaken in accordance with the Biobanking Assessment Methodology (BBAM) 2008), which was replaced by a revised version of the BBAM and the FBA (for major projects) in 2014. While there are some differences in the vegetation assessment methodologies between the BBAM (2008) and FBA (e.g. cover/abundance data, and vegetation classification databases) the methods for collecting site value data that are used to undertake the credit calculations have remained the same. As such, the plot/transect data collected by PDA Services (2012) and Kleinfelder (2013) have been used to undertake credit calculations for the development and offset sites.

The vegetation assessment methodologies used are described in the following sections.

Vegetation Mapping Review (2016)

The previous vegetation mapping (Kleinfelder 2013) was reviewed in 2016 through aerial photo interpretation (API) and ground-truthing using recent high resolution imagery for the site to identify any changes during this period (e.g. natural regeneration) and to ensure stratification of vegetation zones is consistent with Section 5.1 of the FBA. The API was undertaken at a scale of approximately 1:1,500 using a Geographic Information System (ArcGIS) and spatial datasets listed in **Table 3**.

Table 3: Input datasets used in vegetation mapping

Dataset	Application
High resolution aerial photo – 2016	Primary basis for all linework and attribution. This dataset was produced in 2016 by Nearmap © and sourced under licence.
Aerial photo – 2012	Secondary informer of linework. Areas obscured in the primary image by shadows or exposures were double-checked in this image. Dataset sourced from Land and Property Information (© LPI 2012).
Contours (10 m)	10 metre contours were used to assist in the delineation of boundaries between different vegetation communities through examination of slope and aspect. Data sourced from Land and Property Information (© LPI 2016).

Vegetation Classification

The identification of vegetation communities was based on dominant species present in the overstorey, midstorey, shrub and ground layers as recorded in 0.04 ha (20 m x 20 m) floristic plots. The species composition of each vegetation community was compared to the vegetation descriptions in the *Hunter, Central and Lower North Coast Vegetation Classification and Mapping Project* (Somerville 2009) and the *Vegetation Survey Classification and Mapping Lower Hunter and Central Coast Region* (NPWS 2000) in order to determine an equivalent vegetation community.

Plant Community Type Determination

Each vegetation community identified in the study area was assigned to the closest equivalent PCT from those listed in the Vegetation Information System (VIS) Classification Database. The closest equivalent PCT for each vegetation community was determined through a comparison of the floristic descriptions of PCTs in the database with the plot / transect data collected. In addition to floristic and structural similarity, the landscape position, soil type and other diagnostic features of the vegetation communities on the site were also compared to the descriptions in the database in order to determine the most suitable PCT.

Vegetation Mapping and Surveys

Vegetation surveys were conducted across the study area by Kleinfelder on 7, 15 and 17 December 2012, 17 January 2013, 4 February 2013, 18-19 October 2016 and 30 November 2016. The boundaries of each of the identified vegetation communities within the study area were mapped using a combination of rapid data points (RDP) and walking transects. RDPs involved collecting waypoints over the study area using a hand held GPS unit and recording dominant species, structure and condition. Walking transects involved verifying polygons were homogenous in floristic composition and condition, as well as walking vegetation ecotones and using the recorded tracks to define vegetation community boundaries. The RDPs and survey tracks were then overlaid on an aerial photograph and used to delineate and/or clarify vegetation boundaries (**Figure 4**).

Linework and Attribution

RDPs and floristic plots were classified and tagged with a PCT by field surveyors. Polygons produced from the API work adopted the PCT of the sample point that they intersected. Field surveyors undertook a desktop inspection of linework, aerial photos and other GIS data to attribute any remaining polygons.

Vegetation Zones

Vegetation zones were identified and delineated on the development and offset sites in accordance with Section 5.2.2 of the FBA. A vegetation zone is defined in the FBA as a relatively homogenous area that is the same vegetation type and broad condition.

Assessing Site Value

Following stratification of the sites into vegetation zones, plots / transects were undertaken to collect site condition value data for each of the 10 attributes listed in Table 2, Section 5.3 of the FBA. The location of the plots / transects were selected through stratified random sampling to provide a representative sample of the variation in vegetation composition and condition within each vegetation zone.

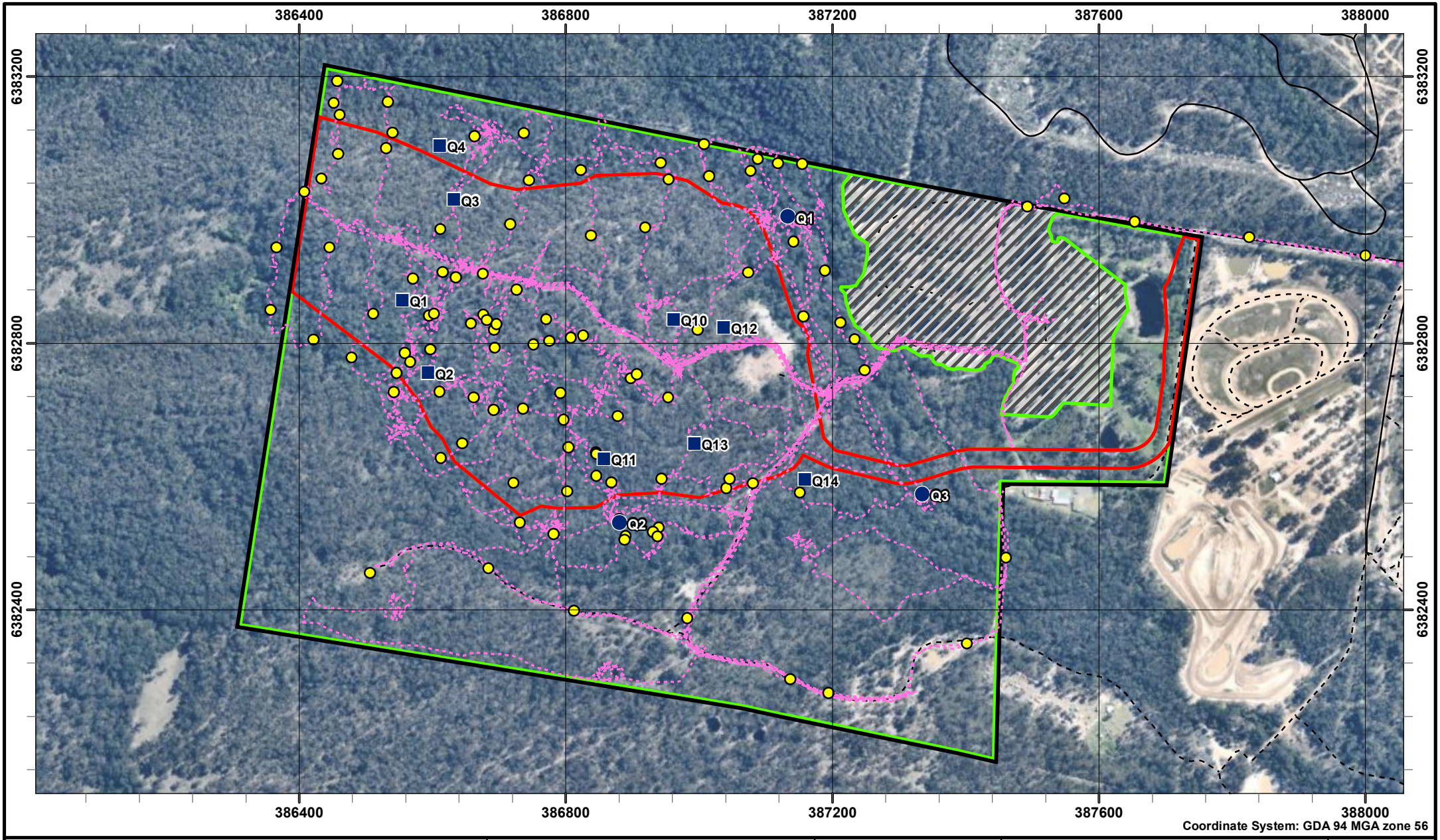
The number of plots / transects undertaken across the study area meets or exceeds the minimum number of transects required for each vegetation zone area as detailed in Section 5.3.2, Table 3 of the FBA. A total of 20 plots / transects undertaken within the study area were used in the credit calculations (nine plots conducted by PDA Services in 2011; 11 plots conducted by Kleinfelder in 2013-2016). It is noted that only a subset of the plots undertaken by PDA Services were used in the calculations following a data review by Kleinfelder. The locations of the plots / transects undertaken on the study area are shown in **Figure 4**.

It is noted that as the majority of the plots / transects undertaken by Kleinfelder (2013) were conducted prior to the release of the BBAM 2014 and FBA, the methodology for estimating cover/abundance was in accordance with the modified Braun-Blanquet cover-abundance scale (Poore 1955):

1. <5% cover, less than 5 individuals
2. <5% cover, more than 5 individuals
3. 5 – 25% cover
4. 26 – 50% cover
5. 51 – 75% cover
6. 76 – 100% cover.

Floristic Identification and Nomenclature

Floristic identification and nomenclature was based on Harden (1992, 1993, 2000 and 2002) with subsequent revisions as published on PlantNet (http://plantnet.rbgsyd.nsw.gov.au).



Coordinate System: GDA 94 MGA zone 56

- Study Area (100.94 ha)
- Development Site (33.68 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Local Road
- Track
- Plot Locations (PDA Services, 2011)
- Plot Locations (Kleinfelder, 2012/13)
- Rapid Data Point (Kleinfelder, 2012/13)
- Flora Survey Tracks (Kleinfelder, Dec 2012 - Feb 2013)

Metres
0 25 50 100 150 200 250

N

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PROJECT REFERENCE: 20173040
DATE DRAWN: 20-Jun-17 14:38 Version 1
DRAWN BY: amarshall
DATA SOURCE:
NSW Land and Property Information - 2011
nearmap - 2016

Flora Survey Effort (2011/13) - Development & Offset Sites

Eagleton Rock Syndicate Pty Ltd
Biodiversity Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
4A

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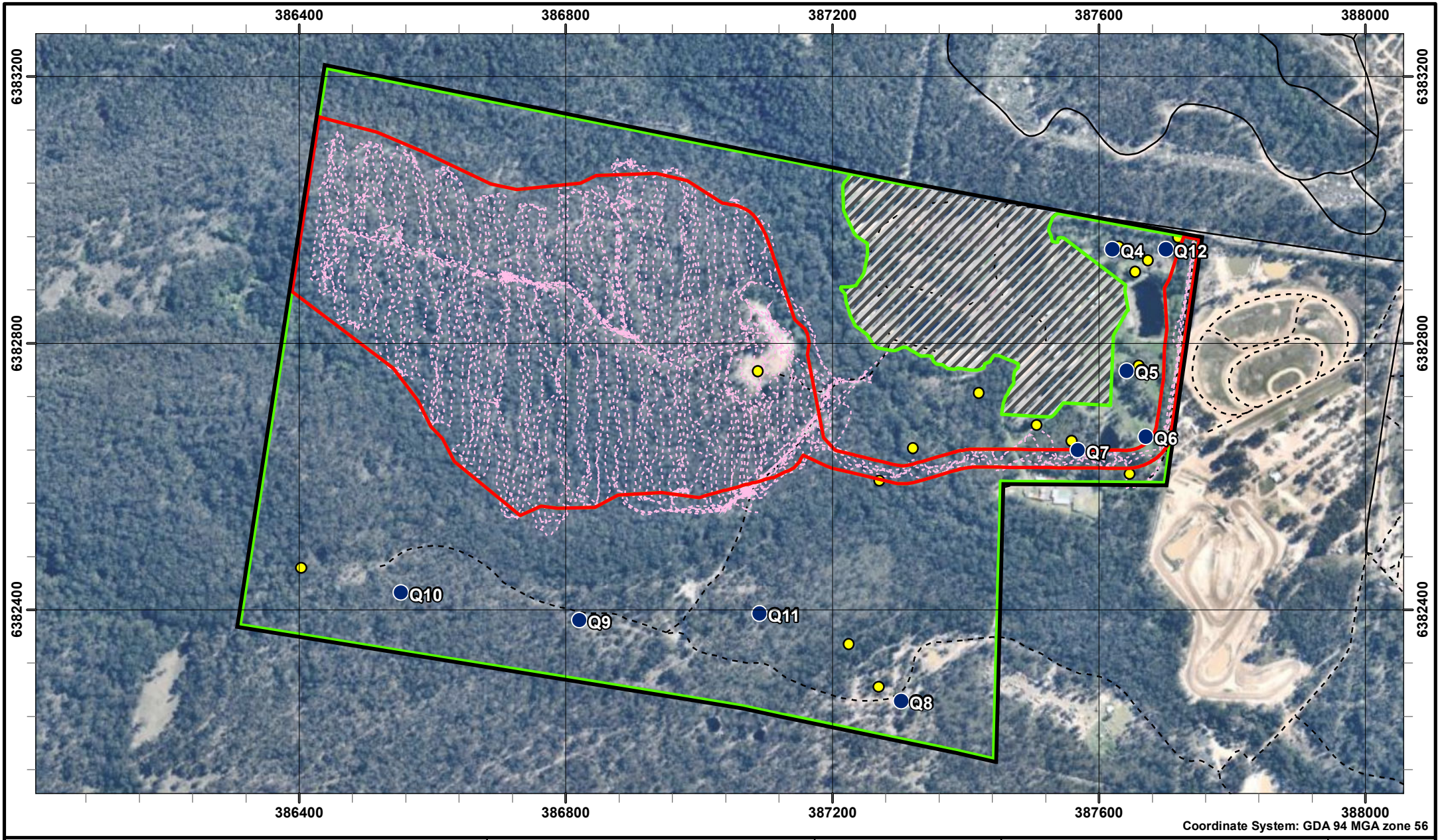

Coordinate System: GDA 94 MGA zone 56

- Study Area (100.94 ha)
- Development Site (33.68 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Plot Locations
- Rapid Data Point
- Targeted Flora Survey Tracks
- Local Road
- Track

Metres
0 25 50 100 150 200 250

N

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PROJECT REFERENCE: 20173040
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DRAWN BY: amarshall

DATA SOURCE:
NSW Land and Property Information - 2011 nearmap - 2016

Flora Survey Effort (2016) - Development & Offset Sites

Eagleton Rock Syndicate Pty Ltd
Biodiversity Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
4B

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1.3.2 Assessment Results

Kleinfelder (2013) identified two native vegetation communities within the study area based on the NPWS (2000) classification:

- MU16 Seaham Spotted Gum – Ironbark Forest; and
- MU12 Hunter Valley Moist Forest.

Both of these vegetation communities within the study area were determined to comprise one equivalent vegetation community described by Somerville (2009): MU65 Spotted Gum/ Broad-leaved Mahogany/ Red Ironbark moist shrubby open forest. Both of these vegetation communities were also determined to comprise one plant community type (PCT) as defined in the VIS database: HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest.

It is noted that the study area includes several drainage lines, and the native vegetation in close proximity to these drainage lines have a higher abundance of mesic understorey species than the adjacent hills and slopes. With the exception of Seven Mile Creek, these areas are considered to be variation within HU804 and contain a number of dominant species which have been described for MU65 (Somerville 2009) from which this PCT is derived.

The vegetation along Seven Mile Creek has been determined (in consultation with OEH) to correspond to the PCT as defined in the VIS database: HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley. This PCT was assigned to the riparian vegetation along Seven Mile Creek on the basis of a moderate floristic similarity between the PCT and the riparian habitat, and vegetation formation (wet sclerophyll forest).

HU804 was determined to comprise one vegetation zone (i.e. moderate-good condition) within the development site. A very small area of another vegetation zone (HU804_moderate-good_poor) occurs in the north-east corner of the development site (haul road). However, as this small area of vegetation is <0.1 ha in size, it has not been identified as a separate vegetation zone for the credit calculations, and has been included within the zone 1 (HU804_moderate-good). Small areas of non-native vegetation (i.e. exotic vegetation) and several un-vegetated areas (i.e. access tracks and bare ground) also occur within the development site. No areas of HU798 greater than 0.25 ha occur within the development site.

The vegetation within the study area is not consistent with any threatened ecological communities (TECs) listed under the TSC Act 1995 and/or EPBC Act. The Spotted Gum-Ironbark Forest vegetation community in the study area was assessed against the *Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion* endangered ecological community (EEC) final determination (NSW Scientific Committee 2010). The vegetation within

the study area is not considered to form part of the *Lower Hunter Spotted Gum – Ironbark Forest* EEC based on location, geology and floristics. The final determination describes the EEC as occurring within the Sydney Basin bioregion; the study area is located within the NSW North Coast bioregion.

The study area is also inconsistent with the geology of the *Lower Hunter Spotted Gum – Ironbark Forest* EEC, as the study area occurs on the Ten Mile Road soil landscape (Matthei 1995) which consists of undulating low hills on Carboniferous sediments and acid volcanics. This EEC is primarily associated with Permian substrates of the Lower Hunter soil landscapes of Aberdare, Branxton and Neath. The NSW Scientific Committee (2010) states that the "*Seaham Spotted Gum – Ironbark Forest typically occurs on sediments of Carboniferous age, in contrast to the younger Permian sediments that support Lower Hunter Spotted Gum-Ironbark Forest".* The floristic composition of the vegetation in the study area also has a higher similarity to the Seaham Spotted Gum-Ironbark Forest community than the Lower Hunter Spotted Gum-Ironbark Forest described in *Vegetation Survey Classification and Mapping Lower Hunter and Central Coast Region* (NPWS 2000) as it typically contains a number of other dominant or co-dominant eucalypt species in addition to *Corymbia maculata* and *Eucalyptus fibrosa*.

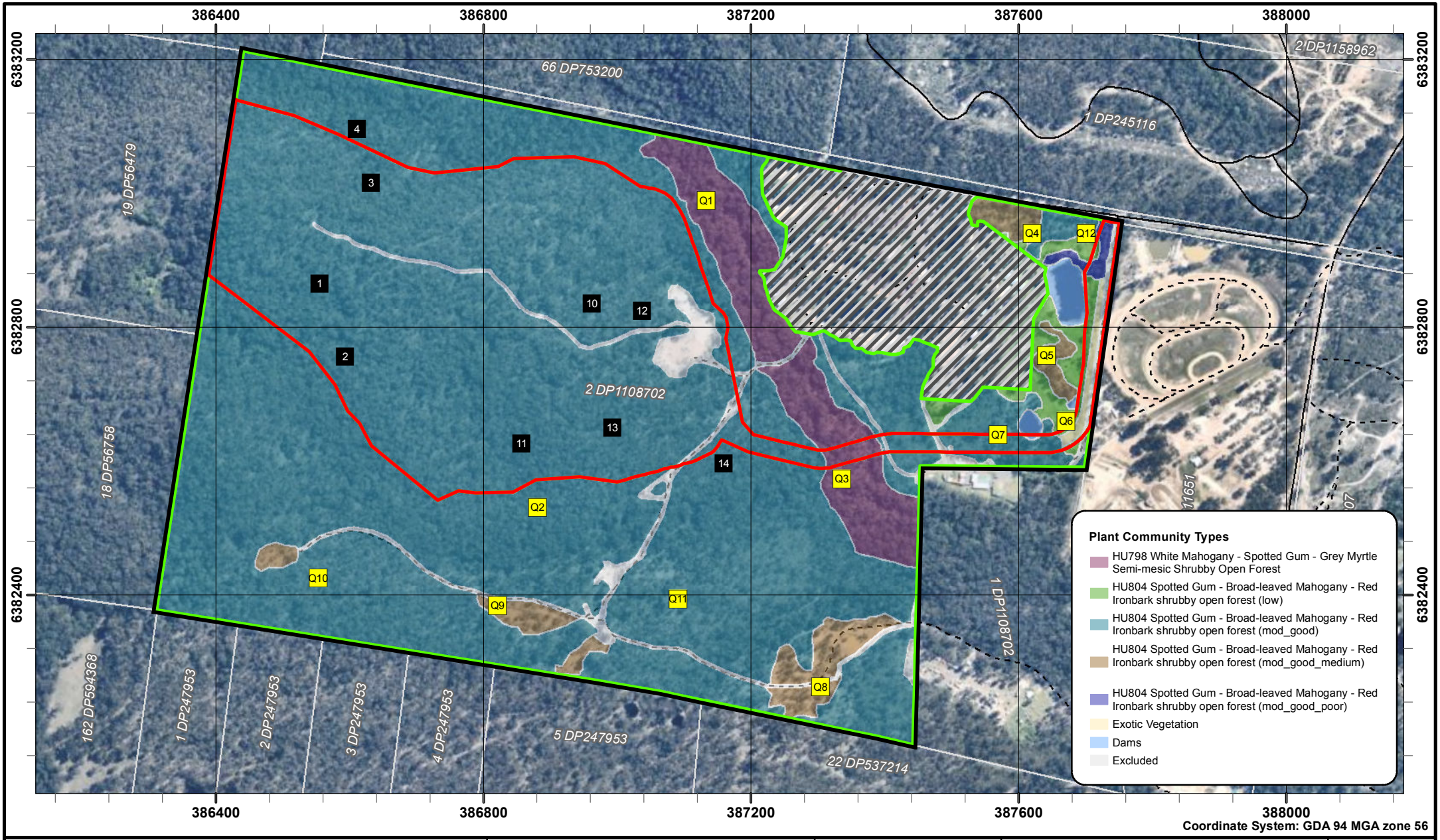
The SEARs also indicate that based on existing regional vegetation mapping, vegetation consistent with the *Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions* may be present on the site. No vegetation consistent with the structure or floristic composition of dry rainforest was identified in the study area during the surveys.

Table 4 provides a detailed description of each PCT, including the vegetation class, floristic description, and justification of evidence used to determine PCTs. **Figure 5** shows the distribution of PCTs / vegetation zones on the development site. Plot and transect data are provided in **Appendix 3**.

Table 4: Descriptions of PCTs within the development site

Veg Zone	Plant Community Type	Vegetation Class	Floristic description	Justification for PCT selection	Area (ha)
1	HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (moderate-good) **Equivalent Somerville (2009) map unit:** MU65 Spotted Gum/ Broad-leaved Mahogany/ Red Ironbark moist shrubby open forest	Hunter-Macleay Dry Sclerophyll Forests	The canopy layer of this community on the site is typically dominated by *Corymbia maculata* with a range of co-dominant species across the site including *Eucalyptus punctata, E. acmenoides, E. fibrosa, E. crebra, E. canaliculata* and *E. globoidea*. Within the drainage lines, the relative abundance of *E. punctata* and *E. acmenoides* is higher, and other co-dominants such as *E. siderophloia, C. gummifera* and *Angophora costata* also occur. The midstorey is sparse across most of the site, with a higher midstorey cover typically occurring in the drainage lines. Common midstorey species include *Dodonaea triquetra*, *Allocasuarina torulosa, Acacia falcata*, *Persoonia linearis, Melaleuca nodosa, Myrsine variabilis, Glochidion ferdinandi, Acacia irrorata* and *Melaleuca styphelioides.* The shrub layer ranges from moderately sparse to dense, with common species including *Leucopogon juniperinus*, *Breynia oblongifolia*, *Bursaria spinosa, Pultenaea villosa, Leptospermum polygalifolium, Zieria smithii, Acacia ulicifolia, Acrotriche divaricata* and *Notelaea ovata*. Common native species in the ground layer include *Imperata cylindrica*, *Microlaena stipoides, Themeda australis, Entolasia stricta, Oplismenus aemulus, Lepidosperma laterale*, *Dianella caerulea*, *Lomandra longifolia, Lomandra multiflora, Pratia purpurascens, Desmodium rhytidophyllum* and *Cheilanthes sieberi*. This majority of this vegetation zone has a relatively low abundance of exotic species. The most abundant exotic species in this vegetation zone is *Lantana camara*, which occurs most frequently in the drainage lines and lower slopes.	HU804 was determined as the closest equivalent PCT for this community on the site. Comparison of floristic data indicates a very high similarity between this PCT and the community onsite, with the majority of species listed in the VIS for HU804 recorded consistently across this vegetation zone. The following key species that have been relied upon for identification of this vegetation type were consistently present and/or recorded at relatively high abundance within the plots conducted: *Corymbia maculata, Eucalyptus fibrosa, Allocasuarina torulosa, Persoonia linearis, Leucopogon juniperinus, Breynia oblongifolia, Bursaria spinosa, Pultenaea villosa, Microlaena stipoides, Themeda australis, Lepidosperma laterale, Dianella caerulea, Lomandra multiflora, Pratia purpurascens,* and *Cheilanthes sieberi.* The structure of this vegetation on the site is consistent with the description for HU804, comprising an open eucalypt forest with a grass understorey. The description for HU804 is also consistent with the location and landscape position (i.e. low ranges of the lower Hunter Valley) of this community on the site. All PCTs in the dry sclerophyll forest (shrub/grass) subformation, and the wet sclerophyll forest formations (i.e. for assessing vegetation in the drainage lines) listed for the Hunter-Central Rivers CMA were considered in undertaking the above determination. Four other potentially suitable PCTs were identified (HU803, HU806, HU814 and HU798). HU803 was considered the next closest equivalent PCT as it has a relatively high similarity in all strata for this community onsite; however, this PCT was excluded as it is described as occurring on the Central Coast, and does not list the Mitchell landscape of the site. HU806 and HU814 also have a moderate floristic similarity with the vegetation onsite but were excluded due to an overall lower floristic similarity compared to HU804. HU798 was also considered for the areas of this vegetation community within the drainage lines which have a higher abundance of mesic species. While this PCT has a moderate floristic similarity to the drainage lines areas, the vegetation is not consistent with a wet sclerophyll forest formation.	32.03

Veg Zone	Plant Community Type	Vegetation Class	Floristic description	Justification for PCT selection	Area (ha)
-	Exotic Vegetation	-	The north-eastern part of the development site includes areas dominated by exotic vegetation. These include modified grasslands that are routinely slashed, and an exotic shrubland occurring on a constructed bund which extends along the north-east boundary. The modified grasslands are dominated by a variety of exotic grass and herb species including *Stenotaphrum secundatum, Axonopus fissifolius, Paspalum dilatatum, Sporobolus africanus, Hypochaeris radicata, Richardia stellaris* and *Lotus subbiflorus*. A very low abundance of native ground cover species occur in these areas, such as *Cynodon dactylon, Lachnagrostis filiformis* and *Dichondra repens*. The exotic shrubland occurring as a thin strip on the constructed bund is dominated by *Lantana camara* and includes a variety of other exotic species. Scattered planted and regenerating juvenile trees also occur on this constructed bund, such as *Corymbia maculata* and *Eucalyptus grandis*.	The exotic grassland areas were verified as being in low condition and having a site value score of <17 at Q6 (2016). While the exotic shrubland area was too narrow to sample with a plot/transect, this area does not have any native understorey, and only contains occasional planted and regenerating trees (i.e. overall canopy cover of <5%). As such, these areas do not require further assessment in accordance with Section 9 of the FBA.	0.27
-	Excluded	-		The excluded areas include all un-vegetated areas consisting of access tracks and bare ground from previous disturbance.	1.39
				Total	**33.7**



Coordinate System: GDA 94 MGA zone 56

Study Area (100.94 ha)
Development Site (33.68 ha)
Offset Site (57.2 ha)
Gardenland (Excluded - 10.05 ha)
Lot
Local Road
Track
Plot Locations (KLF)
Plot Locations (PDA Services)

Metres
0 25 50 100 150 200 250

N

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DRAWN BY: amarshall
DATA SOURCE:
NSW Land and Property Information - 2017
Nearmap - 2017

Plant Community Types and Vegetation Zones

Eagleton Rock Syndicate Pty Ltd
Biodiversity Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
5

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1.4 THREATENED SPECIES

1.4.1 Ecosystem Credit Species

Predicted ecosystem credit species for the development site were identified and assessed in accordance with Section 6.3 of the FBA. No ecosystem credit species were excluded from the predicted species list for the purpose of the assessment, and no species had their offset multiplier modified for the assessment.

1.4.2 Species Credit Species

Species credit species requiring targeted surveys were determined in accordance within Section 6.5 of the FBA. Subsequent surveys were undertaken in accordance with Section 6.6 of the FBA.

1.4.2.1 Methodology: Flora Surveys

Targeted searches for threatened flora species were undertaken by Kleinfelder in December 2012 and January – February 2013 in accordance with the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004). Targeted searches were undertaken along numerous walking/meandering transects within suitable habitat for target species.

Additional targeted searches were undertaken for threatened flora species within the development site in October 2016. The surveys consisted of traversing areas of potential habitat across the development site through systematic parallel transects at approximately 10 m apart in accordance with the *NSW Guide to Surveying Threatened Plants* (OEH 2016).

The survey tracks from the targeted searches are shown on **Figure 4, Section 1.3.1**.

Table 5 provides a list of flora species credit species identified as having potential habitat in the study area (i.e. targeted threatened flora species), and the required survey period for each species as detailed in the calculator or Threatened Species Profile Database (TSPD). Following completion of database searches (refer to **Appendix 5**), several other flora species credit species were also added to the candidate species list in **Table 5** in addition to those automatically generated by the calculator.

An assessment of the likelihood of threatened flora species recorded or modelled to occur in the locality (i.e. 5 km radius) occurring in the development site is provided in **Appendix 5**. This includes the methods for the threatened species database searches, and justification for the exclusion of other threatened flora species from further assessment.

Table 5: Survey details summary for targeted threatened flora species

Species	Survey Period (TSPD)	Survey Adequacy (Kleinfelder)
Angophora inopina Charmhaven Apple	All year	Surveys undertaken in December 2012, January/February 2013 and October 2016 are considered adequate for this species. Low habitat suitability (Appendix 5).
Asperula asthenes Trailing Woodruff	All year but best when flowering (spring)	Targeted surveys undertaken in October 2016 are considered adequate for this species.
Callistemon linearifolius Netted Bottle Brush	September - March	Surveys undertaken in December 2012, January/February 2013 and October 2016 are considered adequate for this species.
Cryptostylis hunteriana Leafless Tongue Orchid	November – February	Surveys undertaken in December 2012, January/February 2013 are considered adequate for this species.
Cynanchum elegans White-flowered Wax Plant	All year (easiest when flowering in August - May)	Surveys undertaken in December 2012, January/February 2013 and October 2016 are considered adequate for this species.
Diuris pedunculata Small Snake Orchid	September - November	Targeted surveys undertaken in October 2016 are considered adequate for this species. Unsuitable distribution (Appendix 5).
Eucalyptus glaucina Slaty Red Gum	All year	Surveys undertaken in December 2012, January/February 2013 and October 2016 are considered adequate for this species.
Grevillea guthrieana Guthrie's Grevillea	All year (best when flowering in spring)	Surveys undertaken in December 2012, January/February 2013 and October 2016 are considered adequate for this species.
Grevillea parviflora subsp. *parviflora* Small-flower Grevillea	All year (best when flowering between July-December)	Surveys undertaken in December 2012, January/February 2013 and October 2016 are considered adequate for this species.
Maundia triglochinoides	All year (best during warmer months when flowering)	Surveys undertaken in December 2012, January/February 2013 and October 2016 are considered adequate for this species. Low habitat suitability (Appendix 5).
Melaleuca biconvexa Biconvex Paperbark	All year	Surveys undertaken in December 2012, January/February 2013 and October 2016 are considered adequate for this species. Low habitat suitability (Appendix 5).
Persicaria elatior Knotweed	Summer-autumn	Surveys undertaken in December 2012, January/February 2013 are considered adequate for this species.
Pterostylis chaetophora	September - November	Targeted surveys undertaken in October 2016 using a known reference population to identify and coordinate optimum survey timing are considered adequate for this species (see 'matters for further consideration' in the following section).
Rhizanthella slateri Eastern Underground Orchid	September - November	Targeted surveys undertaken in October 2016 are considered adequate for this species.
Tetratheca juncea Black-eyed Susan	July - December	Targeted surveys undertaken in October 2016 are considered adequate for this species.

Matters for Further Consideration

One threatened flora species (*Pterostylis chaetophora*) is listed in the SEARs by OEH as a matter for further consideration under the FBA. This species has been recorded to the east of the proposed development site (approximately 1.5 km) in the Grahamstown Dam area, which contains the largest known population of this species and represents the eastern most limit of its known geographic range.

The study area contains potential habitat for this species. Targeted searches were undertaken across the development site on 18-19 October 2016. The known reference population located 1.5 km to the east of the study area (location provided by OEH) was surveyed immediately prior to undertaking the searches (i.e. on 18 October 2016), which confirmed that the species was flowering in the locality at the time of the survey as requested in the SEARs.

1.4.2.2 Methodology: Fauna Surveys and Habitat Mapping

Candidate Fauna Species Credit Species

Table 6 provides a list of the candidate fauna species credit species identified as having potential habitat in the study area as per Section 6.5.1.2 of the FBA. **Table 6** also details the required survey period for each species as detailed in the calculator or TSPD, and the field method(s) used to survey for each species. Following completion of database searches (refer to **Appendix 5**), a number of other species credit species were also added to the candidate species list in **Table 6** in addition to those automatically generated by the calculator.

An assessment of the likelihood of all threatened fauna species (i.e. both ecosystem and species credit species) recorded or modelled to occur in the locality (i.e. 5 km radius) occurring in the development site is provided in **Appendix 5**. This includes the methods for the threatened species database searches, and justification for the exclusion of other threatened fauna species from further assessment. **Appendix 6** provides Assessments of Significance as required under Section 5A of the EP&A Act and/or under the EPBC Act for threatened and migratory fauna species considered likely to be affected by the proposed development.

Table 6: Survey details summary for candidate fauna species credit species

Species	Source	Survey Period (TSPD)	Survey and Assessment Method(s) Conducted
Anthochaera phrygia Regent Honeyeater	BC	All year (coastal visitor mostly March – August)	Bird surveys
Cercartetus nanus Eastern Pygmy-possum	BC	Mid-spring to mid-autumn	Terrestrial and arboreal Elliot trapping Hair tubes Habitat assessment
Dromaius novaehollandiae - endangered population Emu population, NSW North Coast Bioregion and Port Stephens Local Government Area	BC	All year	Bird surveys
Hoplocephalus bitorquatus Pale-headed Snake	BC	October - April	Spotlighting Habitat assessment
Kerivoula papuensis Golden-tipped Bat	BC	October - March	Anabat recording Harp traps
Litoria aurea Green and Golden Bell Frog	BC	August - March; during or immediately following substantial rain in this period	Spotlighting Habitat assessment
Litoria brevipalmata Green-thighed Frog	BC	October to March within 3 days of heavy rains (5 cm plus in 24 hours)	Spotlighting Habitat assessment
Myotis macropus Large-footed Myotis	Atlas	October - March	Anabat recording Harp traps
Phascogale tapoatafa Brush-tailed Phascogale	BC	All year	Terrestrial and arboreal Elliot trapping Hair tubes Spotlighting
Phascolarctos cinereus Koala	BC	All year	Spotlighting Call playback SAT tests Habitat assessment
Planigale maculata Common Planigale	BC	All year	Terrestrial and arboreal Elliot trapping Hair tubes
Turnix maculosus Red-backed Button-quail	BC	All year	Bird surveys Spotlighting Habitat assessment

Sources for identifying candidate species: BC = Biobanking Calculator; Atlas = PMST = EPBC Protected Matters Search; Atlas = NSW Wildlife Atlas

Survey Weather Conditions

Fauna surveys were undertaken across the study area on 14 - 18 January 2013 and on 4 February 2013. Weather conditions during the survey period are provided in **Table 7**. This information was sourced from the weather observation database compiled by the Bureau of Meteorology from the Williamtown weather station (ID: 061078).

Table 7: Weather conditions during the survey period

Date	Temps		Rain	9:00 AM					3:00 PM				
	Min	Max		Temp	RH	Cld	Dir	Spd	Temp	RH	Cld	Dir	Spd
	°C	°C	mm	°C	%	8th	km/h		°C	%	8th	km/h	
Jan (2013)													
14th	18.6	23.8	7.4	19.4	74	7	S	30	22.4	46	2	S	43
15th	14.9	25.5	5.2	20.2	79	7	NW	11	23.5	59	7	ESE	24
16th	13.4	31.1	0.2	22.6	69	4	WNW	11	30.1	48	5	E	24
17th	18.3	31.8	0	24.1	78	6	WSW	7	30.9	52	0	E	20
18th	20.4	44.8	0	29.5	60	-	NW	13	44.2	15	-	NW	31
Feb (2013)													
4th	16.3	25.3	0.2	20.2	81	7	WSW	13	24.1	61	3	SSE	33

Survey Effort Summary

Field surveys and habitat mapping for fauna species credit species were conducted by Kleinfelder in January and February 2013 in accordance with the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004). A total of three fauna survey transects were undertaken on 14-18 January 2013 across the study area within one stratification unit (dry sclerophyll forest shrub/grass subformation). Two of the transects were undertaken within the drier parts of the Spotted Gum – Ironbark Forest, and one transect was completed in the riparian areas (3rd order drainage line) of this community.

A summary of the fauna survey effort is provided in **Table 8.** The fauna survey locations across the study area are shown in **Figure 6**. A description of the survey methodologies for each fauna group is provided in the following sections.

Table 8: Fauna survey effort summary

Survey Method	Hours / Trap Nights	Effort required for stratification unit between 50-150 hectares (DEC 2004)	Compliance with DEC (2004) guidelines
Terrestrial Elliot A traps	25 traps per transect over 4 nights (total 300 trap nights)	200 trap nights	Yes – exceeds guidelines
Terrestrial Elliot B traps	10 traps / transect over 4 nights (total 120 trap nights)	200 trap nights	Partial*
Arboreal Elliot B traps	10 traps / transect over 4 nights (total 120 trap nights)	48 trap nights	Yes – exceeds guidelines
Terrestrial cage traps	Three traps / transect over 4 nights (total 36 trap nights)	48 trap nights	Partial*

Survey Method	Hours / Trap Nights	Effort required for stratification unit between 50-150 hectares (DEC 2004)	Compliance with DEC (2004) guidelines
Arboreal hair tubes	10 hair tubes / transect over 4 nights (120 trap nights)	60 trap nights	Yes – exceeds guidelines
Terrestrial hair tubes	10 hair tubes / transect over 4 nights (120 trap nights). Hair tubes used by Kleinfelder are cone shaped and narrow towards the bait, allowing for the full size range of mammals to be sampled.	80 trap nights	Yes – exceeds guidelines
Harp traps	1 harp trap / transect over 4 nights (total 12 trap nights)	4 trap nights	Yes – exceeds guidelines
Anabat recording	One Anabat recording overnight for 2 nights / transect (total 72 hours or 6 Anabat nights)	Two Anabats recording overnight for two nights (4 Anabat nights)	Yes – exceeds guidelines
Bird surveys	One 2 ha plot for 20 mins on two occasions per transect (total of 6 x 20 min surveys)	No specific methodology detailed – however, states that the Loyn 2ha/20 min area search is an accepted methodology per stratification unit	Yes – meets guidelines
Spotlighting (targeting nocturnal mammals, amphibians and reptiles)	One person hour per transect per night over on two separate nights (total of 6 hours spotlighting)	Mammals: 2 x 1 hour on 2 separate nights (up to 200 ha stratification unit) Amphibians: 30 mins on two separate nights targeting suitable habitat.	Yes – exceeds guidelines
Owl call playback	20 mins at each transect on two nights	At least 5 visits for the Powerful Owl and up to 8 visits for the Masked Owl	Partial*
Targeted Koala surveys	Two nights call playback Diurnal searches 14 SAT tests	N/A	N/A

**Terrestrial Elliot B trapping and terrestrial cage trapping are the main shortfall in fauna survey effort. However, this shortfall was compensated for by undertaking additional spotlighting and hair tubes.*

Terrestrial Mammals

Terrestrial trapping was undertaken using Elliott A, Elliott B, hair tubes and cage traps which were placed along each of the transects at regular intervals. The numbers of each type of trap setup at each transect is detailed in **Table 8**. All traps were baited using a mixture of peanut butter, honey, oats and vanilla essence. Cages were also baited with a mixture of canned chicken and canned tuna in order to attract carnivores. All baits were changed twice during surveys.

Spotlighting for terrestrial mammals (and other fauna groups) was undertaken for a total of six person hours across all survey events (**Table 8**) on 15-16 January 2013. Spotlighting surveys were conducted on foot around each transect.

Arboreal Mammals

Elliott B traps and hair tubes were placed in trees at a height of approximately 3 m. Arboreal traps were baited with a mixture of oats, honey, peanut butter and vanilla essence. The trunks of trees containing the traps were sprayed with a honey and water mixture to act as an additional attractant. All Elliott B traps were checked daily and re-sprayed with the honey-water mix for four consecutive nights. All baits were changed twice during the surveys. Hair tube wafers were collected at the end of each respective trapping period. Hair identification methods followed those of Brunner *et al*. (2002).

Spotlighting was undertaken for a total of six person hours across all survey events (**Table 8**) on 15-16 January 2013. Spotlighting surveys were conducted on foot around each transect. Trees were inspected during daylight hours for the presence of habitat hollows and, if present, these were watched at dusk to see if any nocturnal birds or mammals emerged. The calls of several nocturnal arboreal mammals were broadcast at each transect on two nights. Species targeted during call playback included the Koala (*Phascolarctos cinereus*), Squirrel Glider (*Petaurus norfolcensis*) and the Yellow-bellied Glider (*Petaurus australis*).

Bats

Anabat II bat-call recorders (Titley Electronics, Ballina) were used to record the calls of any Microchiropteran bats feeding in the area. One anabat was positioned at each transect overnight for two nights, with a total of approximately 72 hours of anabat recording across the three transects.

One harp trap was also setup at each transect for four consecutive nights. Harp traps were placed on bat 'flyways' in order to capture and identify any additional bat species. 'Flyways' are areas where bats are likely or forced to travel within an area i.e. along tracks, canopy gaps etc. Spotlighting searches of blossoming trees were also undertaken to identify any Megachiropteran bat species.

Birds

An area search was carried out to survey for diurnal birds. In total, three two hectare survey plots were conducted at each transect. Each plot was surveyed for 20 minutes and repeated over two mornings (16-17 January 2013). Birds were identified either visually, with the aid of binoculars, or by call interpretation. Surveys were conducted in the morning when bird activity is maximised (Bibby *et al.* 2000). The broadcasting of owl calls was undertaken at each transect for approximately 20 minutes per night for two nights (15-16 January 2013). Calls were broadcast for five minutes, followed by a listening period. Species targeted in surveys included the Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*), Barking Owl (*Ninox connivens*) and Masked Owl (*Tyto novaehollandiae*).

Amphibians and Reptiles

Standardised nocturnal amphibian and reptile survey techniques were employed during spotlighting on two nights (15-16 January 2013). Searches for amphibians were primarily restricted to the vicinity of the transect on the eastern part of the study area with suitable habitat (i.e. riparian vegetation and dams). Spotlight searches were conducted by walking lengths/perimeter of suitable habitat and using head torches. Frogs were identified by sight or by their distinct advertisement calls. It is also noted that the surveys were preceded by rainfall on 14 and 15 January 2013 (7.4 mm and 5.4 mm, respectively), increasing the detectability of frogs including targeted threatened species.

Koala Habitat Mapping and Targeted Surveys

The *Port Stephens Council Comprehensive Koala Plan of Management* (CKPoM) (Port Stephens Council [PSC] 2002) applies to all development applications on land within the Port Stephens LGA. The CPKoM Guidelines for Koala Habitat Assessments were used to determine the extent of Koala habitat within the study area and development site based on a four step process:

1. **Preliminary Assessment:** examination of the Koala Habitat Planning Map of the Port Stephens LGA was undertaken to determine mapped Koala Habitat in the study area, and an inspection of the site was then conducted to determine if the site contains individuals of preferred Koala feed trees (**Table 9**) outside areas mapped as Preferred Koala Habitat.

2. **Vegetation Mapping**: vegetation types were mapped across the study area using aerial photography and detailed ground-truthing (refer to **Section 1.3.1**). Floristic and structural characteristics of each vegetation community were determined using quadrat and transect based survey methods.

3. **Koala Habitat Identification:** If the LGA-wide vegetation map produced by PSC is inaccurate for the study area, a revised Koala Habitat Planning Map in accordance with the vegetation community definitions of the CKPoM must be produced.

   The Port Stephens LGA Koala Habitat Mapping was determined to be inaccurate following the vegetation mapping. As such, Kleinfelder conducted additional field surveys on 4 February 2013 to determine the extent of preferred Koala feed trees (including those listed under the CKPoM and SEPP 44) across the study area. It is noted that the CKPoM does not list *Eucalyptus punctata* as a preferred feed tree species, which is a co-dominant species in most areas of the site. However, the assessment of suitable Koala habitat in the study area included *E. punctata* as it is listed as a preferred tree species under SEPP 44. A total of 40 point estimates were conducted across the study area to assess the percentage cover of preferred Koala feed trees species. These data was then used to estimate a percentage of core feed trees within the development footprint. When the trees of the types listed in Schedule 2 of SEPP 44 constitute at least 15% of the total number of

trees in the upper or lower strata of the tree component, then SEPP 44 considers those areas as Potential Koala Habitat.

Targeted field surveys were then undertaken using the Spot Assessment Technique (SAT) to quantify the level of use by Koalas (Phillips and Callaghan, 2011) across the site. This technique involves the selection of a centre tree (survey point) which is chosen according to the following criteria:

- A tree of any species beneath which one or more Koala faecal pellets have been observed; and/or
- A tree in which a Koala is observed; and/or
- Any other tree known or considered to be potentially important for Koalas, or for other assessment purposes.

A minimum of 30 trees (including the centre tree) with a diameter at breast height (DBH) of 100 mm or greater must be surveyed. Surveys involve the inspection of the ground surface within 100 centimetres from the base of the tree. If faecal scats are identified, the survey concludes.

Diurnal searches for Koalas were also undertaken across the study area on 4 February 2013 by Kleinfelder ecologists experienced in Koala surveys and identification.

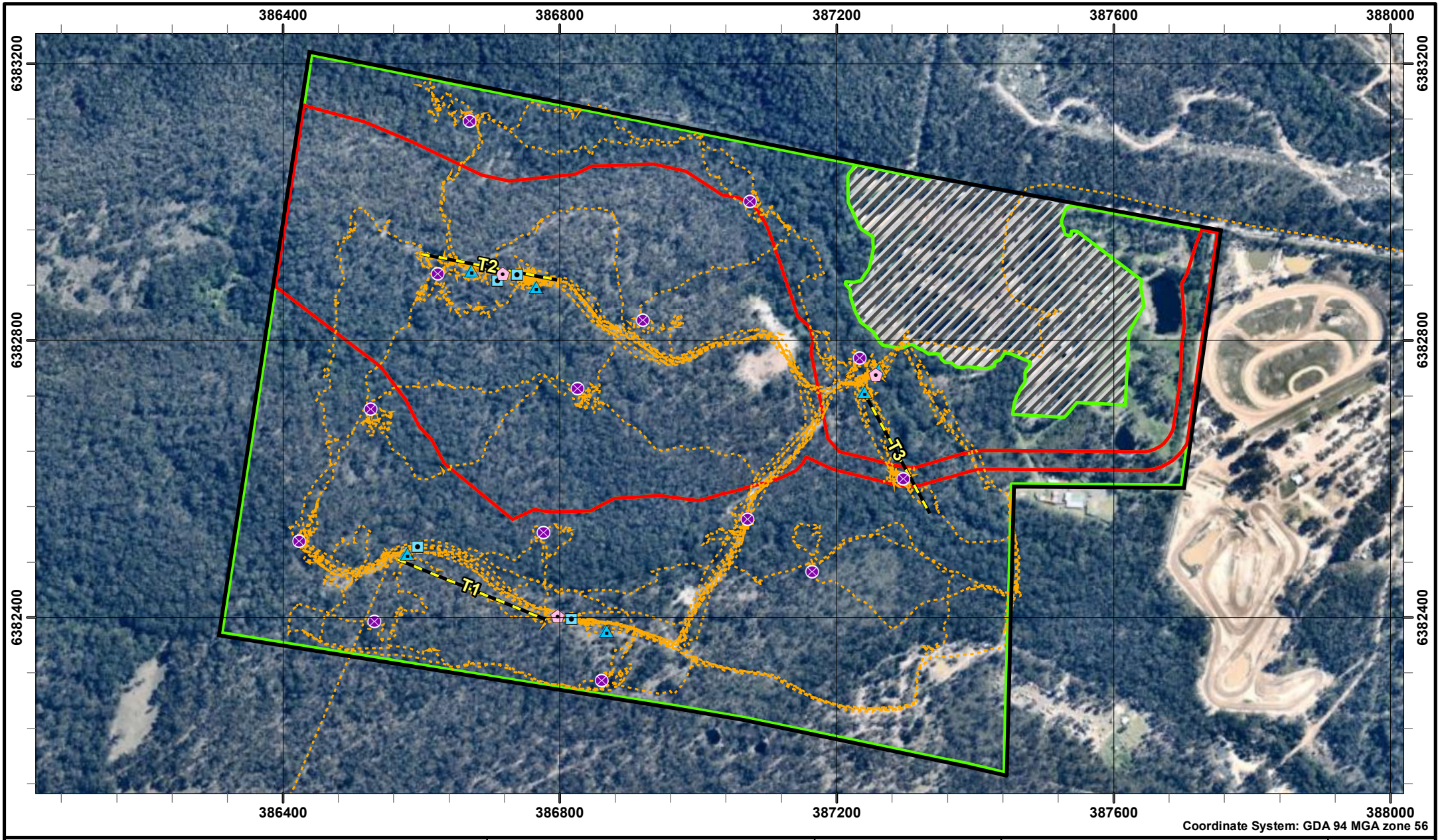
4. **Assessment of Proposal:** a revised Koala habitat map was produced showing information gathered in Steps 1, 2 and 3 to assist in evaluating the potential impacts of the proposal on Koala habitat.

Table 9: List of Preferred Koala Feed Trees in the Port Stephens LGA.

Scientific Name	Common Name
Eucalyptus robusta	Swamp Mahogany
Eucalyptus tereticornis	Forest Red Gum
Eucalyptus parramattensis	Earp's Gum

Assessment of Geographic / Habitat Features

The FBA requires assessment of a number of questions relating to the presence of geographic and habitat features associated with specific species credit species. Questions relating to habitat features associated with four species credit species (Pale-headed Snake, Common Planigale, Green and Golden Bell Frog and Green-thighed Frog) were generated in the FBA. All questions were answered 'Yes', and as such these species are retained for further consideration in Section 1.4.2.3 of the BAR.



Coordinate System: GDA 94 MGA zone 56

- Study Area (100.94 ha)
- Development Site (33.68 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Anabat
- Harp Trap
- Owl Call Playback
- SAT Test
- Trapping Transect
- Fauna Meander

Metres
0 25 50 100 150 200 250

N

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DATA SOURCE:
NSW Land and Property Information - 2011
nearmap - 2016

Fauna Survey Effort - Development and Offset Sites

Eagleton Rock Syndicate Pty Ltd
Biodiversity Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
6

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1.4.2.3 Assessment Results

Flora

No threatened flora species were recorded in the study area during the surveys by Kleinfelder (2013, 2016) or by previous consultants (PDA Services 2012; GHD 2012). No flora species credit species were considered likely to occur in the development site following targeted surveys and habitat assessments (**Appendix 5**). As such, no flora species credit requirements have been identified.

Fauna

Survey Results Summary

Fauna surveys undertaken by Kleinfelder in 2013 identified a total of 81 native fauna species in the study area, including 50 bird, 20 mammal, six amphibian and five reptile species (**Appendix 9**). Of these, seven species are listed under the NSW TSC Act and/ or the EPBC Act, and one species is listed as migratory under the EPBC Act (**Table 10**). Previous surveys completed by PDA Services (2012) and GHD (2012) identified an additional five threatened bird species (**Table 10**). As such, a total of 12 threatened fauna species and one EPBC Act-listed migratory species have been recorded in the study area.

Table 10: Threatened and migratory species recorded in the study area

Scientific name Common name	TSC status	EPBC status	Species Credit Species	Source
Chalinolobus dwyeri Large-eared Pied Bat	V	V	No (breeding habitat only; no breeding habitat identified on the development site)	Kleinfelder
Circus assimilis Spotted Harrier	V	-	No	PDA
Climacteris picumnus victoriae Brown Treecreeper (eastern subspecies)	V	-	No	GHD
Falco subniger Black Falcon	V	-	No	GHD
Falsistrellus tasmaniensis Eastern False Pipistrelle	V	-	No	Kleinfelder
Lophoictinia isura Square-tailed Kite	V	-	No	GHD
Miniopterus australis Little Bentwing-bat	V	-	No (breeding habitat only; no breeding habitat identified on the development site)	Kleinfelder
Mormopterus norfolkensis Eastern Freetail-bat	V	-	No	Kleinfelder
Myotis macropus Large-footed Myotis	V	-	Yes (suitable breeding habitat identified in the development site)	Kleinfelder
Phascolarctos cinereus Koala	V	V	Yes (suitable habitat identified in the development site)	Kleinfelder, GHD
Pomatostomus temporalis temporalis	V	-	No	GHD

Scientific name Common name	TSC status	EPBC status	Species Credit Species	Source
Grey-crowned Babbler (eastern subspecies)				
Rhipidura rufifrons Rufous Fantail	-	M	No	Kleinfelder
Vespadelus troughtoni Eastern Cave Bat	V	-	No (breeding habitat only; no breeding habitat identified on the development site)	Kleinfelder

Assessment of Candidate Fauna Species Credit Species

Table 11 provides an assessment of candidate fauna species credit species identified in **Section 1.4.2.2** based on a literature review, database searches, and results of the fauna surveys and habitat assessments. This assessment provides justification for whether each candidate species is considered to be present or not present (or unlikely to be present) as required in Section 6.5 of the FBA. All species credit species confirmed or considered to be present on the development site are subject to further assessment in the following section to identify the extent of habitat within the development site.

Table 11: Assessment of Candidate Fauna Species Credit Species

Species	Present / Not Present	Justification
Anthochaera phrygia Regent Honeyeater	Not present	The development site contains potential foraging habitat for this species, as suitable feed tree species are present (e.g. Spotted Gum). However, habitat usage in the study area is likely to be infrequent as the site is not within a known breeding area and as there are no records of the species in the locality. Additionally, there are only two records of this species in the last 20 years in the Port Stephens LGA. This species was not detected in the study area during the surveys. This species is considered unlikely to be present on the development site.
Cercartetus nanus Eastern Pygmy-possum	Not present	There is one record for this species within 2 km to the north of the study area from 2005. This is also the only record of this species within the Port Stephens LGA. This species is found in a broad range of habitats, but in most areas woodlands and heath appear to be preferred. The species is typically associated with an understorey containing heath, banksias or myrtaceous shrubs including Leptospermum spp. As such, the habitat within the development site is considered to be marginally suitable for this species, as the vegetation predominately consists of a grassy understorey with a relatively low abundance of shrubs and midstorey trees. This species was not detected in the study area during the surveys, which used a range of suitable methods including terrestrial and arboreal trapping, hair tubes, and spotlighting. This species is considered unlikely to be present on the development site.

Species	Present / Not Present	Justification
Dromaius novaehollandiae - endangered population Emu population, NSW North Coast Bioregion and Port Stephens LGA	Not present	This species occupies a range of predominantly open habitats, including plains, grasslands, woodlands and shrubs, and may occur occasionally in forest. The forest vegetation across the development site is considered to be unsuitable for this species. This species was not detected in the study area during the surveys. This species is considered unlikely to be present on the development site.
Hoplocephalus bitorquatus Pale-headed Snake	Not present	While the study area occurs within the known distribution of this species, no records for this species occur within the Port Stephens LGA (nearest records approximately 15 km to north-west near Paterson from 1994). This species was not detected in the study area during the surveys. This species is considered unlikely to be present on the development site.
Kerivoula papuensis Golden-tipped Bat	Not present	The study area contains potential habitat for this species. However, there are no records of this species in the locality, with only one record in the Port Stephens LGA approximately 7 km to the north-west of the study area. This species was not detected in the study area during the surveys. This species is considered unlikely to be present on the development site.
Litoria aurea Green and Golden Bell Frog	Not present	The dams and riparian areas in the study area represent potential marginal habitat for this species. However, there are no records of this species in the locality. There is only one record of this species in the last 20 years in the Port Stephens LGA from 2000 near Tomago, >15 km to the south-west of the study area. This species was not detected in the study area during the surveys. This species is considered unlikely to be present on the development site.
Litoria brevipalmata Green-thighed Frog	Not present	The riparian areas in the study area represent potential marginal habitat for this species. However, there are no records of this species in the locality, or the Port Stephens LGA. This species was not detected in the study area during the surveys. This species is considered unlikely to be present on the development site.
Myotis macropus Large-footed Myotis	**Present**	This species was recorded in the study area during the surveys and suitable breeding habitat was identified in the study area and development site. This species is subject to further assessment in the following section.
Phascogale tapoatafa Brush-tailed Phascogale	Not present	The study area and the development site contain suitable habitat for this species. The species prefers dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter, which is consistent with the Spotted Gum-Ironbark Forest in the study area. There are nine records of this species in the locality, including several within one kilometre to the north of the study area from 2005. However, this species was not detected in the study area during the surveys, which used a range of suitable methods including terrestrial and arboreal trapping, hair tubes, and spotlighting. This species is considered unlikely to be present on the development site.
Phascolarctos cinereus Koala	**Present**	The species was recorded in the study area during the surveys and suitable habitat was identified in the study area and development site. This species is subject to further assessment in the following section.

Species	Present / Not Present	Justification
Planigale maculata Common Planigale	Not present	This species inhabits a broad range of habitats and the study area contains potential habitat for this species. However, there are no records of this species in the locality or the Port Stephens LGA. This species was not detected in the study area during the surveys. This species is considered unlikely to be present on the development site.
Turnix maculosus Red-backed Button-quail	Not present	This species typically inhabits grasslands, open and savannah woodlands with grassy ground layer, pastures and crops of warm temperate areas. The vegetation in the study area (forest) is considered to be suboptimal for this species. Additionally, there are no records of this species in the locality or the Port Stephens LGA. This species was not detected in the study area during the surveys. This species is considered unlikely to be present on the development site.

Species Credit Species – Habitat Mapping

Koala

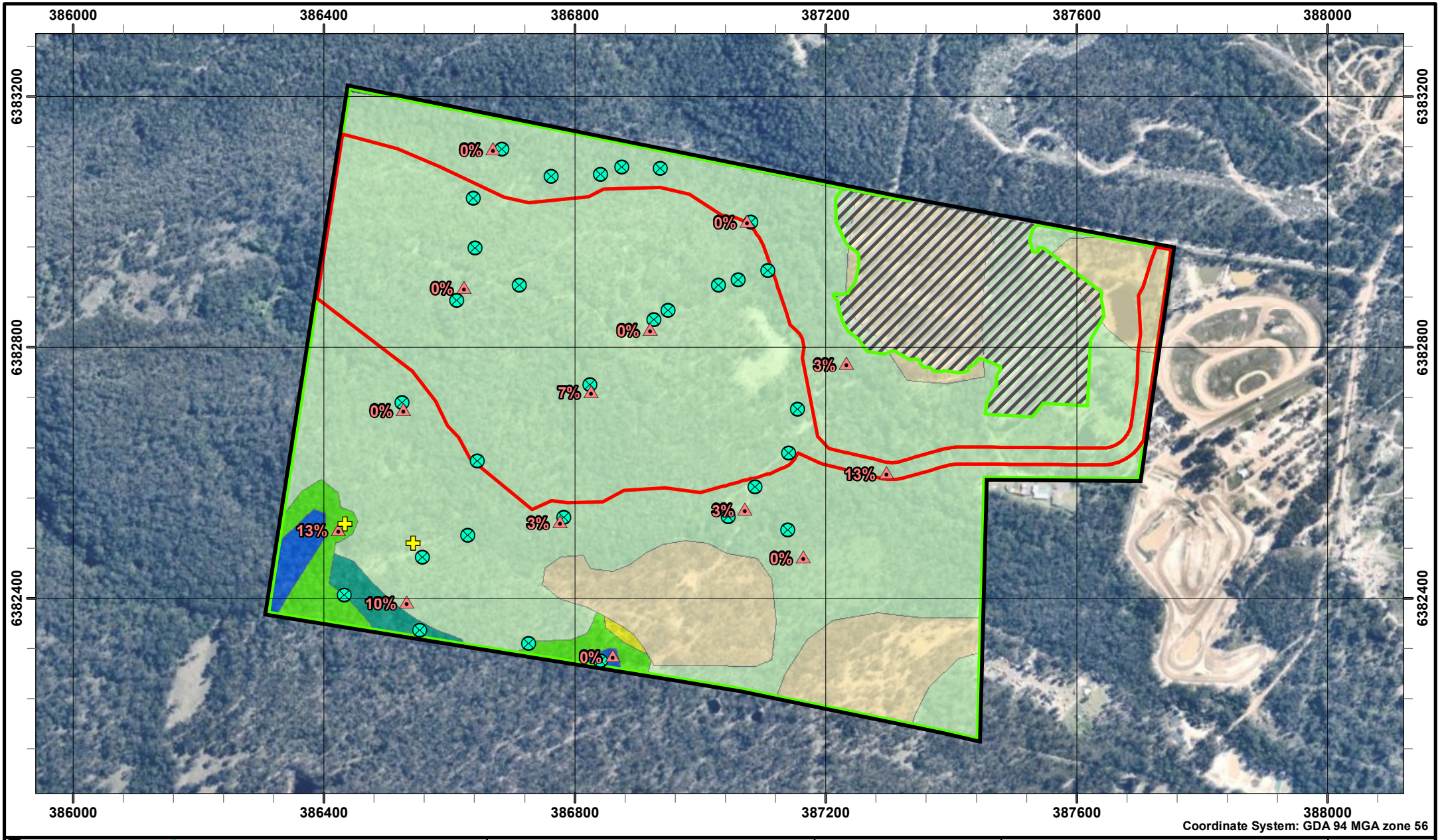
Two Koalas were sighted in the south-western part of the study area during the surveys by Kleinfelder (2013) (**Figure 7**). SAT tests also detected Koala activity on the south-west, central, and north-east parts of the study area (**Figure 7**). Fifty percent of the SAT tests (N=14) showed some sign of Koala activity (range 3%-13%). According to Phillips and Callaghan (2011), this level of activity is considered to be low use range (<22.52% activity levels) and therefore the use by Koalas is "likely to be transitory" (p.776). **Table 12** summarises the results of the SAT tests that showed signs of activity.

SAT tests and sightings determined that Koalas were using a range of tree species throughout the study area including Grey Gum (*E. punctata*), White Mahogany (*E. acmenoides*), Grey Ironbark (*E. siderophloia*), Forest Red Gum (*E. tereticornis*) and Spotted Gum (*Corymbia maculata*). Of these, Forest Red Gum and Grey Gum are the only species listed as Koala feed trees under SEPP 44. Grey Gum, White Mahogany and Spotted Gum are listed as tree species that may be important to Koalas in the Port Stephens LGA under the CKPoM (PSC 2002).

The CKPoM Koala habitat mapping for the study area shows only a very small area of preferred Koala habitat in the south-west, with the remainder of the site mapped as marginal habitat (**Figure 7**). Detailed assessment of Koala feed tree density across the study area identified a total of 52.59 ha of suitable Koala habitat as defined under SEPP 44 (i.e. 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) (**Figure 8**). Of this, 11.19 ha of suitable Koala habitat occurs within the development site.

Table 12: SAT test results

SAT ID	Trees with pellets	Total trees surveyed	Activity level %
8	1	30	3%
11	1	30	3%
5	2	30	7%
13	2	30	7%
7	3	30	10%
10	4	30	13%
12	4	30	13%
		MEAN	**8%**



Coordinate System: GDA 94 MGA zone 56

- Study Area (100.94 ha)
- Development Site (33.68 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Assessment Points
- SAT Test Location (Label indicates activity level)
- Koala Sighting

CKPoM Habitat Mapping (PSC 2007)

- Preferred Koala Habitat
- Marginal Koala Habitat
- Link Over Marginal
- 50m Buffer Over Marginal
- 50m Buffer Over Cleared
- Mainly Cleared

Metres
0 25 50 100 150 200 250

N

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DRAWN BY: amarshall

DATA SOURCE:
NSW Land and Property Information - 2017
Nearmap - 2017

CKPoM Koala Habitat Mapping

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13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
7

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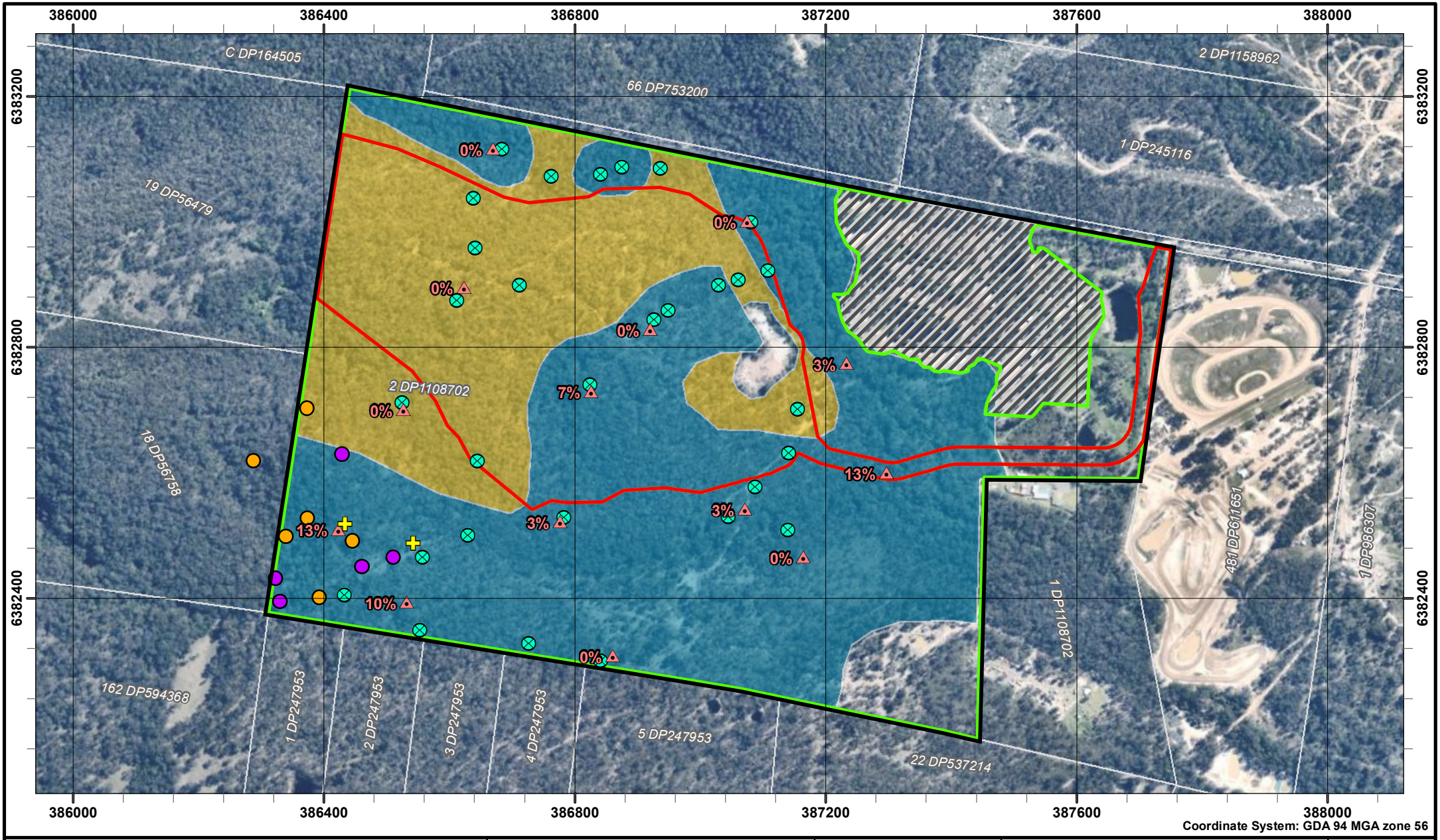

- Study Area (100.94 ha)
- Development Site (33.68 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Lot
- less than 15% *Eucalyptus Punctata*
- greater than 15% *Eucalyptus Punctata*
- Assessment Points
- SAT Test Location (Label indicates activity level)
- Koala Sighting

SEPP 44 Koala Habitat Mapping

- <15% SEPP 44 Koala Feed Trees
- >15% SEPP 44 Koala Feed Trees

Metres
0 25 50 100 150 200 250

N

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DATA SOURCE:	NSW Land and Property Information - 2017 Nearmap - 2017

SEPP 44 Koala Habitat Mapping

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FIGURE:

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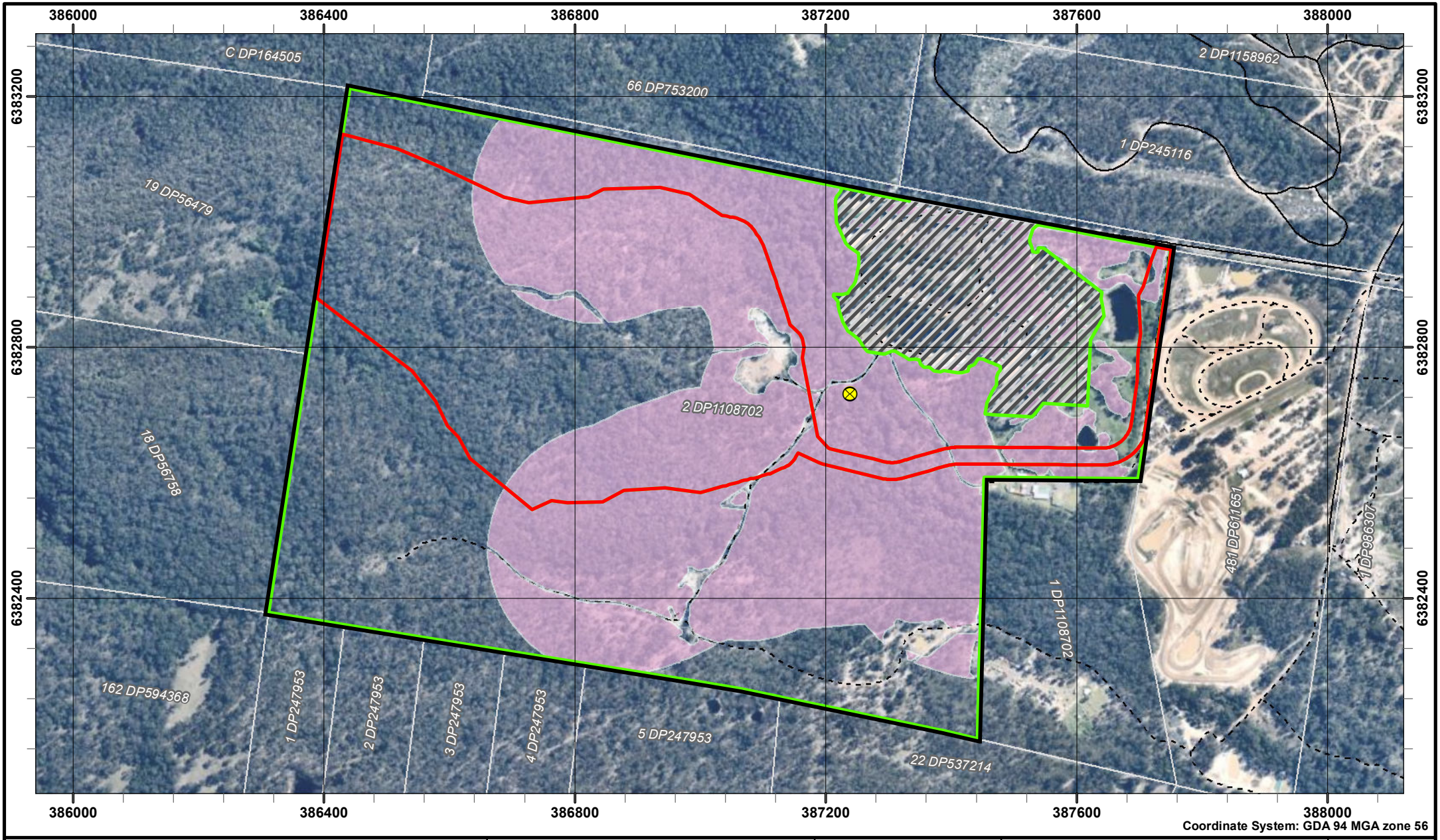
Southern Myotis

The Southern Myotis was recorded at one location along Seven Mile Creek in the eastern part of the study area (**Figure 9**). The TSPD indicates that breeding habitat for the Southern Myotis includes hollow-bearing trees, bridges, caves or artificial structures within 200 m of riparian zone. Hollow-bearing trees are present (albeit in low to moderate abundance) throughout the forest vegetation in the study area. All areas of HU804 (moderate-good) within 200 m of the dams and the 2nd and 3rd order streams on the eastern part of the site were mapped as suitable breeding habitat for this species (**Figure 9**). The remaining 1st order drainage lines in the study area are highly ephemeral and do not contain suitable foraging habitat (i.e. streams and pools).

A total of 49.49 ha of Southern Myotis habitat occurs in the study area. Of this, 16.36 ha of Southern Myotis habitat occurs in the development site.



Coordinate System: GDA 94 MGA zone 56

- Study Area (100.94 ha)
- Development Site (33.68 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Lot
- Local Road
- Track
- Southern Myotis Location
- Southern Myotis Habitat

Metres
0 25 50 100 150 200 250

N

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DRAWN BY: amarshall

DATA SOURCE:
NSW Land and Property Information - 2017
Nearmap - 2017

Southern Myotis Habitat Mapping

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FIGURE:
9

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STAGE 2: IMPACT ASSESSMENT

2.1 AVOID AND MINIMISE IMPACTS

2.1.1 Summary of Avoidance and Minimisation Measures

The direct and potential indirect impacts of the proposed development on biodiversity values, and the proposed avoidance and minimisation measures relating to each impact are summarised in **Table 13**. Further details on site selection, avoidance, and minimisation measures are provided in the following sections.

Table 13: Summary of potential impacts and proposed avoidance and minimisation measures

Type and phase of impact	Biodiversity values potentially affected	Proposed avoidance and minimisation measures
Direct Impacts		
Clearing of native vegetation during the construction phase – total of 32.03 ha of HU804 to be removed.	All threatened species known or likely to occur in the study area as assessed in Appendix 5.	Avoidance and retention of 57.2 ha of native vegetation within the study area. This retained vegetation is proposed to be secured under a biobanking agreement as part of the offset. Avoidance of 2nd and 3rd order streams and the associated riparian buffers in the study area, with the exception of a small area for the proposed haul road. Preparation of Flora and Fauna Management Plan (F&FMP), including pre-clearing fauna surveys, and clearing protocols. Preparation and implementation of a Landscape and Rehabilitation Management Plan (L&RMP).
Loss of hollow-bearing trees during the construction phase.	All hollow-dependent threatened fauna species assessed in Appendix 5.	Avoidance and retention of 57.2 ha of vegetation within the study area. The majority of this vegetation contains hollow-bearing trees that will be retained. Preparation of F&FMP, including pre-clearing fauna surveys, and clearing protocols.
Removal of dead wood and dead trees during the construction phase.	All hollow-dependent threatened fauna species assessed in Appendix 5.	Preparation of F&FMP, including pre-clearing fauna surveys, and clearing protocols.
Reduction in habitat connectivity in the study area.	Native fauna	Retention of vegetation corridors on the southern, central and north-east parts of the study area. Connectivity through the eastern corridor would be enhanced through revegetation of grassland areas. The retained vegetation within the study area would be protected and managed in-perpetuity under a biobanking agreement. The development site would be cleared in stages and progressively rehabilitated with native vegetation to provide connectivity through the north-west part of the site during operations.
Potential Indirect Impacts		

Type and phase of impact	Biodiversity values potentially affected	Proposed avoidance and minimisation measures
Loss of individuals through: Starvation / exposure Predation by domestic and/or feral animals Loss of breeding opportunities Loss of sheltering habitat Alteration to hydrological regimes	All threatened species known or likely to occur in the study area as assessed in Appendix 5.	Avoidance and retention of 57.2 ha of vegetation within the study area. Haul road design and construction to ensure existing hydrological regimes for Seven Mile Creek are maintained. Preparation of F&FMP, including pre-clearing fauna surveys, and clearing protocols. Preparation and implementation of a Water Management Plan.
Erosion and sedimentation Construction and operation phases.	All flora and fauna species, vegetation, and fauna habitats adjoining the development site.	Preparation and implementation of a Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP). These plans would include measures to prevent and manage potential erosion and sedimentation from the site. Refer to the EIS for further details. Preparation and implementation of a Water Management Plan. This plan has been prepared and submitted as part of the EIS.
Increased nutrients, contaminants and pollutants (e.g. petrochemicals, herbicides, pesticides, fertilisers etc.) Construction and operation phases.	All flora and fauna species, vegetation, and fauna habitats adjoining the development site.	Preparation and implementation of a CEMP and OEMP. Preparation and implementation of a Water Management Plan. These plans must include measures to restrict use of pollutants on the site, and to prevent and minimise stormwater run-off containing contaminants.
Introduced species (animals and weeds). Weeds may be introduced and/or spread into native vegetation adjoining the development site. Proposed development may facilitate movement of vertebrate pest species. Construction and operation phases.	All flora and fauna species, vegetation, and fauna habitats adjoining the development site.	Implementation of management plans within the offset site as part of a biobanking agreement. This would include a weed management plan, and vertebrate pest management plan. Preparation and implementation of a Landscape and Rehabilitation Management Plan (L&RMP) for the development site.
Noise, vibration, lighting, dust and air pollution. Increased human activity directly adjacent to sensitive vegetation and habitats. This may disturb flora and fauna in adjoining habitat. Ongoing human-induced impacts such as damage to vegetation from vehicles or trampling, death and injury to fauna from vehicle impact, increased rubbish and alteration to normal behaviour patterns are also possible. Construction and operation phases.	All flora and fauna species, vegetation, and fauna habitats adjoining the development site.	Preparation and implementation of a CEMP and OEMP. These plans must consider measures to mitigate impacts on flora and fauna from noise, vibration, dust, light, and air pollution. Preparation and implementation of a L&RMP. Preparation and implementation of a waste management plan, traffic management plan, and dust management plan. Refer to the EIS for details. The development site should be delineated with permanent wildlife-friendly fencing, and include signage to identify 'no-go' areas. Speed limits on traffic using access roads to 40 km / hr (in accordance with CKPoM 2002) will reduce potential for death or injury to wildlife as well as reduce noise and pollution levels.

2.1.2 Site Selection, Planning and Avoidance

The proposed quarry location and layout was determined in consideration of a variety of site values and constraints, including biodiversity. Alternative locations for the proposed quarry within Lot 2 DP1108702 are limited due to the lack of suitable rock reserves in other areas. For example, the north-east part of the study area contains the areas of lowest biodiversity value, but does not contain suitable rock reserves for extraction (as well as a number of other constraints). Further detail on the project justification and alternatives is provided in Section 3.0 of the EIS (JBA Urban Planning Consultants Pty Ltd 2016).

The extent and layout of the proposed development site has been selected to avoid and retain the following biodiversity values:

- The proposal would retain 57.2 ha of native vegetation (approximately 63%) within the study area. This retained vegetation is proposed to be secured under a biobanking agreement as part of the offset to provide in-perpetuity protection and management of this native vegetation and threatened species habitat.
- The proposed development has been positioned to avoid the 2nd and 3rd order streams and the associated riparian buffers in the study area, with the exception of a small area for the proposed haul road. A new bridge or culvert crossing is proposed to be constructed over Seven Mile Creek.
- The proposed development would avoid the majority of suitable Koala habitat in the study area (approximately 79%). These retained areas of suitable Koala habitat (41.40 ha) would be protected and managed in-perpetuity under a biobanking agreement.
- The proposed development would avoid the majority of Southern Myotis breeding habitat in the study area (approximately 67%). These retained areas of Southern Myotis habitat (33.03 ha) would be protected and managed in-perpetuity under a biobanking agreement.

The proposed development would not impact on any threatened ecological communities (TECs), critical habitat, riparian areas of 4th order or higher, important wetlands, estuaries, or state significant biodiversity links.

2.1.3 Impact Minimisation

A range of management plans are proposed to be prepared and implemented to minimise impacts of the proposed development and ensure the long term protection of the retained native vegetation and threatened species habitats in the study area. An overview of the scope and content of the proposed management plans are provided in the following sections.

2.1.3.1 Flora and Fauna Management Plan

This plan is intended to provide detailed measures and protocols to minimise potential impacts upon wildlife and ensure protection of vegetation immediately adjacent to the development site during the *construction phase* of the project. The Flora and Fauna Management Plan should include the following:

- Pre-clearing fauna surveys;
- Clearing protocols;
- Hollow-bearing tree clearing protocol;
- Fauna translocation protocol; and
- Vegetation clearing protocol.

Further details of these items are provided below.

Pre-clearing Surveys

The following pre-clearing protocols and recommendations shall be included as a minimum in the Flora and Fauna Management Plan:

- Approximately one week prior to any vegetation clearing a survey of habitat trees should be conducted in the planned clearing area. These trees should be marked with flagging tape and subsequently watched at dusk during the week prior to clearing to determine whether any of the hollows are in use by fauna.
- Within 24 hours prior to vegetation clearing, pre-clearing surveys must be undertaken by a suitably qualified ecologist to ensure the absence of Koalas within each planned clearing area. Any trees identified as containing Koalas will be clearly marked to indicate occupation so that this can be communicated to the clearing contractor and supervising ecologist. If prior to clearing commencing the Koala(s) have not self-relocated from the planned clearing area the following procedure will be followed:
    - A 30 m exclusion zone around occupied trees will be maintained during clearing. To encourage self-relocation all other surrounding vegetation, apart from that within 30 m of the occupied tree, will be cleared. No vegetation will be felled onto the occupied tree and where possible vegetation links to adjacent retained vegetation will be maintained;
    - The occupied tree (and vegetation within the 30 m exclusion zone) will be left standing for a minimum of two nights to encourage self-relocation to vegetation outside the development site;

- If after this period the Koala(s) have not self-relocated, they may be retrieved from the tree by a suitably qualified ecologist prior to felling and relocated to a safe location within the adjacent biodiversity offset area. If it is not considered safe or practical to retrieve the Koala(s) from the tree, the occupied tree will be left standing until self-relocation occurs.

- Temporarily fence off and clearly mark out all vegetation which will not be cleared adjacent to the development site so that they are clearly visible as “no-go areas” to construction staff and vehicles.

- A survey of all noxious weed infestations (primarily Lantana and Bitou Bush) should be conducted in the planned clearing area at least one month prior to any vegetation clearing. Each weed infestation should be clearly marked and subsequently treated to minimise spread of weed propagules in the development site and adjacent native vegetation. Topsoil from these areas which are likely to contain weed propagules should also be stockpiled separately and not used in any rehabilitation works.

Clearing Protocols

Hollow-bearing Tree Clearing Protocol

The felling of all habitat trees should be attended by a suitably trained fauna ecologist experienced in fauna handling in order to ensure the safety of any fauna found to be in the hollows. On all occasions, trees having potential habitat hollows should be ‘soft felled’ by an experienced machine operator in accordance with ‘soft-felling’ procedures. Hollows should be inspected by the supervising ecologist immediately post-felling. All fauna found to occupy any hollows should be assessed for injury, and if healthy and uninjured, subsequently be released at a suitable nearby location (in accordance with the Fauna Translocation Protocol described below). If any fauna are injured during the felling process, they are to be taken to a nearby veterinarian or wildlife care group for treatment.

Fauna Translocation Protocol

Any translocation of wildlife required during the clearing process must be conducted in consideration of the Policy for the Translocation of Threatened Fauna in NSW (NPWS 2001). Fully qualified, experienced and licensed Ecologists should be contracted to undertake any fauna translocation to outside of the development area. It is envisaged that captured fauna and/or displaced fauna would be relocated to adjacent habitat or on-site retained habitats by an experienced Ecologist. During the tree removal process or any other construction activity, the following protocol should be followed in case of an injured animal:

- If possible any fauna fleeing the clearing area should be directed to a safe area outside the development site, or captured and relocated if necessary. All fauna are to be handled in such a way as to prevent injury to the animal or the handler.

- Once the animal has been safely captured, it should be relocated or caged in a hessian bag or box and released at an appropriate time of day;
- All fauna that are captured during the clearing operations that are uninjured will be relocated to a safe and appropriate location within the adjacent offset area on the same day as capture if possible;
- Any microbats or other nocturnal species captured during the tree removal process should be held in cotton or hessian bags and released at dusk if possible;
- If any animal is injured during the vegetation clearing works, a veterinarian should be contacted immediately for professional advice on the best course of action; and
- If any native animal is injured during other construction or operational processes while an ecologist, environmental representative or animal handler is not present, they must be contacted immediately. The procedure and relevant contacts for wildlife injuries will be communicated to all staff during the site induction.

Vegetation Clearing Protocol

Project Ecologists shall work in consultation with the construction contractor during vegetation clearing to provide assessment and direction to ensure that the process allows retention of the site's habitat and ecological values where possible. Key vegetation clearing protocols include:

- An Ecologist should be present on site during all clearing operations.
- Trees should be cleared in a way that will allow fauna living in or near the development site enough time to move out of the area without additional human intervention.
- When clearing areas greater than three hectares in size, clearing must be undertaken in separate stages. Each stage must be separated by at least one 12-hour period that occurs between 6 pm and 6 am on the following day.
- Habitat links must be maintained during clearing to allow fauna species to move safely from the site to adjacent areas.
- Clearing should begin in the area that is furthest from habitat adjacent to the area being cleared. The direction of clearing should also ensure that fauna species are directed away from threats such as roads and developed or disturbed areas (e.g. residential areas or cleared spaces > 100 m).
- Sequential clearing should not create an 'island' of habitat that is isolated from adjoining habitat by roads or cleared and disturbed areas.

- Habitat features such as rocks, logs and hollows should be salvaged and retained where possible and either used in any rehabilitation areas or carefully placed in areas of retained vegetation under the supervision of an Ecologist.

2.1.3.2 Landscape and Rehabilitation Management Plan

This plan is intended to detail the short and long term measures that would be implemented during the *construction and operation phases* of the project to minimise impacts on native vegetation and fauna on the site, and ensure the development site is progressively rehabilitated with self-sustaining native vegetation. The Landscape and Rehabilitation Management Plan should include the following as a minimum:

- Weed management within the development site during operations;
- Management of any retained vegetation within the development footprint during operations;
- Measures to protect areas of native vegetation and fauna habitats occurring adjacent to the development site;
- Details of traffic-calming measures and signage to be installed within the site to reduce the risk of vehicle strike to Koalas and other native fauna;
- Details of proposed rehabilitation and revegetation (including timing, target species composition, rehabilitation methods, and ongoing monitoring);
- Details on appropriate soil handling processes, including topsoil management for later use in any rehabilitation areas;
- Details on the salvage, storage and redistribution of habitat features (e.g. hollows and logs) within the rehabilitation areas;
- Fire management (including management of APZs);
- Vertebrate pest control within the development site;
- Details of maintenance, monitoring and performance criteria to assess the condition and functioning of the adjoining vegetation and fauna habitats, and to evaluate progress of rehabilitation works.

2.2 IMPACT SUMMARY

2.2.1 Ecosystem Credits Required

A total of 1,836 ecosystem credits are required for the proposed development. **Table 14** outlines the biometric vegetation types that would require offsetting for the proposed development and the number of ecosystem credits required to compensate for the proposed impacts at the development site. The credit report for the development site is included in **Appendix 1**.

Table 14: Summary of ecosystems credits required at the development site

Veg Zone #	Biometric Vegetation Type	% Cleared in Major Catchment Area	Area of Zone	Current Site Value	Future Site Value	Credits
1	HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (mod-good)	48	32.03	71.88	0.00	1,836
Total Credit Requirements for HU804						**1,836**

2.2.2 Species Credits Required

The number of species credits required to compensate for the impacts of the proposed development is outlined in **Table 15**. The credit report for the development site is included in **Appendix 1**.

Table 15: Summary of species credits required at the development site

Scientific Name	Common Name	Area (ha) of Habitat Impacted	Species Credits
Myotis macropus	Southern Myotis	16.46 ha	362
Phascolarctos cinereus	Koala	11.19 ha	291

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APPENDIX 1: CREDIT REPORT – DEVELOPMENT SITE

Biodiversity credit report

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

Date of report: 16/06/2017 Time: 3:21:38PM Calculator version: v4.0

Major Project details

Proposal ID:	167/2016/3995MP
Proposal name:	Eagleton Hard Rock Quarry Development
Proposal address:	Barleigh Ranch Way Eagleton NSW 2324
Proponent name:	Eagleton Rock Quarry Pty. Ltd
Proponent address:	PO Box 826 Newcastle NSW 2300
Proponent phone:	0429 877 704
Assessor name:	Samara Schulz
Assessor address:	64 Medcalf Street Warners Bay NSW 2282
Assessor phone:	02 4949 5200
Assessor accreditation:	167

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	32.03	1,836.00
Total	32.03	1,836

Credit profiles

1. Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest, (HU804)

Number of ecosystem credits created 1,836

IBRA sub-region Karuah Manning

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest, (HU804) Melaleuca decora low forest of the central Hunter Valley, Sydney Basin Bioregion, (HU564) Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619) Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast, (HU802) Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast, (HU803) Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter, (HU806) Red Ironbark - Spotted Gum - Prickly-leaved Paperbark shrubby open forest of the Lower Hunter, (HU807) Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814) Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815) Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter, (HU816) Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter, (HU822)	Karuah Manning and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Koala	Phascolarctos cinereus	11.19	291
Southern Myotis	Myotis macropus	16.46	362

APPENDIX 2: BIODIVERSITY OFFSET STRATEGY

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Biodiversity Offset Strategy

Eagleton Rock Syndicate Pty Ltd

Eagleton Quarry

13 Barleigh Ranch Way, Eagleton NSW

17 July 2017

Biodiversity Offset Strategy

Eagleton Quarry

13 Barleigh Ranch Way, Eagleton NSW

Kleinfelder Document Number: NCA16R50548
Project Number: 20163494

Prepared for:

EAGLETON ROCK SYNDICATE PTY LTD
PO BOX 898
NEWCASTLE NSW 2300

Only Eagleton Rock Syndicate Pty Ltd, its designated representatives or relevant statutory authorities may use this document and only for the specific project for which this report was prepared. It should not be otherwise referenced without permission.

Document Control:

Version	Description	Date	Author(s)	Reviewer(s)
1.0	Draft	9 December 2016	A. Mulcahy	S. Schulz A. Blundell
2.0	Draft	19 June 2017	C. Phu	S. Schulz J. Berry
3.0	Final	17 July 2017	C. Phu	J. Berry

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Cardiff, NSW 2285
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ABN: 23 146 082 500

Contents

Tables

Figures

Abbreviations

BAR	Biodiversity Assessment Report
BBAM	BioBanking Assessment Methodology (2014)
BOS	Biodiversity Offset Strategy
ECs	Ecosystem Credits
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
FBA	Framework for Biodiversity Assessment
GIS	Geographic Information System
ha	hectares
IBRA	Interim Biogeographic Regionalisation of Australia
OEH	Office of Environment and Heritage (NSW)
RDP	Rapid Point Data
SCs	Species Credits
TEC	Threatened Ecological Community (as defined under Commonwealth and NSW Legislation)
TSC Act	*Threatened Species Conservation Act* 1995 (NSW)

STAGE 3: BIODIVERSITY OFFSET STRATEGY

Kleinfelder were commissioned by Eagleton Rock Syndicate Pty Ltd to prepare a Biodiversity Assessment Report (BAR) and Biodiversity Offset Strategy (BOS) for a proposed hard rock quarry at Lot 2 DP1108702, 13 Barleigh Ranch Way, Eagleton NSW (hereafter referred to as the 'study area'). The BAR and BOS have been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) (SSD 7332, dated 6 November 2015). The relevant SEARs relating to these reports include:

- *"Accurate predictions of any vegetation clearing on site;*
- *A detailed assessment of the potential biodiversity impacts, paying particular attention to threatened species, populations and ecological communities, having regard to the requirements of OEH (see Attachment 2); and*
- *A detailed description of the proposed measures to maintain or improve the biodiversity values of the region in the medium to long term"* (p.2).

Points 1 and 2 are addressed in the BAR, and point 3 is addressed in the BOS (this report). This project has been assessed under the NSW Biodiversity Offsets Policy for Major Projects using the Framework for Biodiversity Assessment (FBA) (OEH 2014) in accordance with OEH's requirements in the SEARs. This BOS forms an addendum to the BAR and provides an assessment of proposed offset measures for the development, including their suitability to compensate for loss of biodiversity values on the proposed development site.

This strategy has been structured to comply with the reporting requirements of the FBA, as detailed in Appendix 9 of the FBA. Section 1.1 of this strategy provides an assessment of the proposed onsite offset site. Section 1.2 of this strategy provides a summary of the biodiversity credits for the proposed development and offset sites, and Section 1.3 details the proposed strategy for securing any remaining biodiversity offsets/credits not fulfilled by the onsite offset.

1.1 OFFSET SITE

1.1.1 Site Description

It is proposed that the majority of land not subject to development within Lot 2 DP 1108702 be secured as a biobank site as part of the offset for the project. The proposed offset site is 60.83 ha and occupies that southern and eastern parts of the study area. The proposed offset site would exclude the existing operational areas of Port Stephens Gardenland which is located on the north-east part of the site. The majority of the offset site is vegetated with dry sclerophyll

forest. Small areas of modified grasslands (1.56 ha), dams (0.61 ha), un-vegetated areas and access tracks (1.41 ha) also occur in the proposed offset site.

A Location Map and Site Map of the proposed offset site is provided in **Figures 1 and 2** respectively.

1.1.2 Landscape Features

1.1.2.1 Identification of Landscape Features

The landscape features detailed in Section 4.1 of the BBAM 2014 including IBRA bioregion, IBRA subregion, Mitchell landscape, rivers and streams, wetlands, and the extent of native vegetation in the outer assessment circle for the offset site are described in **Table 1**. These landscape features are also shown in **Figure 1, Section 1.1.1**.

Table 1: Landscape features of the offset site

Landscape Feature	Offset Site
IBRA bioregion	NSW North Coast
IBRA subregion	Karuah Manning
Mitchell landscape	Newcastle Coastal Ramp
River, streams and estuaries	The biobank site contains a series of 1st order streams, two 2nd order streams and one 3rd order stream (i.e. Seven Mile Creek) and the associated riparian buffers
Wetlands	No important or local wetlands occur within the biobank site.
Native vegetation extent	See Section 1.1.2.2
State or regionally significant biodiversity links	None identified

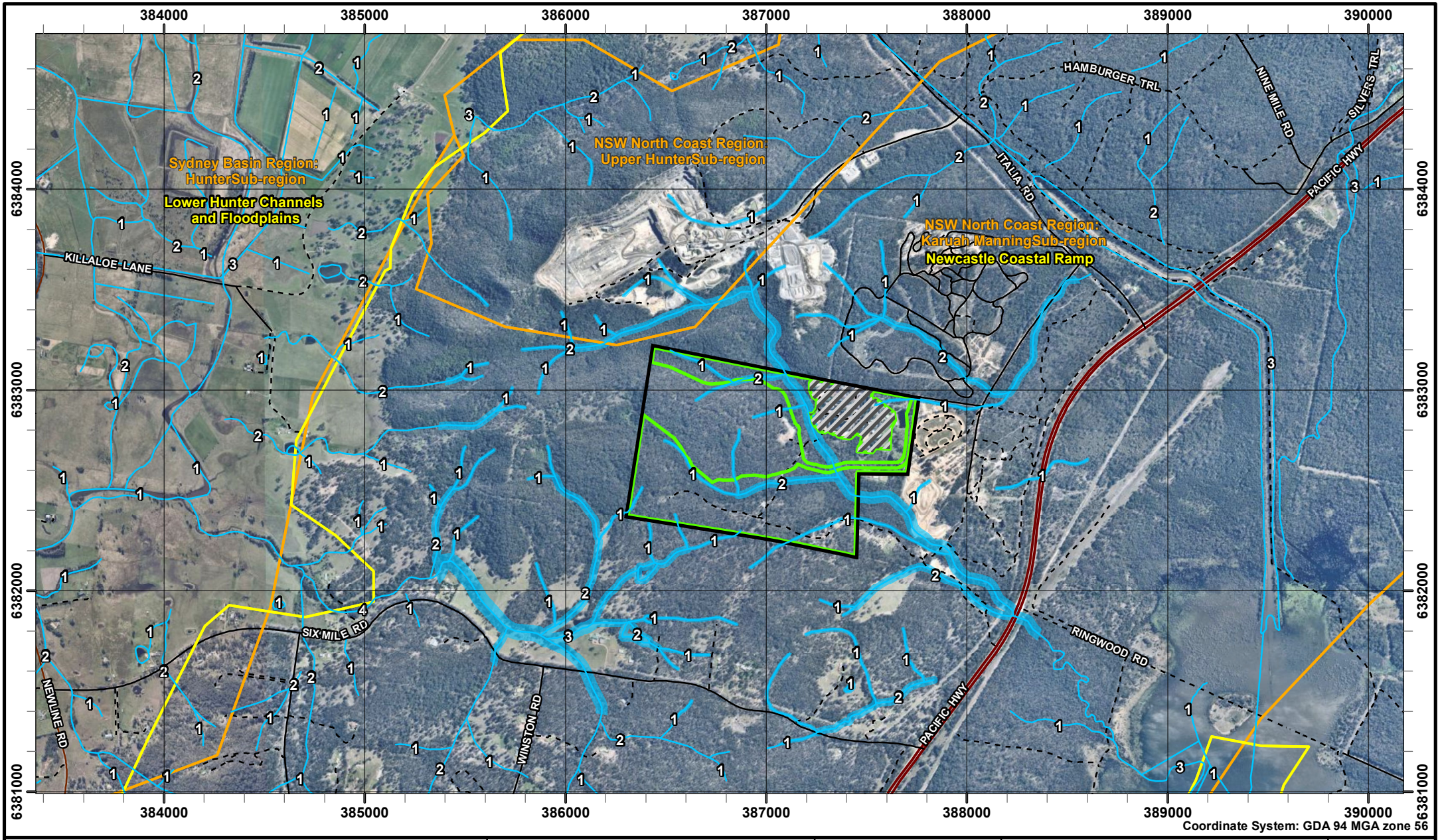
1.1.2.2 Determining Landscape Values

The landscape assessment for the offset site was undertaken in accordance with Section 4.2 and Appendix 6 of the BBAM 2014 through a combination of GIS analysis and ground-truthing. The patch size was determined to be >1,000 ha through aerial photo analysis. The offset site was assessed as occurring within a 'strategic location' as defined in Section 4.2.6 and Appendix 6 of the BBAM 2014 as the site contains a riparian buffer on both sides of a 3rd order stream (i.e. Seven Mile Creek).

Details of the landscape assessment are provided in **Table 2** and **Figure 3**.

Table 2: Offset site landscape assessment

Assessment Circle	Vegetation cover before biobank	Vegetation cover after biobank
100 ha circle	73% (71-75)	73% (71-75)
1000 ha circle	74% (71-75)	74% (71-75)
Patch Size	**Landscape Value Score**	
>1000 ha	21.00	



Coordinate System: GDA 94 MGA zone 56

- Study Area (100.94 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Riparian Buffers
- Mapped Rivers & Streams (labelled with stream order)
- Mitchell Landscapes Boundary (V3)
- IBRA Subregion Boundary (V7)
- PrimaryRoad
- Sub-arterial Road
- Local Road
- Track

Metres
0 100 200 400 600 800 1,000

N

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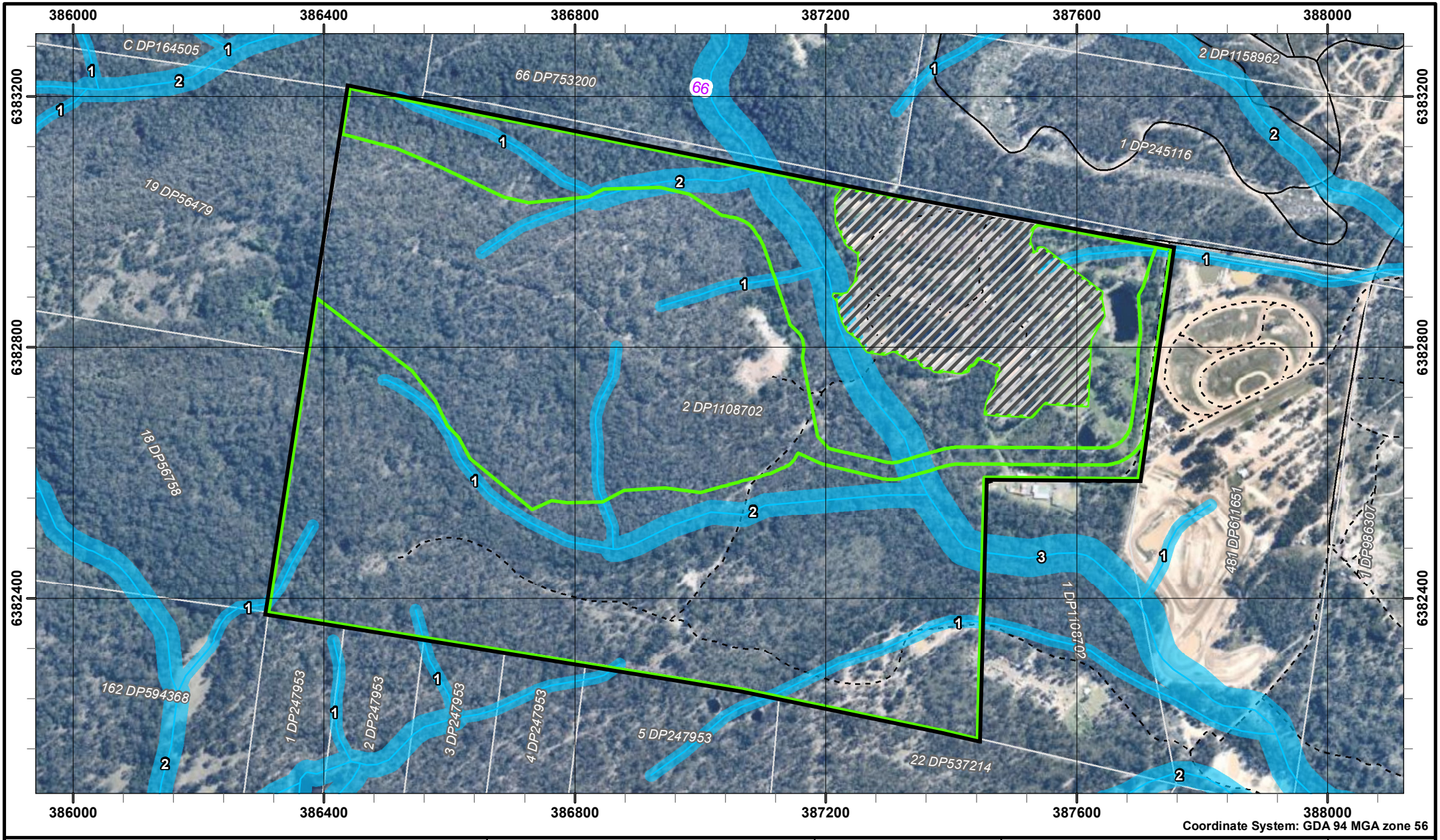
PROJECT REFERENCE: 20173040
DATE DRAWN: 6/19/2017 12:22 Version 1
DRAWN BY: bdeane
DATA SOURCE:
NSW Land and Property Information - 2017
Nearmap - 2017

Location Map - Offset Site

Eagleton Rock Syndicate Pty Ltd
Biodiversity Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
1

L:\GIS FOLDER\00 CLIENT FILES\127626_EagleRockTrust\20173040_EagletonRockQuarry\GIS ONLY\MXDs\Figures\CPhu_Report_Offset\20173040_Fig01_LocationMap.mxd



Study Area (100.94
Offset Site (57.2 ha)
Gardenland (Excluded - 10.05 ha)

Local Road
Track
Mapped Rivers & Streams (labelled with stream order)
Lot
Riparian Buffers

Metres
0 25 50 100 150 200 250

N

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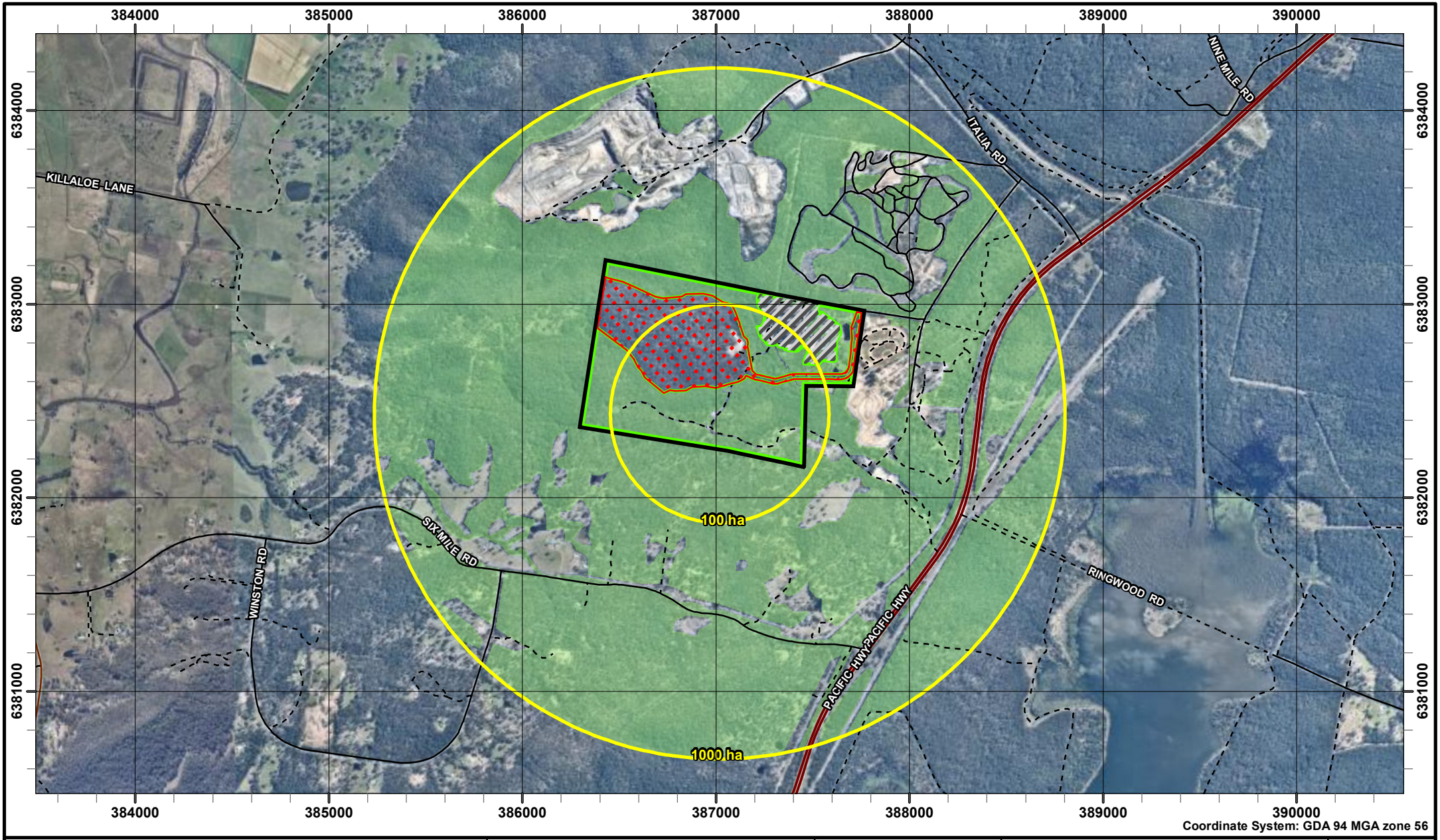
PROJECT REFERENCE: 20173040
DATE DRAWN: 6/19/2017 12:27 Version 1
DRAWN BY: bdeane
DATA SOURCE:
NSW Land and Property Information - 2017
Nearmap - 2017

Site Map - Offset Site

Eagleton Rock Syndicate Pty Ltd
Biodiversity Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
2

L:\GIS FOLDER\00 CLIENT FILES\127626_EagleRockTrust\20173040_EagletonRockQuarry\GIS ONLY\MXDs\Figures\CPhu_Report_Offset\20173040_Fig02_SiteMap.mxd



- Study Area (100.94 ha)
- Development Site (33.7 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Assessment Circles
- Native Vegetation
- Primary Road
- Sub-arterial Road
- Local Road
- Track

Metres
0 100 200 400 600 800 1,000

N

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PROJECT REFERENCE: 20173040
DATE DRAWN: 20-Jun-17 12:47 Version 1
DRAWN BY: amarshall
DATA SOURCE:
NSW Land and Property Information - 2017
Nearmap - 2017

Landscape Assessment - Offset Site

Eagleton Rock Syndicate Pty Ltd
Biodiversity Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
3

\\newcastle.kleinfelder.com\Newcastle-Data\Company\GIS FOLDER\00 CLIENT FILES\127626_EagleRockTrust\20173040_EagletonRockQuarry\GIS ONLY\MXDs\Figures\CPhu_Report_Offset\20173040_Fig03_LAT.mxd

1.1.3 Native Vegetation

1.1.3.1 Methodology

Native vegetation at the offset site was assessed in accordance with Section 5 of the BBAM 2014. Full descriptions of the specific methods used to undertake the assessment of the native vegetation in the offset site are provided in Section 1.3.1 of the BAR.

1.1.3.2 Assessment Results

The vegetation within the proposed offset site was determined to comprise two plant community types (PCTs) as defined in the VIS database: HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest; and HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley. These PCTs are not consistent with any threatened ecological communities (TECs) listed under the TSC Act 1995 and/or EPBC Act. Section 1.3.2 of the BAR provides detailed discussion of the vegetation classification across the study area (i.e. development and offset sites) and justification for determining that the vegetation in the study area is not consistent with any TECs.

The HU804 vegetation in the offset site was stratified into three vegetation zones based on differences in vegetation structure and condition resulting from past disturbance:

1. HU804_moderate-good: this zone includes the majority of HU804 vegetation in the offset site and contains vegetation in relatively high condition with low disturbance.

2. HU804_moderate-good_medium: this zone includes areas of HU804 in the southern and north-east parts of the offset site which have been degraded through understorey slashing and/or disturbance, and past clearing. However, these areas still contain relatively high native overstorey cover and/or native ground cover. Weed abundance is higher in this zone than zone 1.

3. HU804_low: this zone consists of modified exotic grasslands that are currently slashed, and small areas of highly disturbed vegetation. It is proposed that these areas be revegetated to improve connectivity on the eastern side of the site.

4. HU804_moderate-good_poor: a very small area of this zone has been mapped on the north-east part of the site, and consists of a thin strip of planted and regenerating native trees with no native understorey (i.e. dominated by Lantana). As this zone is <0.25 ha it has been mapped in with the adjoining vegetation zone for the calculations.

The HU798 vegetation in the offset site was identified as the riparian vegetation associated with Seven Mile Creek in the eastern part of the proposed offset site. The occurrence of HU798 within the offset site comprises a fourth vegetation zone:

5. HU798_moderate-good: this zone includes all of HU798 vegetation in the offset site and contains vegetation in relatively high condition with low disturbance.

A number of small un-vegetated areas and access tracks also occur within the offset site.

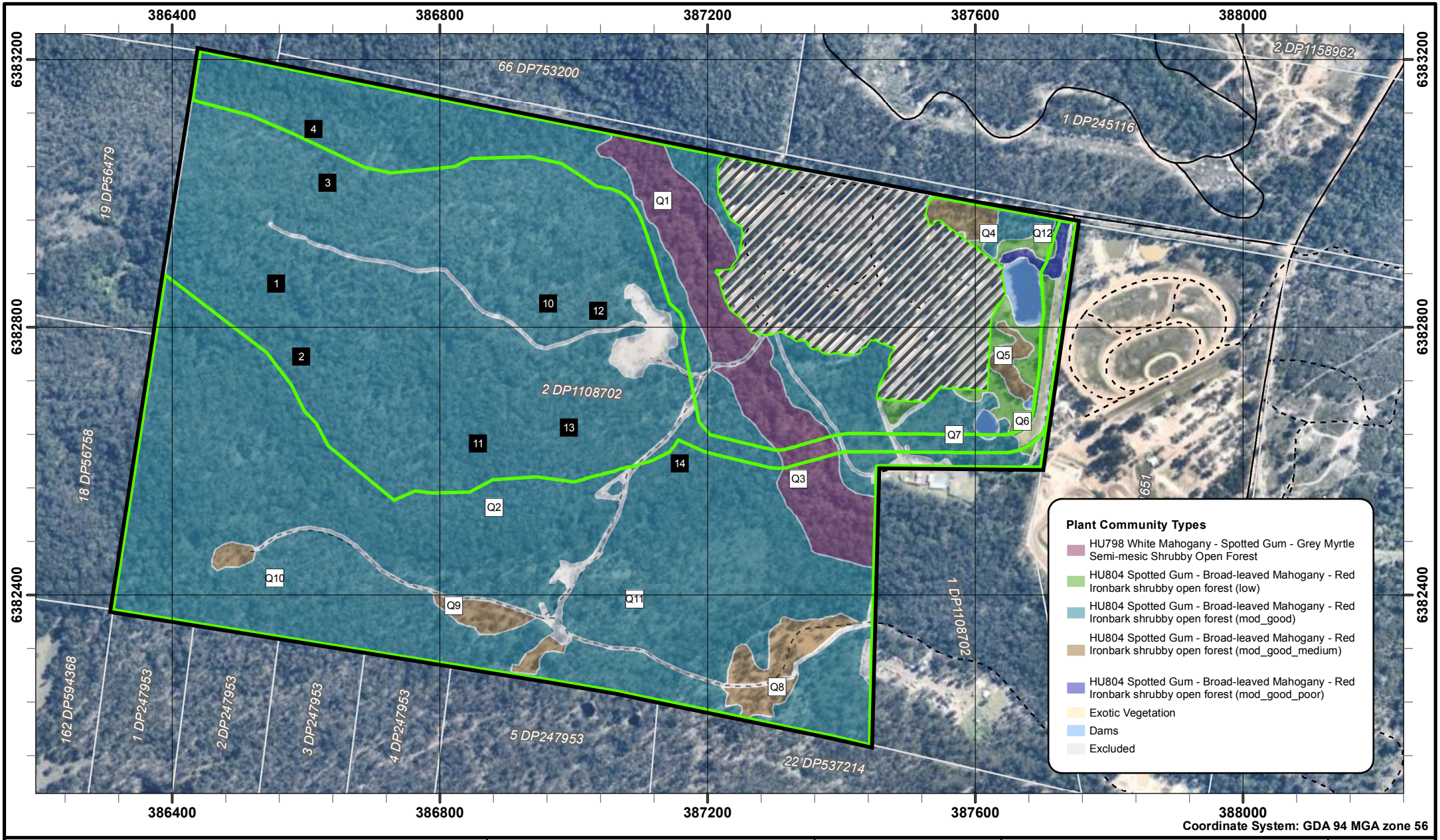
Table 3 provides a detailed description of each PCT, including the vegetation class, floristic description, and justification of evidence used to determine PCTs. **Figure 4** shows the distribution of PCTs / vegetation zones on the offset site. Plot and transect data are provided in Appendix 3 of the BAR.

Table 3: Descriptions of PCTs and vegetation zones within the offset site

Veg Zone	Plant Community Type	Vegetation Class	Floristic description	Justification for PCT selection	Area (ha)
1	HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (moderate-good) **Equivalent Somerville (2009) map unit:** MU65 Spotted Gum/ Broad-leaved Mahogany/ Red Ironbark moist shrubby open forest	Hunter-Macleay Dry Sclerophyll Forests	The canopy layer of this community on the site is typically dominated by *Corymbia maculata* with a range of co-dominant species across the site including *Eucalyptus punctata, E. acmenoides, E. fibrosa, E. crebra,* and *E. globoidea*. Within the drainage lines, other co-dominants the relative abundance of *E. punctata* and *E. acmenoides* is higher, and other co-dominants such as *E. siderophloia, C. gummifera* and *Angophora costata* also occur. The midstorey is sparse across most of the site, with a higher midstorey cover typically occurring in the drainage lines. Common midstorey species include *Dodonaea triquetra*, *Allocasuarina torulosa, Acacia falcata*, *Persoonia linearis, Melaleuca nodosa, Myrsine variabilis, Glochidion ferdinandi, Acacia irrorata* and *Melaleuca styphelioides.* The shrub layer ranges from moderately sparse to dense, with common species including *Leucopogon juniperinus*, *Breynia oblongifolia*, *Bursaria spinosa, Pultenaea villosa, Leptospermum polygalifolium, Zieria smithii, Acacia ulicifolia, Acrotriche divaricata* and *Notelaea ovata*. Common native species in the ground layer include *Imperata cylindrica*, *Microlaena stipoides, Themeda australis, Entolasia stricta, Oplismenus aemulus, Lepidosperma laterale*, *Dianella caerulea*, *Lomandra longifolia, Lomandra multiflora, Pratia purpurascens, Desmodium rhytidophyllum* and *Cheilanthes sieberi*. This majority of this vegetation zone has a relatively low abundance of exotic species. The most abundant exotic species in this vegetation zone is *Lantana camara*, which occurs most frequently in the drainage lines and lower slopes.	HU804 was determined as the closest equivalent PCT for this community on the site. Comparison of floristic data indicates a very high similarity between this PCT and the community onsite, with the majority of species listed in the VIS for HU804 recorded consistently across this vegetation zone. The following key species that have been relied upon for identification of this vegetation type were consistently present and/or recorded at relatively high abundance within the plots conducted: *Corymbia maculata, Eucalyptus fibrosa, Allocasuarina torulosa, Persoonia linearis, Leucopogon juniperinus, Breynia oblongifolia, Bursaria spinosa, Pultenaea villosa, Microlaena stipoides, Themeda australis, Lepidosperma laterale, Dianella caerulea, Lomandra multiflora, Pratia purpurascens,* and *Cheilanthes sieberi.* The structure of this vegetation on the site is consistent with the description for HU804, comprising an open eucalypt forest with a grass understorey. The description for HU804 is also consistent with the location and landscape position (i.e. low ranges of the lower Hunter Valley) of this community on the site. All PCTs in the dry sclerophyll forest (shrub/grass) subformation, and the wet sclerophyll forest formations (i.e. for assessing vegetation in the drainage lines) listed for the Hunter-Central Rivers CMA were considered in undertaking the above determination. Four other potentially suitable PCTs were identified (HU803, HU806, HU814 and HU798). HU803 was considered the next closest equivalent PCT as it has a relatively high similarity in all strata for this community onsite; however, this PCT was excluded as it is described as occurring on the Central Coast, and does not list the Mitchell landscape of the site (i.e. Newcastle Coastal Ramp). HU806 and HU814 also have a moderate floristic similarity with the vegetation onsite but were excluded due to an overall lower floristic similarity compared to HU804. HU798 was also considered for the areas of this vegetation community within the drainage lines which have a higher abundance of mesic	45.35

Veg Zone	Plant Community Type	Vegetation Class	Floristic description	Justification for PCT selection	Area (ha)
				species. While this PCT has a moderate floristic similarity to most of the drainage lines within the offset site, only the riparian vegetation associated with the third order stream, Seven Mile Creek, is consistent with a wet sclerophyll forest formation.	
2	HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (moderate-good_medium)	Hunter-Macleay Dry Sclerophyll Forests	This vegetation zone has similar dominant species and floristic composition to the vegetation in zone 1, but has a lower species diversity. The midstorey and shrub layers are also very sparse or absent in this vegetation zone as a result of slashing and past disturbance. In the south-east part of the site, the ground layer of this zone is also relatively sparse as a result of Hunter Valley Paintball previously operating in this area. Exotic plant cover is also higher in this vegetation zone.	See discussion and justification of PCT selection in zone 1.	3.10
3	HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (low)	Hunter-Macleay Dry Sclerophyll Forests	This zone consists of modified grasslands that are currently slashed, and small areas of highly disturbed vegetation. These areas are dominated by a number of exotic grasses and herbs such as *Paspalum dilatatum, Axonopus fissifolius, Vulpia myuros, Stenotaphrum secundatum, Panicum repens, Hypochaeris radicata* and *Senecio madagascariensis*. Native ground cover species occur in relatively low abundance in these areas; common species include *Cynodon dactylon, Eragrostis brownii, Dichondra repens* and *Pratia purpurascens*. While this zone currently contains non-native vegetation, it is proposed that these areas be revegetated to improve connectivity on the eastern side of the site with a species composition consistent with HU804.	See discussion and justification of PCT selection in zone 1.	1.29

Veg Zone	Plant Community Type	Vegetation Class	Floristic description	Justification for PCT selection	Area (ha)
4	HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (moderate-good) **Equivalent Somerville (2009) map unit:** The best fit for HU798 is MU59 White Mahogany/ Spotted Gum/ Grey Myrtle shrubby open forest of the central and lower Hunter Valley. Although MU59 is reported to be a dry sclerophyll forest, this map unit has a dominance of *Eucalyptus acmenoides*, *Backhousia myrtifolia* and a mesic understorey characterised by a variety of fern species.	Northern Hinterland Wet Sclerophyll Forests	This vegetation zone is floristically similar to the vegetation in zone 1 but has a dominance of *Eucalyptus acmenoides*, *Backhousia myrtifolia*, *Melaleuca linearifolia*, *Callistemon salignus* and ferns in the understorey. The dominance of such species and the mesic understorey is consistent with a wet sclerophyll forest formation.	HU798 was considered for the vegetation within the drainage lines across the offset site, which have a higher abundance of mesic species. This PCT has a moderate floristic similarity to most of the drainage lines within the offset site but the first and second order streams are too dry to be considered mesic. The riparian vegetation associated with the first and second order streams are considered to represent a minor variation within HU804. Only the riparian vegetation associated with the third order stream, Seven Mile Creek, is consistent with a wet sclerophyll forest formation and as such, HU798 was determined to be the most appropriate equivalent PCT for this vegetation in the offset site.	5.48
-	Excluded	-	-	The excluded areas include dams, access tracks and un-vegetated areas (i.e. fill material) in the offset site.	1.98
				Total	**57.21**



Coordinate System: GDA 94 MGA zone 56

- Study Area (100.94 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Lot
- Local Road
- Track
- Plot Locations (KLF)
- Plot Locations (PDA Services)

Metres
0 25 50 100 150 200 250

N

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DRAWN BY: bdeane
DATA SOURCE:
NSW Land and Property Information - 2017
Nearmap - 2017

Plant Community Types and Vegetation Zones

Eagleton Rock Syndicate Pty Ltd
Biodiversity Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
4

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1.1.4 Threatened Species

1.1.4.1 Ecosystem Credit Species

Predicted ecosystem credit species for the offset site were identified and assessed in accordance with Section 6.3 of the BBAM 2014. No ecosystem credit species were excluded from the predicted species list for the purpose of the assessment, and no species had their offset multiplier modified for the assessment.

1.1.4.2 Species Credit Species

Methodology

An assessment for two species credit species, Koala (*Phascolarctos cinereus*) and Southern Myotis (*Myotis macropus*), was undertaken on the offset site in accordance with Section 6.5 and 6.5 of the BBAM 2014. The assessment methodology (i.e. targeted surveys and habitat mapping) for each species is described in Section 1.4.2.2 of the BAR.

Assessment Results

Koala

Two Koalas were sighted in the south-western part of the offset site during the surveys by Kleinfelder in 2013 (**Figure 5**). SAT tests also detected Koala activity on the south-west, central, and north-east parts of the study area (**Figure 5**). Fifty percent of the SAT tests (N=14) showed some sign of Koala activity across the study area (range 3%-13%). According to Phillips and Callaghan (2011), this level of activity is considered to be low use range (<22.52% activity levels) and therefore the use by Koalas is “likely to be transitory” (p.776). **Table 4** summarises the results of the SAT tests that showed signs of activity.

SAT tests and sightings determined that Koalas were using a range of tree species throughout the study area including Grey Gum (*E. punctata*), White Mahogany (*E. acmenoides*), Grey Ironbark (*E. siderophloia*), Forest Red Gum (*E. tereticornis*) and Spotted Gum (*Corymbia maculata*). Of these, Forest Red Gum and Grey Gum are the only species listed as Koala feed trees under SEPP 44. Grey Gum, White Mahogany and Spotted Gum are listed as tree species that may be important to Koalas in the Port Stephens LGA under the CKPoM (PSC 2002).

The CKPoM Koala habitat mapping for the study area shows only a very small area of preferred Koala habitat in the south-west, with the remainder of the site mapped as marginal habitat. Detailed assessment of Koala feed tree density across the study area identified a total of 52.59 ha of suitable Koala habitat as defined under SEPP 44 (i.e. 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) (**Figure 5**). Of this, 41.40 ha of suitable Koala habitat occurs within the offset site.

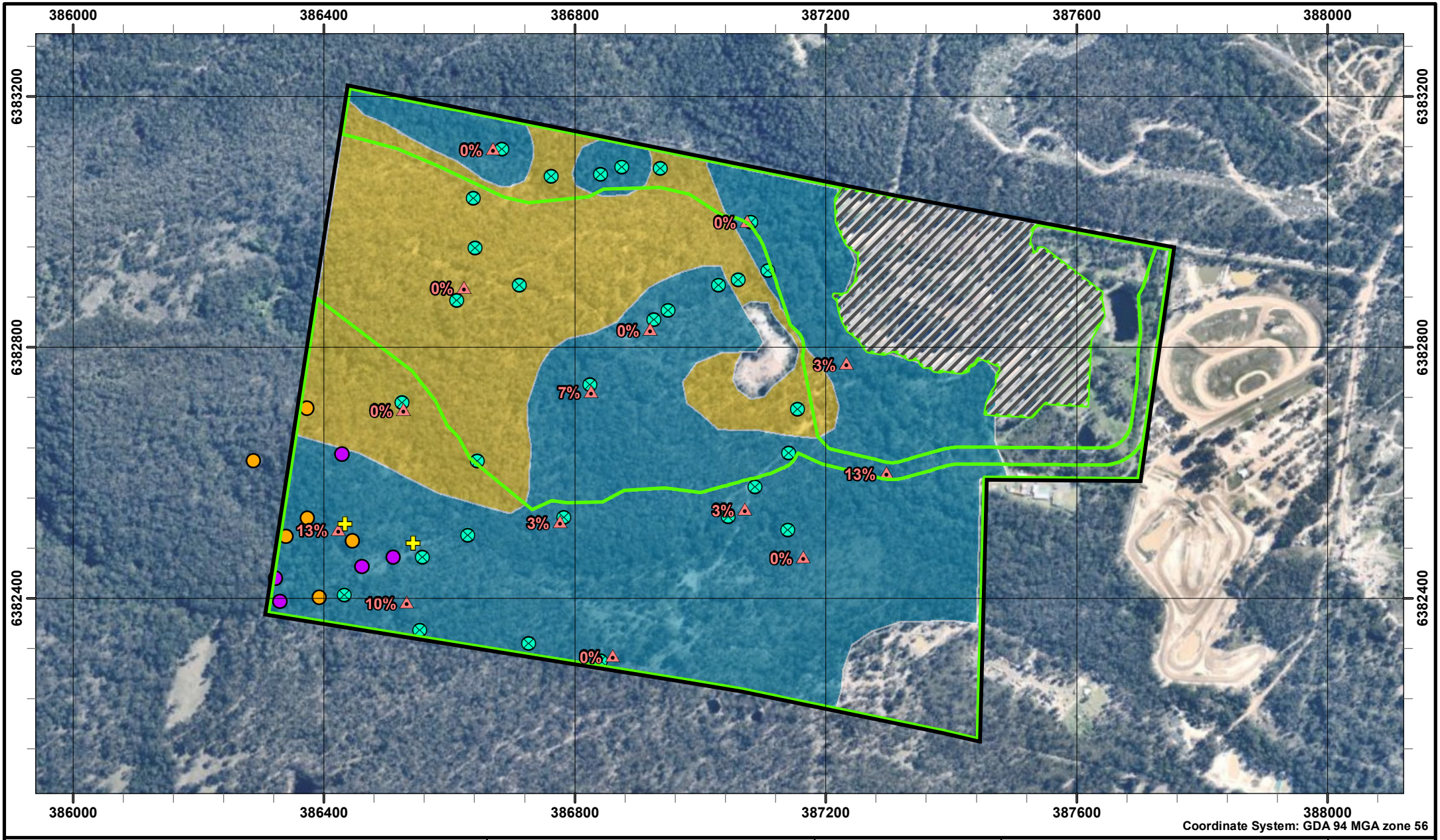
Table 4: SAT test results

SAT ID	Trees with pellets	Total trees surveyed	Activity level %
8	1	30	3%
11	1	30	3%
5	2	30	7%
13	2	30	7%
7	3	30	10%
10	4	30	13%
12	4	30	13%
		MEAN	8%

Southern Myotis

The Southern Myotis was recorded at one location along Seven Mile Creek in the eastern part of the study area, within the offset site (**Figure 6**). The TSPD indicates that breeding habitat for the Southern Myotis includes hollow-bearing trees, bridges, caves or artificial structures within 200 m of riparian zone. Hollow-bearing trees are present (albeit in low to moderate abundance) throughout the forest vegetation in the study area. All areas of HU804 (moderate-good) and HU798 within 200 m of the dams and the 2nd and 3rd order streams on the eastern part of the offset site were mapped as suitable breeding habitat for this species (**Figure 6**). The remaining 1st order drainage lines in the study area are highly ephemeral and do not contain suitable foraging habitat (i.e. streams and pools).

A total of 49.49 ha of Southern Myotis habitat occurs in the study area. Of this, 33.03 ha of Southern Myotis habitat occurs in the offset site.



Coordinate System: GDA 94 MGA zone 56

- Study Area (100.94 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- less than 15% *Eucalyptus Punctata*
- greater than 15% *Eucalyptus Punctata*
- Assessment Points
- SAT Test Location (Label indicates activity level)
- Koala Sighting

SEPP 44 Koala Habitat Mapping

- <15% SEPP 44 Koala Feed Trees
- >15% SEPP 44 Koala Feed Trees

Metres
0 25 50 100 150 200 250

N

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DRAWN BY: amarshall

DATA SOURCE:
NSW Land and Property Information - 2017
Nearmap - 2017

SEPP 44 Koala Habitat Mapping

Eagleton Rock Syndicate Pty Ltd
Biodiversity Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
5

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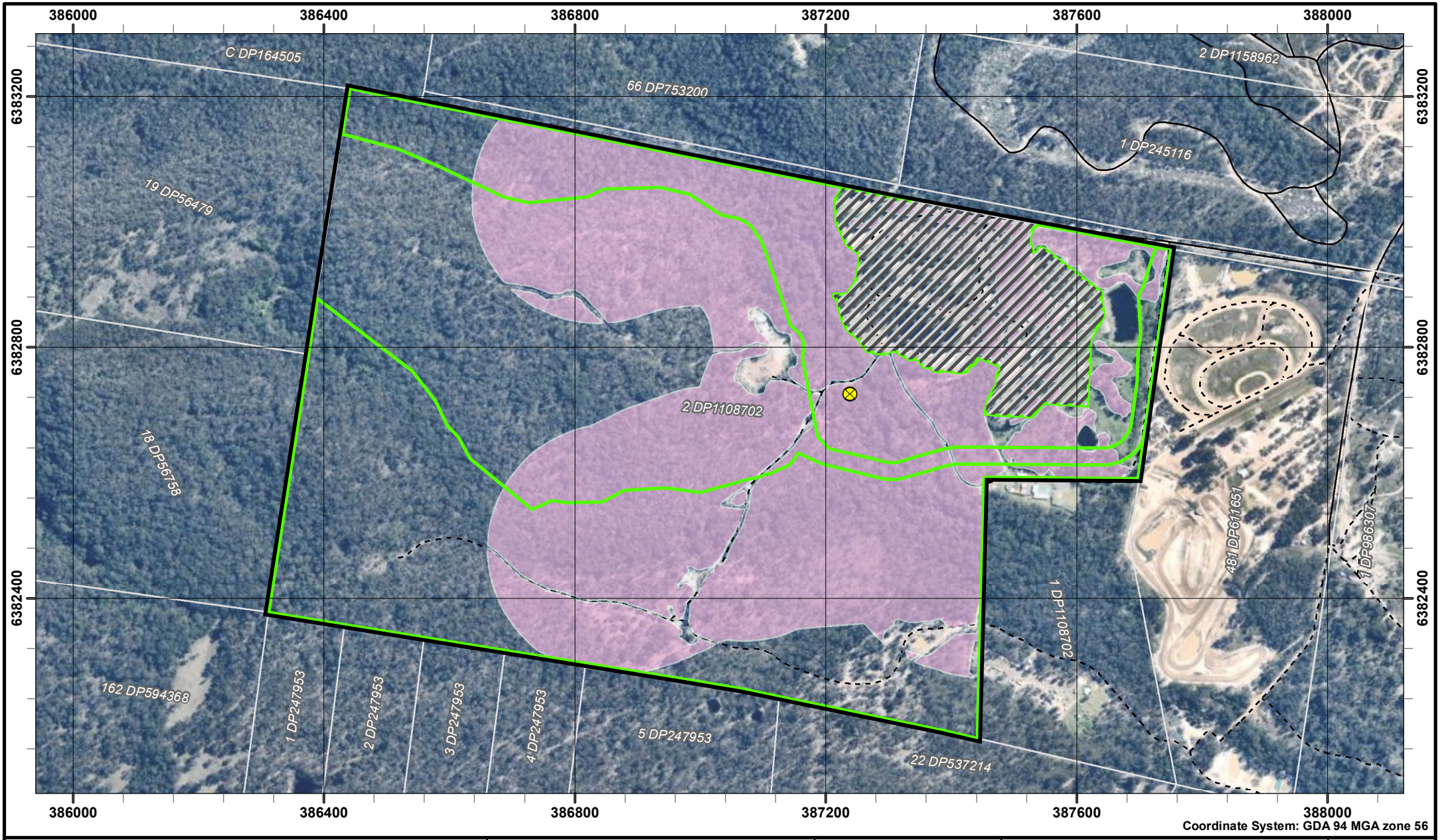

- Study Area (100.94 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Lot
- Local Road
- Track
- Southern Myotis Location
- Southern Myotis Habitat

Metres
0 25 50 100 150 200 250

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DRAWN BY: bdeane

DATA SOURCE:
NSW Land and Property Information - 2017
Nearmap - 2017

Southern Myotis Habitat Mapping

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13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
6

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1.1.5 Offset Site Biodiversity Credits

1.1.5.1 Ecosystem Credits Created

Table 5 provides a summary of the ecosystem credits generated for each vegetation zone at the offset site. **Table 5** also shows the percentage cleared within the major catchment area, current and future biometric site value scores, and averted loss in site value for each vegetation zone. The biobanking credit report for the offset site is included in this strategy.

Table 5: Summary of ecosystems credits generated at the offset site

Veg Zone #	Plant Community Type	% Cleared in Major Catchment Area	Site value score		Averted loss in site value	Area (ha)	Credits
			Before	After			
1	HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (moderate-good)	48	83.85	98.44	7.16	45.35	485
2	HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (moderate-good_medium)	48	75.00	93.75	5.73	3.10	35
3	HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (low)	48	22.40	40.89	2.08	1.29	13
4	HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (moderate-good)	42	73.61	92.19	6.25	5.48	63
					Total	**55.22**	**596**

1.1.5.2 Species Credits Created

Table 6 provides a summary of the credits generated for each species credit species assessed at the offset site. The biobanking credit report for the offset site is included in this strategy.

Table 6: Summary of species credits generated at the offset site

Scientific Name	Common Name	Area of Habitat (ha)	Species Credits
Myotis macropus	Southern Myotis	33.03	235
Phascolarctos cinereus	Koala	41.40	294

1.1.5.3 Management Actions

Retirement of biodiversity credits requires certain management actions to be implemented that underpin the predicted improvements to biodiversity values on the biobank site. These management actions are divided into two categories: standard management actions required for all biobank sites and additional management actions required for certain vegetation types and species. The specific actions proposed for each standard and additional management action category for the biobank site are set out in **Table 7** and **Table 8**, respectively. The additional actions are also listed in the biobanking credit report for the biobank site in this strategy. Specific details on the management actions to be undertaken at the biobank site would be provided as part of the biobanking agreement and will be detailed in the Management Actions Template.

Table 7: Standard management actions for biobank sites

Standard management action category	Proposed actions
Management of grazing for conservation	• Installation and/or maintenance of stock exclusion fencing (wildlife friendly) along external property boundaries.
Weed control	• Preparation and implementation of a weed control action plan.
Management of fire for conservation	• Preparation and implementation of a fire management plan.
Management of human disturbance	• Installation and/or maintenance of fencing along boundaries to discourage encroachment of adjoining landholders and restrict recreational activities (e.g. trail bike riding, horse riding and hunting). • Restriction of vehicular access to the site by road. • Installation of signage at appropriate locations. • Liaison with adjoining landholders (where appropriate).
Retention of regrowth and remnant vegetation	• Installation and/or maintenance of fencing along certain boundaries. • Permitted clearing provisions of the NSW *Native Vegetation Act* are extinguished. • Firewood collection and timber harvesting are not permitted.
Replanting or supplementary planting where natural regeneration will not be sufficient	• Implementation of the planting actions.
Retention of dead timber	• Installation and/or maintenance of fencing or markers along boundaries. • Restriction of vehicular access to the site by road. • Installation of signage at appropriate locations.
Erosion control	• Repair existing tracks displaying active erosion. • Implementation of the erosion control actions.
Retention of rocks	• Installation and/or maintenance of fencing along land boundaries. • Restriction of vehicular access to the site by road. • Installation of signage at appropriate locations.
Note: These management actions are required to be considered under the BBAM; however, it is noted that not all are applicable to the site.	

Table 8: Additional management actions required for the biobank site

Additional management action category	PCTs and species credit species to be targeted	Proposed actions
Exclude commercial apiaries	HU804	No establishment of commercial apiaries within the site.
Exclude miscellaneous feral species	HU804 and Koala	The implementation of the vertebrate pest management plan.
Feral and/or overabundant native herbivore control	HU804	No evidence of overabundant native herbivores (e.g. heavily grazed vegetation or large areas of bare ground) was observed during the assessment.
Fox control	HU804	The implementation of the vertebrate pest management plan.
Maintain or re-introduce natural flow regimes	Southern Myotis	The proposed haul road will be designed to maintain natural flow regimes along Seven Mile Creek. None of the drainage lines within the biobank site have been altered or modified; the existing natural flow regimes will be maintained with no additional management.
Slashing	Koala	The exclusion of slashing would be achieved through installation and maintenance of boundary fencing around the biobank site.

1.2 CREDIT SUMMARY

A summary of the biodiversity credits required at the proposed development site, and the credits that would be generated at the offset site is provided in **Table 9**.

The proposed offset site would satisfy a large proportion of the biodiversity credits required at the development site. There is a shortfall of 1,303 HU804 ecosystem credits and 127 Southern Myotis species credits once the credits generated at the onsite offset are accounted for. The Koala species credit requirement would be fully satisfied by the credits generated at the onsite offset site. The proposed strategy for securing the remaining biodiversity credits to satisfy the shortfall is discussed in **Section 1.3**.

Table 9: Summary of biodiversity credits generated at the development and offset sites

Ecosystem / Species	Credits Required at Development Site	Credits Generated at Onsite Offset Site	Credit Balance
HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	1,836	533	-1,303
HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (moderate-good)	0	63	+63

Ecosystem / Species	Credits Required at Development Site	Credits Generated at Onsite Offset Site	Credit Balance
Southern Myotis (*Myotis macropus*)	362	235	-127
Koala (*Phascolarctos cinereus*)	291	294	+3

1.3 ADDITIONAL CREDIT REQUIREMENTS

At this stage, the proponent intends to secure the remaining 1,303 HU804 ecosystem credits and 127 Southern Myotis species credits that would be required for the proposed development by purchasing suitable credits from existing biobank sites. For example, the biobank site under biobanking agreement no. 96 has HU804 ecosystem credits that are currently available for purchase and retirement. The proponent intends to pursue negotiations to purchase the required credits from existing biobank sites should the project be approved.

A search for available or pending Southern Myotis species credits was undertaken on 17 July 2017. No Southern Myotis species credits were available or pending issue at that time. Kleinfelder have lodged a “credits wanted” expression of interest on the OEH Biobanking website on 17 July 2017.

A search for available or pending HU804 ecosystem credits (and matching credits) was undertaken on 10 May 2017 and again on 22 May 2017. There is a total of 3,238 matching credits currently available on the credit register to address the 1,303 ecosystem credit shortfall for HU804 (see **Table 10** below).

Table 10: Number of HU804 matching credits available (at 22 May 2017)

Matching Ecosystem Credit Type	IBRA Sub-region	Agreement ID	Credits Available
HU804	Upper Hunter	188	1,711
HU804	Karuah Manning	214	328
HU804	Karuah Manning	223	47
HU802	Upper Hunter	188	310
HU630	Karuah Manning	96	842
Total ecosystem credits available			**3,238**

However, if the required credits are unavailable at existing biobank sites at the time, the proponent may also secure an offsite offset site under a biobanking agreement to satisfy the credit requirements.

1.3.1 Offset Availability

The development site credit report lists the following PCTs as offsetting options for HU804:

- Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest, (HU804);
- Melaleuca decora low forest of the central Hunter Valley, Sydney Basin Bioregion, (HU564);
- Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619);
- Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast, (HU802);
- Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast, (HU803);
- Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter, (HU806);
- Red Ironbark - Spotted Gum - Prickly-leaved Paperbark shrubby open forest of the Lower Hunter, (HU807);
- Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814);
- Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815);
- Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter, (HU816); and
- Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter, (HU822).

A large area of freehold land containing these PCTs is present within the Karuah-Manning IBRA sub-region. A preliminary assessment of available vegetation mapping (Sivertsen *et al*. 2011) for the Karuah-Manning IBRA sub-region indicates that approximately 26,300 ha of vegetation equivalent to the PCTs listed above is present on freehold land. A large portion of this vegetation would also provide suitable breeding habitat for the Southern Myotis. As such, it is considered that there is sufficient land available that could be secured as a biobank site to generate the quantity of ecosystem and species credits required for the development, should the credits be unavailable for purchase at existing biobank sites.

1.3.2 Credit Retirement

All ecosystem and species credits required for the development will be retired at the offset sites in accordance with the FBA prior to commencement of clearing and construction. No variation of the offset rules or supplementary measures are sought for the proposed onsite offset or the remaining ecosystem and species credits required.

REFERENCES

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Port Stephens Council (PSC) (2002). *Port Stephens Council Comprehensive Koala Plan of Management (CKPoM) – June 2002*. Prepared by Port Stephens Council with the Australian Koala Foundation.

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CREDIT REPORT – OFFSET SITE

BioBanking credit report

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

Date of report: 19/06/2017 Time: 8:51:34AM Calculator version: v4.0

Biobank details

Proposal ID:	167/2016/3996B
Proposal name:	Eagleton Hard Rock Quarry Offset Area
Proposal address:	Barleigh Ranch Way Eagleton NSW 2324
Proponent name:	Eagleton Rock Quarry Pty. Ltd
Proponent address:	PO Box 826 Newcastle NSW 2300
Proponent phone:	0429 877 704
Assessor name:	Samara Schulz
Assessor address:	64 Medcalf Street Warners Bay NSW 2282
Assessor phone:	02 4949 5200
Assessor accreditation:	167

Additional information required for approval:

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

Ecosystem credits summary

Plant Community type	Area (ha)	Credits created
Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	49.74	533.00
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	5.48	63.00
Total	55.22	596

Credit profiles

1. White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley, (HU798)

Number of ecosystem credits created	63
IBRA sub-region	Karuah Manning

2. Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest, (HU804)

Number of ecosystem credits created	520
IBRA sub-region	Karuah Manning

3. Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest, (HU804)

Number of ecosystem credits created	13
IBRA sub-region	Karuah Manning

Species credits summary

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Koala	Phascolarctos cinereus	41.40	294
Southern Myotis	Myotis macropus	33.03	235

Additional management actions

Additional management actions are required for:

Vegetation type or threatened species	Management action details
Koala	Exclude miscellaneous feral species
Koala	Slashing
Southern Myotis	Maintain or re-introduce natural flow regimes
Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Exclude commercial apiaries
Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Exclude miscellaneous feral species
Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Feral and/or over-abundant native herbivore control
Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Fox control
Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Slashing
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	Exclude commercial apiaries
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	Exclude miscellaneous feral species
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	Feral and/or over-abundant native herbivore control
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	Fox control

APPENDIX 3: PLOT AND TRANSECT DATA

Quadrat Number: Q1 **Waypoint:** 001 **Date:** 17/1/3 **Recorder:** AM

Vegetation Type: Hunter valley Moist Forest **Photos:** YES (1679 - 1680) / NO **Sub-zone Title:**

Over-Storey Species	Regen	CA	Mid-Storey Species	CA	Ground Cover (Shrubs)	CA	Ground Cover (Grasses)	CA	Ground Cover (Other)	CA	Exotic	CA
E. acmenoides		4	M. stypheliodes	3	Notelaea ovata	2	Oplismenus aemu	3	D. repens	3	Lantana	2
E. punctata		3	Acmena sm. thii	3	Maytenus silvestris	2	E. micrantha	3	Tylophora barbata	2	Cenchrus	1
C. maculata		2	Cryptocarya micran	3	Breynia oblongifolia	2	M. stipoides	3	Morinda jasminoides	2	Setaria pumila	2
E. siderophloia		3	Glochidion ferdi	2	Myrsine variabilis	2	Poa affinis	2	Dendrocnide excelsa	4		
			Glochidion sp.	1	Cayratia verr	4			Persoonia stradbroken	2		
					Phyllanthus gunnii	1			Dianella caerulea tasmanica	2		
			or Hymenosporum flavum		Abutilon sp.	2			Carex longebrac	2		
					Acacia maidenii	1			Pastel flower	2		
					Zieria smithii	2			Settlers flax	2		
					[illegible]?	2			Geitoplesium cym	2		
					Pittosporum sp.	1			Smilax australis	2		
									Clematis glycinoides	1		
					Rhodamnia rubescens				Cissus sp.	3		
									Celosia trigyna	2		
									Stephania japonica	2		
									Pratia purpurascens	2		
									Veronica plebeia	1		
									Hydrocotyle tripartita	1		
									Adiantum aethiopicum	2		
									Hydrocotyle peduncularis	2		
									Scrophularia henryi	1		
Total Species =		4	Total Species =	5	Total Species =	11	Total Species =	4	Total Species =	21	Total Species =	3

48

General Comments: (43) NPS

173-1193

Quadrat Number: Q1 **Waypoint:** 001 **Date:** 17/1/13 **Recorder:** SS

	Number of Hits (Tally)										% Foliage Cover
O/S Cover	20	75	~~40~~ 60	56	25	80	75	70	60	30	
MS Cover	75	46	90	30	75	25	25	60	10	–	
GC grasses	////	/	/	///		//	///	////	/////	//	
GC shrub								///	//		
GC other	/////	/	/	///	////	////	///	/	////	///	
Exotic					/////	//			//	/	

10 20 30 40

Native over-storey cover (*):

Over-storey cover is estimated as per cent foliage cover, which is equivalent to the amount of shadow that would be cast on the ground if there were a light source directly overhead and can be estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover directly overhead using the images provided in Appendix 7. Divide the total by the number of points (i.e. 10) measured along transect

Native mid-storey cover:

Percent foliage cover of the mid-storey is estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-storey. Divide the total by the number of points (i.e. 10)

Native ground cover (grasses, shrubs and other):

Percent foliage cover of the ground stratum (grasses, shrubs and other) is estimated as follow:

- At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point. Divide the total of 'hits' by the number of points measured .

Exotic plant cover:

If the exotics are in the over-storey then measure using the same method as native over-storey cover (see above), if exotics are in the mid-storey then measure using the same method as native mid-storey cover (see above) and if exotics are in the ground stratum then measure using the same method as described for native ground cover (grasses)

Number of Hollow Bearing Trees within the 50m x 20m plot	Total Length of fallen timber within the 20mx50m plot	Fauna habitat values (High, Medium, Low)			
1	6, 8, 7, 5, 10	Caves/mines/tunnels	Yes		(No)
		Presence Wet areas/water bodies	(Yes)		No
	3, 2, 3, 4	Abundance of rocks/escarpments	High	Medium	(Low)
		Abundance of nectar resources	High	(Medium)	Low
		Abundance of fruit resources	High	(Medium)	Low
		Community part of wildlife corridor	(Regional)	Local	None
		Structural complexity of habitat	(High)	(Medium)	Low
		Dense shrub or ground cover	High	(Medium)	(Low)
Total Number =	Total Length =	Abundance of dead trees/stags	High	Medium	(Low)

Total length of fallen logs (50mx20m plot): This is the total length of logs at least 10cm diameter and at least 0.5m long. Only those parts of logs lying within the plot are measured.

Number of trees with hollows (50mx20m plot): This is a count of the number of living and dead trees within a 50mx20m plot with at least one hollow (note that the hollows do not have to be within the plot). A hollow is only recorded if: the entrance can be seen; the minimum entrance width is at least 5cm across; the hollow is at least 1m above the ground and the centre of the tree is within the plot. Tree should be examined from all angles.

Fauna Habitat Values: Subjective estimates of habitat value abundance used to assess habitat significance according to observed habitat attributes.

173-1145

Quadrat Number: Q2 **Waypoint:** 002 **Date:** 17/1/13 **Recorder:** SS

Vegetation Type: HVMF **Photos:** YES / NO **Sub-zone Title:**

Aaron

Over Storey Species	Regen	CA	Mid Storey Species	CA	Ground Cover (Shrubs)	CA	Ground Cover (Grasses)	CA	Ground Cover (Other)	CA	Exotic	CA
B. acmin	5		Glochidion	3	Zieria	3	Bladygrass	5	BV. lab/fol.	2	Lantana	4
A. costata	3		Dod. tri	3	Leuc. jon	3	aplis. elem	4	D.C.P.	2		
C. mac	3		Per. lin	2	May. Silv	2	B. stricta	4	M. jasminoid	2		
B. punc	3		Mel. lin	2	B. Spinulosa	2	Panicum sm	2	P. pandor	2		
B. Sp1	3		Sannantha	2	N. ovata	2			Adiantum fae	2		
C. gum	3		Acacia ulicifolia	2	B. oblonga	2			Bracken	2		
			A. torulosa	3	Lepto. polyg	3			P. Stram	2		
					Clerodendrum	1			Cayratia sp	1		
									Sarcopetalum	2		
									Des. gunn	2		
									Lom obliq	2		
									Good. hed	2		
									D. brachy	1		
									D. rhytidophyllum			
Total Species =	6		Total Species =	7	Total Species =	8	Total Species =	4	Total Species =	13	Total Species =	1

General Comments:

Quadrat Number: Q2 **Waypoint:** 002 **Date:** 17/1/13 **Recorder:** AM - phot 1081

	Number of Hits (Tally)										% Foliage Cover
O/S Cover	40	40	35	60	50	50	30	50	35	40	
MS Cover	-	30	20	20	25	30	40	30	10	-	
GC grasses	5	5	5	4	2	0	3	3	5	1	
GC shrub	1	3	4	5	3	1	1	3	5	0	
GC other	3	1	3	1	5	0	1	0	5	0	
Exotic	0	0	0	4	1	0	0	0	0	0	

Native over-storey cover (*):

Over-storey cover is estimated as per cent foliage cover, which is equivalent to the amount of shadow that would be cast on the ground if there were a light source directly overhead and can be estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover directly overhead using the images provided in Appendix 7. Divide the total by the number of points (i.e. 10) measured along transect

Native mid-storey cover:

Percent foliage cover of the mid-storey is estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-storey. Divide the total by the number of points (i.e. 10)

Native ground cover (grasses, shrubs and other):

Percent foliage cover of the ground stratum (grasses, shrubs and other) is estimated as follow:

- At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point. Divide the total of 'hits' by the number of points measured .

Exotic plant cover:

If the exotics are in the over-storey then measure using the same method as native over-storey cover (see above), if exotics are in the mid-storey then measure using the same method as native mid-storey cover (see above) and if exotics are in the ground stratum then measure using the same method as described for native ground cover (grasses)

Number of Hollow Bearing Trees within the 50m x 20m plot	Total Length of fallen timber within the 20mx 50m plot	Fauna habitat values (High, Medium, Low)			
	2, 3, 4, 1, 2, 5, 3, 1, 2	Caves/mines/tunnels	Yes		No
		Presence Wet areas/water bodies	(Yes)		No
		Abundance of rocks/escarpments	High	Medium	(Low)
		Abundance of nectar resources	High	(Medium)	Low
		Abundance of fruit resources	High	(Medium)	Low
		Community part of wildlife corridor	(Regional)	Local	None
		Structural complexity of habitat	High	(Medium)	Low
		Dense shrub or ground cover	(High)	Medium	Low
		Abundance of dead trees/stags	High	Medium	(Low)
Total Number = 0	Total Length = 22				

Total length of fallen logs (50mx20m plot): This is the total length of logs at least 10cm diameter and at least 0.5m long. Only those parts of logs lying within the plot are measured.

Number of trees with hollows (50mx20m plot): This is a count of the number of living and dead trees within a 50mx20m plot with at least one hollow (note that the hollows do not have to be within the plot). A hollow is only recorded if: the entrance can be seen; the minimum entrance width is at least 5cm across; the hollow is at least 1m above the ground and the centre of the tree is within the plot. Tree should be examined from all angles.

Fauna Habitat Values: Subjective estimates of habitat value abundance used to assess habitat significance according to observed habitat attributes.

Quadrat Number: Q7 **Waypoint:** 007 **Date:** 17/1/13 **Recorder:** AM

Vegetation Type: HUMF **Photos:** (YES) / NO -1092-1083 **Sub-zone Title:**

Over-Storey Species			Mid-Storey Species		Ground Cover (Shrubs)		Ground Cover (Grasses)		Ground Cover (Other)		Exotic	
	Regen	CA		CA		CA		CA		CA		CA
E. punctata		3	Cryptocarya mico	2	Clerodendrum tom	1	E. stricta	4	Cchnus sieberianus	3	Lantana	2
E. sclerophylla		4	C. terd.-end.:	3	Notelaea ovata	2	I. cylindrica	2	Dianella caerulea	2		
E. acmenoides		3	Acmena smith.:	2	Zieria smithii	4	O. caerulea	3	Aminella gracilis	3		
C. gummifera		2	Alloxylon flavus	2	Acacia irr/pen	1			Cissus hypoglauca	2		
C. maculata		2	Alphitonia excelsa	3	Rubus moluccanus	2			V. stricta	2		
A. costata		2	Callistemon salig	1	Cabbage palm	2			Hibbertia dentata	2		
					Breynia oblong	2			Dichondra repens	2		
					Hibbertia aspera	2			Goodenia hed	2		
					Maytenus s.l.	2			Einstrophus dilatatus	2		
					Myrsine variabilis	2			Pratia purp	2		
					Polyscias sambu	2			Ripogonum album	2		
					Bursaria spinosa	1			Carex longebrac	1		
					Pittosporum rev	1			Gahnia aspera	2		
									Pandorea pand	1		
									Sellaginella flex	1		
									Dianella caerulea	1		
									Lagenifera stipitata	1		
									Sarcopetalum harv	1		
Total Species =		6	Total Species =	6	Total Species =	13	Total Species =	3	Total Species =	18	Total Species =	1

General Comments:

173-1193

Quadrat Number: Q3 **Waypoint:** 009 **Date:** 17/1/13 **Recorder:** SS

	Number of Hits (Tally)									% Foliage Cover
O/S Cover	15	20	5	5	—	10	40	70	60	30	
MS Cover	60	65	70	75	30	20	60	70	70	60	
GC grasses	1	1	1	1	1	1	1	1	1	1	
GC shrub	1	1	1	1	1	1	1	1	1	1	
GC other	1	1	1	1	1	1	1	1	1	1	
Exotic											

Native over-storey cover (*): 10 20 50 40

Over-storey cover is estimated as per cent foliage cover, which is equivalent to the amount of shadow that would be cast on the ground if there were a light source directly overhead and can be estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover directly overhead using the images provided in Appendix 7. Divide the total by the number of points (i.e. 10) measured along transect

Native mid-storey cover:

Percent foliage cover of the mid-storey is estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-storey. Divide the total by the number of points (i.e. 10)

Native ground cover (grasses, shrubs and other):

Percent foliage cover of the ground stratum (grasses, shrubs and other) is estimated as follow:

- At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point. Divide the total of 'hits' by the number of points measured .

Exotic plant cover:

If the exotics are in the over-storey then measure using the same method as native over-storey cover (see above), if exotics are in the mid-storey then measure using the same method as native mid-storey cover (see above) and if exotics are in the ground stratum then measure using the same method as described for native ground cover (grasses)

Number of Hollow Bearing Trees within the 50m x 20m plot	Total Length of fallen timber within the 20mx 50m plot	Fauna habitat values (High, Medium, Low)			
1	7, 5, 5, 8, 5, 8	Caves/mines/tunnels	Yes		(No)
		Presence Wet areas/water bodies	(Yes)		No
	7, 5, 1, 1	Abundance of rocks/escarpments	High	Medium	(Low)
		Abundance of nectar resources	High	(Medium)	Low
		Abundance of fruit resources	High	(Medium)	Low
		Community part of wildlife corridor	Regional	Local	None
		Structural complexity of habitat	High	(Medium)	Low
		Dense shrub or ground cover	High	(Medium)	(Low)
Total Number =	Total Length =	Abundance of dead trees/stags	High	Medium	(Low)

Total length of fallen logs (50mx20m plot): This is the total length of logs at least 10cm diameter and at least 0.5m long. Only those parts of logs lying within the plot are measured.

Number of trees with hollows (50mx20m plot): This is a count of the number of living and dead trees within a 50mx20m plot with at least one hollow (note that the hollows do not have to be within the plot). A hollow is only recorded if: the entrance can be seen; the minimum entrance width is at least 5cm across; the hollow is at least 1m above the ground and the centre of the tree is within the plot. Tree should be examined from all angles.

Fauna Habitat Values: Subjective estimates of habitat value abundance used to assess habitat significance according to observed habitat attributes.

Quadrat Number: Q4 **Waypoint:** Q4 **Date:** 30/11/16 **Recorder:** PF

Vegetation Type: **Photo(s) ID and direction:** W

Overstorey Species	R	F	Ab	Midstorey Species	F	Ab	Ground Cover (Shrubs)	F	Ab	Ground Cover (Grasses)	F	Ab	Ground Cover (Other)	F	Ab	Exotic	F	Ab	
E. moluccana	✓	3	8	M. nodosa	2	6	A. falcata	1	1	Bothriochloa macra	1	3	Centella asiat	2	100	Axonopus fiss.	75	1000	
C. maculata		1	1	Cloch. d. on f.	1	3	Dodo. tri.	1	5	Microlaena stip	4	50	Dichondra rep	2	100	Richardia stell	5	50	
E. punctata		2	2	[illegible]			Lepto. poly.	1	3	Echinopogon caes	1	10	Patia pur	1	50	[illegible]	1	10	Euphorbia peplus
E. tereticornis	✓	3	6				Leuco. junip.	1	1	E. brownii	1	5	Juncus usi.	1	10	Dandelion	1	10	Taraxacum officinale
[illegible]		[illegible]	[illegible]				Acrotriche d.	1	1	Dichelachne micrantha	1	10	G. homeanum	2	100	Setaria sp.	1	10	viridans
E. eugenioides		1	1							Lachnagrostis fil.	1	5	Hydrocotyle tri	1	50	Bidens pilosa	1	10	
E. fibrosa		1	1							Cymbopogon refract	1	5	[illegible]	[illegible]	[illegible]	Fleabane	1	10	Conyza bon.
										E. stricta	1	10	Dianella long.	1	5	[illegible]	[illegible]		
										E. marginata	1	5	Glycine tab.	1	10	[illegible]	1	5	phytolacca octandra
										Cynodon dactylon	1	10	Parsonsia str.	1	5	Whisky Grass	1	5	
													V. plebeia	1	5	[illegible]	[illegible]		
													Cheilanthes sieb.	1	5	[illegible]	1	5	Senecio madagascariensis
													Cyp. gracilis	1	10	Solanum mauri	1	2	
													Lom. multi	1	2	Scotch thistle	1	5	Cirsium vulgare
													Lom. glauca	1	1	[illegible]	1	5	Poa annua
													Hibb. [illegible]	1	2	[illegible]	[illegible]		
													Commelina cyanea	1	5	[illegible]			
													[illegible]			Lambs tongue	1	15	Plantago lanceolata
													Rumex brownii	1	5	[illegible]			
													Schoenus apo.	1	20	Parra. grass	1	5	Sporobolus africanus
													Solanum prinophyllum	1	1	Slender celery	1	5	
																[illegible]			
																Modiola car.	1	5	
																Scarlet pimp.	1	10	
																Paspalum dil.	1	10	
													Verbena bonariensis			Purple Top.	1	5	
																Vulpia sp.	1	5	
																Bromus cath	1	20	
																Solanum nigrum	1	10	
																Heliotropium amplex	1	20	
																Cyp. brevi	1	10	

R = Regeneration (for entire zone) **F** = Foliage Projective Cover (1-5%, then to nearest 5%)
Ab = Abundance Rating (no. of individuals or shoots. 1-10, 20, 50, 100, 500, 1000 (or specify a number greater than 100 if required; numbers > 20 are estimates only)

6 3 5 10 19

General Comments:

(43) NPS

Quadrat Number: Q4 **Date:** 30.11.16. **Recorder:** STEVE L

	Number of Hits (Tally)										Foliage Cover (%)
O/S Cover	20	45	—	40	—	[illegible]	—	—	20	—	[illegible] 12.5%
MS Cover	—	—	—	—	—		—	—		—	
GC grasses						45					4.5%
GC shrub											40%
GC other											2%
Exotic (Ground)											36%
Exotic (Mid)											90%
Exotic (Canopy)											—

Native over-storey cover (*):
Over-storey cover is estimated as per cent foliage cover, which is equivalent to the amount of shadow that would be cast on the ground if there were a light source directly overhead and can be estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover directly overhead using the images provided in Appendix 7. Divide the total by the number of points (i.e. 10) measured along transect

Native mid-storey cover:
Percent foliage cover of the mid-storey is estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-storey. Divide the total by the number of points (i.e. 10)

Native ground cover (grasses, shrubs and other):
Percent foliage cover of the ground stratum (grasses, shrubs and other) is estimated as follow:

- At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point. Divide the total of 'hits' by the number of points measured.

Exotic plant cover:
If the exotics are in the over-storey then measure using the same method as native over-storey cover (see above), if exotics are in the mid-storey then measure using the same method as native mid-storey cover (see above) and if exotics are in the ground stratum then measure using the same method as described for native ground cover (grasses)

Number of Hollow Bearing Trees within the 50m x 20m plot	Total Length of fallen timber within the 20mx 50m plot	Fauna habitat values (High, Medium, Low)			
		Caves/mines/tunnels	Yes		No
	10 - TIMBER STACK	Presence Wet areas/water bodies	Yes		No
		Abundance of rocks/escarpments	High	Medium	Low
		Abundance of nectar resources	High	Medium	Low
		Abundance of fruit resources	High	Medium	Low
		Community part of wildlife corridor	Regional	Local	None
		Structural complexity of habitat	High	Medium	Low
Total Number =	**Total Length =** 10m	Dense shrub or ground cover	High	Medium	Low
		Abundance of dead trees/stags	High	Medium	Low

Total length of fallen logs (50mx20m plot): This is the total length of logs at least 10cm diameter and at least 0.5m long. Only those parts of logs lying within the plot are measured.

Number of trees with hollows (50mx20m plot): This is a count of the number of living and dead trees within a 50mx20m plot with at least one hollow (note that the hollows do not have to be within the plot). A hollow is only recorded if: the entrance can be seen; the minimum entrance width is at least 5cm across; the hollow is at least 1m above the ground and the centre of the tree is within the plot. Tree should be examined from all angles.

Fauna Habitat Values: Subjective estimates of habitat value abundance used to assess habitat significance according to observed habitat attributes.

Quadrat Number: Q5 Waypoint: Q5 Date: 30/11/16 Recorder: PF

Vegetation Type: Photo(s) ID and direction: E

Overstorey Species	R	F	Ab	Midstorey Species	F	Ab	Ground Cover (Shrubs)	F	Ab	Ground Cover (Grasses)	F	Ab	Ground Cover (Other)	F	Ab	Exotic	F	Ab
C. maculata	✓	5	67	M. nodosa	3	10	lave. juniper.	1	1	Cymbopogon-ref	1	5	Parsonsia stra	1	5	Vulpia myur	85	1000
E. crebra		10	1	M. linariifolia	1	1	Breynia oblo	1	1	Dichelachne micr	1	10	Glycine tab.	1	10	F. weed	10	100
E. [illegible]				A. [illegible]	[illegible]		Notelaea long	1	1	Lachnagrostis	2	20	Juncus usit	2	20	Briza (M) max	1	20
E. camaldulata		5	1	Glochidion ferd		1	MBursaria spin	1	2	Ento. marg.	2	20	Dichondra repe	1	50	Bidens pilosa	1	10
				Acacia irrorata	1	3				E. striata	2	20	Hardenbergia vi	1	10	Slender celery	1	10
										Paspal. distans	1	20	Pratia pur	1	20	Moth Vine	1	1
										Era. brownii	1	10	Dianella long.	1	10	Lantana cam	1	10
							Bolboschlo			Pentag micra	1	10	Pseuderanthemum	1	5	Whisky Grass	1	10 5
							fulv (?)			Rhytidosperma	1	10	Eustrephus lat	1	2	[illegible]	1	20 - Toronion officin
										[illegible]			Oplismenus ha			Plantago [illegible]		
										Poa labill (M)	1	20	Hib. lob. (?) pedunc	1		[illegible]	1	10 - E. curvula
										Sporobolus creber	1	20	Centella asiat	1	50	Spear thistle	1	10 - Cirsium vulgare
													Polymeria calyc	1	3	Slender celery		
													[illegible]	[illegible]		Ehrharta long	1	10
													Hem. multi	1	10	Asp. dilat	1	10
													Opercularia diph	1	2	Axonopus fur	1	20
													Lagenophora stip.	1	3	Plantago lanc	1	20
													Dichella rev.	1	5	Sc. pimpernel	1	10
													Schoenus apo.	1	20	[illegible]	1	10 - H. radicata
																Digitaria (?)		
														calycina		Gamochaeta	2	100
																Spor. afr.	1	20
																Briza minor	1	20
																Aira sp	1	100

R = Regeneration (for entire zone) F = Foliage Projective Cover (1-5%, then to nearest 5%)
Ab = Abundance Rating (no. of individuals or shoots. 1-10, 20, 50, 100, 500, 1000 (or specify a number greater than 100 if required; numbers > 20 are estimates only)

3 4 4 11 17

General Comments:

(39) NPS

Quadrat Number: Q5 **Date:** 30.11.2016 **Recorder:** STEVE W

	Number of Hits (Tally)	Foliage Cover (%)
O/S Cover	75 — 15 — 50 — — 30 — —	17%
MS Cover	30 30 — 65 — — — — —	12.5%
GC grasses		80%
GC shrub		4%
GC other		20%
Exotic (Ground)		32%
Exotic (Mid)		—
Exotic (Canopy)		—

Native over-storey cover (*):
Over-storey cover is estimated as per cent foliage cover, which is equivalent to the amount of shadow that would be cast on the ground if there were a light source directly overhead and can be estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover directly overhead using the images provided in Appendix 7. Divide the total by the number of points (i.e. 10) measured along transect

Native mid-storey cover:
Percent foliage cover of the mid-storey is estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-storey. Divide the total by the number of points (i.e. 10)

Native ground cover (grasses, shrubs and other):
Percent foliage cover of the ground stratum (grasses, shrubs and other) is estimated as follow:

- At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point. Divide the total of 'hits' by the number of points measured.

Exotic plant cover:
If the exotics are in the over-storey then measure using the same method as native over-storey cover (see above), if exotics are in the mid-storey then measure using the same method as native mid-storey cover (see above) and if exotics are in the ground stratum then measure using the same method as described for native ground cover (grasses)

Number of Hollow Bearing Trees within the 50m x 20m plot	Total Length of fallen timber within the 20mx 50m plot	Fauna habitat values (High, Medium, Low)			
		Caves/mines/tunnels	Yes		No
11	3, 1, 2	Presence Wet areas/water bodies	Yes		No
		Abundance of rocks/escarpments	High	Medium	Low
		Abundance of nectar resources	High	Medium	Low
		Abundance of fruit resources	High	Medium	Low
	[illegible]	Community part of wildlife corridor	Regional	Local	None
		Structural complexity of habitat	High	Medium	Low
Total Number = 2	**Total Length =** 6m	Dense shrub or ground cover	High	Medium	Low
		Abundance of dead trees/stags	High	Medium	Low

Total length of fallen logs (50mx20m plot): This is the total length of logs at least 10cm diameter and at least 0.5m long. Only those parts of logs lying within the plot are measured.

Number of trees with hollows (50mx20m plot): This is a count of the number of living and dead trees within a 50mx20m plot with at least one hollow (note that the hollows do not have to be within the plot). A hollow is only recorded if: the entrance can be seen; the minimum entrance width is at least 5cm across; the hollow is at least 1m above the ground and the centre of the tree is within the plot. Tree should be examined from all angles.

Fauna Habitat Values: Subjective estimates of habitat value abundance used to assess habitat significance according to observed habitat attributes.

Quadrat Number: Q6 **Waypoint:** Q6 **Date:** 30/11/16 **Recorder:** AM

Vegetation Type: Exotic grassland-managed **Photo(s) ID and direction:** NW

Overstorey Species				Midstorey Species			Ground Cover (Shrubs)			Ground Cover (Grasses)			Ground Cover (Other)			Exotic		
	R	F	Ab		F	Ab		F	Ab		F	Ab		F	Ab		F	Ab
										Cynodon dactylon	20	500	Dichondra repens	1	20	H. radiata	3	100
										Lachnagrostis filiformis	1	20				Richardia stellaris	2	100
										Eragrostis brownii	2	50				Paspalum dil	50	1000
										Imperata cylindrica	1	20				Medicago sp	1	20
																Vulpia myuros	25	1000
																Eragrostis bon	1	20
																Axonopus fissif	20	500 1000
																Sporobolus elon	2	50
																Angelis anvi	1	20
																Lotus subbiflor	3	500
																Stem secundum	1	20
																Verbena bonar	1	5
																Briz. minor	1	10
																Andropogon virg	1	20

R = Regeneration (for entire zone) F = Foliage Projective Cover (1-5%, then to nearest 5%)
Ab = Abundance Rating (no. of individuals or shoots. 1-10, 20, 50, 100, 500, 1000 (or specify a number greater than 100 if required; numbers > 20 are estimates only)

General Comments:

(5) NPS

Quadrat Number: 26 **Date:** 30/11/16 **Recorder:** AA

	Number of Hits (Tally)	Foliage Cover (%)
O/S Cover		—
MS Cover		—
GC grasses		—
GC shrub		44%
GC other		—
Exotic (Ground)		2%
Exotic (Mid)		82%
Exotic (Canopy)		—

Native over-storey cover (*):
Over-storey cover is estimated as per cent foliage cover, which is equivalent to the amount of shadow that would be cast on the ground if there were a light source directly overhead and can be estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover directly overhead using the images provided in Appendix 7. Divide the total by the number of points (i.e. 10) measured along transect

Native mid-storey cover:
Percent foliage cover of the mid-storey is estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-storey. Divide the total by the number of points (i.e. 10)

Native ground cover (grasses, shrubs and other):
Percent foliage cover of the ground stratum (grasses, shrubs and other) is estimated as follow:

- At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point. Divide the total of 'hits' by the number of points measured.

Exotic plant cover:
If the exotics are in the over-storey then measure using the same method as native over-storey cover (see above), if exotics are in the mid-storey then measure using the same method as native mid-storey cover (see above) and if exotics are in the ground stratum then measure using the same method as described for native ground cover (grasses)

Number of Hollow Bearing Trees within the 50m x 20m plot	Total Length of fallen timber within the 20mx 50m plot	Fauna habitat values (High, Medium, Low)			
		Caves/mines/tunnels	Yes		No
		Presence Wet areas/water bodies	Yes		No
		Abundance of rocks/escarpments	High	Medium	Low
		Abundance of nectar resources	High	Medium	Low
		Abundance of fruit resources	High	Medium	Low
		Community part of wildlife corridor	Regional	Local	None
		Structural complexity of habitat	High	Medium	Low
Total Number =	Total Length =	Dense shrub or ground cover	High	Medium	Low
		Abundance of dead trees/stags	High	Medium	Low

Total length of fallen logs (50mx20m plot): This is the total length of logs at least 10cm diameter and at least 0.5m long. Only those parts of logs lying within the plot are measured.

Number of trees with hollows (50mx20m plot): This is a count of the number of living and dead trees within a 50mx20m plot with at least one hollow (note that the hollows do not have to be within the plot). A hollow is only recorded if: the entrance can be seen; the minimum entrance width is at least 5cm across; the hollow is at least 1m above the ground and the centre of the tree is within the plot. Tree should be examined from all angles.

Fauna Habitat Values: Subjective estimates of habitat value abundance used to assess habitat significance according to observed habitat attributes.

Quadrat Number: Q67 **Waypoint:** **Date:** 30/11/16 **Recorder:** PF

Vegetation Type: **Photo(s) ID and direction:** N

Overstorey Species	R	F	Ab	Midstorey Species	F	Ab	Ground Cover (Shrubs)	F	Ab	Ground Cover (Grasses)	F	Ab	Ground Cover (Other)	F	Ab	Exotic	F	Ab
C. maculata		10	8	M. nodosa	40	50	Notelaea long.	1	1	Themeda tri.	10	50	Hibb. aspera	2	20	Lantana	1	5
~~[illegible]~~			1	Glochidion (?) ferdinandi	1	10	A. falcata	5	20	Rhyncho. fulv.	10	50	Lomandra multi	1	10	Fireweed	1	10 — senecio mad
E. resinifera		3	1				~~Polygala~~			Imperata cyl	20	100	Lom. long.	1	10	Cyp. eragrostis	1	10
E. fibrosa		15	3				Breynia obl.	1	2	E. stricta	20	100	Lepido. lat.	20	100	Crofton weed	1	10 — A. adenophora
							Dodo tri.	20	100	Microlaena sti.	1	10	Phill. hirtellus	1	10	Pasp. dil. urvi	1	10
							~~A. [illegible]~~ (?)			~~[illegible]~~		10	Hibb. ~~[illegible]~~ pedunculatus	1	10	~~[illegible]~~ Conyza bon.	1	10
							Leuc. junip.	1	10	Eragrostis lepto.	1	10	Gono. teuc.	1	10			
							Alphitonia exc.	1	1	Dichelachne mic.	1	10	Dianella long.	1	10			
							Lepto. poly.	1	10	E. margi.	1	10	Pseuderanthemum	1	1			
							Acrotriche div	1	10	Panicum simile	1	10	Parsonsia stra.	1	2			
							Pers. linearis	1	1	Echino. caesp.	1	10	Bill. scandens	1	2			
				Denhamia silvestris —			Maytenus (?) silv	1	5	Cymbopogon ref.	2	20	Pratia purpu.	1	10			
							Dav. uli. (?)	1	1	Aristida vag.	1	10	~~[illegible]~~					
							exchila Pultenaea (?)	1	5				Cheilanthes sieb.	1	10			
							A. ulicifolia	1	10				Good. hetero.	1	10			
													~~[illegible]~~					
													Tricoryne el.	1	10			
													Junc. cont.	1	10			
													Lepto neesii	2	50			
													Dianella revol.	1	10			
													Glycine tabac.	1	10			
													Geitonoplesium cym.	1	5			
													Operculavia di.	1	5			
													Eustrephus lat.	1	5			
													Lom. filiformis	1	10			

R = Regeneration (for entire zone) **F** = Foliage Projective Cover (1-5%, then to nearest 5%)
Ab = Abundance Rating (no. of individuals or shoots. 1-10, 20, 50, 100, 500, 1000 (or specify a number greater than 100 if required; numbers > 20 are estimates only)

3 2 13 12 23

General Comments:

(53) NPS

Quadrat Number: Q 7 **Date:** 30.11.16 **Recorder:** STEVE W

	Number of Hits (Tally)										Foliage Cover (%)
O/S Cover	70	20	–	–	–	–	40	–	–	–	13%
MS Cover	40	10	50	–	–	15	10	[illegible]	[illegible]	20	14.5%
GC grasses	[tally marks]										80%
GC shrub	[tally marks]										2%
GC other	[tally marks]										14%
Exotic (Ground)	[tally marks]										–
Exotic (Mid)											18%
Exotic (Canopy)											–

Native over-storey cover (*):
Over-storey cover is estimated as per cent foliage cover, which is equivalent to the amount of shadow that would be cast on the ground if there were a light source directly overhead and can be estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover directly overhead using the images provided in Appendix 7. Divide the total by the number of points (i.e. 10) measured along transect

Native mid-storey cover:
Percent foliage cover of the mid-storey is estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-storey. Divide the total by the number of points (i.e. 10)

Native ground cover (grasses, shrubs and other):
Percent foliage cover of the ground stratum (grasses, shrubs and other) is estimated as follow:

- At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point. Divide the total of 'hits' by the number of points measured.

Exotic plant cover:
If the exotics are in the over-storey then measure using the same method as native over-storey cover (see above), if exotics are in the mid-storey then measure using the same method as native mid-storey cover (see above) and if exotics are in the ground stratum then measure using the same method as described for native ground cover (grasses)

Number of Hollow Bearing Trees within the 50m x 20m plot	Total Length of fallen timber within the 20mx 50m plot	Fauna habitat values (High, Medium, Low)			
1	2, 1, 5, 2, 2, 1	Caves/mines/tunnels			
		Presence Wet areas/water bodies	Yes		No
	3, 2.5, 3, 5, 1.5, 1, 1	Abundance of rocks/escarpments	Yes		No
		Abundance of nectar resources	High	Medium	Low
	1.5, 3.5, 6, 6, 1, 3, 2	Abundance of fruit resources	High	Medium	Low
	3, 2, 2.5, 5, 10, 3,	Community part of wildlife corridor	High	Medium	Low
		Structural complexity of habitat	Regional	Local	None
		Dense shrub or ground cover	High	Medium	Low
Total Number = 1	**Total Length =** 81.5	Abundance of dead trees/stags	High	Medium	Low
			High	Medium	Low

Total length of fallen logs (50mx20m plot): This is the total length of logs at least 10cm diameter and at least 0.5m long. Only those parts of logs lying within the plot are measured.

Number of trees with hollows (50mx20m plot): This is a count of the number of living and dead trees within a 50mx20m plot with at least one hollow (note that the hollows do not have to be within the plot). A hollow is only recorded if: the entrance can be seen; the minimum entrance width is at least 5cm across; the hollow is at least 1m above the ground and the centre of the tree is within the plot. Tree should be examined from all angles.

Fauna Habitat Values: Subjective estimates of habitat value abundance used to assess habitat significance according to observed habitat attributes.

Quadrat Number: Q8 **Waypoint:** Q8 **Date:** 30/11/16 **Recorder:** PF

Vegetation Type:

Photo(s) ID and direction:

Overstorey Species	R	F	Ab	Midstorey Species	F	Ab	Ground Cover (Shrubs)	F	Ab	Ground Cover (Grasses)	F	Ab	Ground Cover (Other)	F	Ab	Exotic	F	Ab
E. fibrosa	✓	25	84	M. nodosa	1	1	Dodo. [illegible]	35	30	Themeda trian	1	20	Lep. lateale	2	50	Gamochaeta	1	5
E. [illegible]		[illegible]		Glochidion (Kg) ferdinandi	1	1	Leuc. juniy	1	10	A. vagans	1	20	Mibb. (Kg)	1	10	Paspalum dil.	1	5
E. [illegible]			~				Ozo. diosm	1	10	Ento. stricta	2	100	Bill. scandens	1	5	Whisky G.	1	2
E. crebra		3	-				A. falcata	2	20	Panicum sim.	1	20	Phyll. hist.	1	10			
C. maculata		5	-				Ac. irrorata (Kg)	1	1	Era. brownii	1	10	Lom. multi.	1	10	pedunculata		
E. [illegible]		20	[illegible]				Polt. euch.	1	5	Microlaena st	1	10	Cheilanthes. sieb	1	10			
E. punctata							Dav. ulicic	1	5	Cymbopogon ref	1	10	Mirb. rubrifol.	1	10			
							Polt. villosa	1	5	Rhytachaperm fil	1	10	Tricoryne simp.	1	5			
							Lepto. [illegible] polyanthum	1	10				Glycine tab.	1	10			
							Ac. ulicifolia	1	10				Diaella long.	1	10			
							Jacksonia (Kg)	1	2				Schoenus apo.	1	10			
							[illegible]						Laxmunia grac.	1	10			
							[illegible]						Stackhousia (Kg)	1	5	viminea		
													Lom long	1	2			
													D. vittelina	1	10			

R = Regeneration (for entire zone) F = Foliage Projective Cover (1-5%, then to nearest 5%)
Ab = Abundance Rating (no. of individuals or shoots. 1-10, 20, 50, 100, 500, 1000 (or specify a number greater than 100 if required; numbers > 20 are estimates only)

4 2 11 8 15

General Comments:

(40) NPS

Quadrat Number: Q8 **Date:** 30.11.16 **Recorder:** STEVE W

	Number of Hits (Tally)	Foliage Cover (%)
O/S Cover	15 — — 65 30 — — — 40 —	17%
MS Cover	— — — — — 40 — — — —	4%
GC grasses	111 1 1 1 1 1 1 1 1 1	28%
GC shrub	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	16%
GC other	3 3 3 3 1 1	4%
Exotic (Ground)		-
Exotic (Mid)		—
Exotic (Canopy)		—

Native over-storey cover (*):
Over-storey cover is estimated as per cent foliage cover, which is equivalent to the amount of shadow that would be cast on the ground if there were a light source directly overhead and can be estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover directly overhead using the images provided in Appendix 7. Divide the total by the number of points (i.e. 10) measured along transect

Native mid-storey cover:
Percent foliage cover of the mid-storey is estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-storey. Divide the total by the number of points (i.e. 10)

Native ground cover (grasses, shrubs and other):
Percent foliage cover of the ground stratum (grasses, shrubs and other) is estimated as follow:

- At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point. Divide the total of 'hits' by the number of points measured.

Exotic plant cover:
If the exotics are in the over-storey then measure using the same method as native over-storey cover (see above), if exotics are in the mid-storey then measure using the same method as native mid-storey cover (see above) and if exotics are in the ground stratum then measure using the same method as described for native ground cover (grasses)

Number of Hollow Bearing Trees within the 50m x 20m plot	Total Length of fallen timber within the 20mx 50m plot	Fauna habitat values (High, Medium, Low)			
		Caves/mines/tunnels	Yes		No
	2, 5, 4	Presence Wet areas/water bodies	Yes		No
		Abundance of rocks/escarpments	High	Medium	Low
		Abundance of nectar resources	High	Medium	Low
		Abundance of fruit resources	High	Medium	Low
		Community part of wildlife corridor	Regional	Local	None
		Structural complexity of habitat	High	Medium	Low
Total Number =	Total Length = 11 m	Dense shrub or ground cover	High	Medium	Low
		Abundance of dead trees/stags	High	Medium	Low

Total length of fallen logs (50mx20m plot): This is the total length of logs at least 10cm diameter and at least 0.5m long. Only those parts of logs lying within the plot are measured.

Number of trees with hollows (50mx20m plot): This is a count of the number of living and dead trees within a 50mx20m plot with at least one hollow (note that the hollows do not have to be within the plot). A hollow is only recorded if: the entrance can be seen; the minimum entrance width is at least 5cm across; the hollow is at least 1m above the ground and the centre of the tree is within the plot. Tree should be examined from all angles.

Fauna Habitat Values: Subjective estimates of habitat value abundance used to assess habitat significance according to observed habitat attributes.

Quadrat Number: Q9 **Waypoint:** Q9 **Date:** 30/11/16 **Recorder:** PF

Vegetation Type: **Photo(s) ID and direction:** S

Overstorey Species	R	F	Ab
E. ~~conferta~~ ~~decussata~~	✓	10	4
E. fibrosa	✓	5	4
~~E. sugenton~~	✓	20	2
E. globoidea			

Midstorey Species	F	Ab
M. nodosa ~~M. squarrosa~~	2	1

Ground Cover (Shrubs)	F	Ab
Dodo. tri.	5	50
Leuc. junip.	2	20
Hepto. poly.	1	10
Exocarpos cup	1	1
Pers. linearis	1	1
Dav. ulicifolia	1	5
Pult. palacea	1	5
A. ulicif.	1	2

Ground Cover (Grasses)	F	Ab
Echinopogon Cae.	1	20
Ento. stricta	2	50
Cymbopogon 20 ~~30~~		500
Microlaena st	1	20
Panicum sim.	2	50
Dichelachne mic.	25	500
Era. brownii	~~35~~ 5	100
Pasp. distans	1	20
Aristida warb.	15	100
Cynodon dactyla	15	50

Ground Cover (Other)	F	Ab
Hibbertia aspera	1	10
Hom. multi	1	10
Bill-scandens	1	10
Cheilanthes sie	1	10
Pratia purp	1	20
Lepido- lat.	1	20
Mirbelia rub.	1	10
Centella asiat	1	20
Dampiera stricta	1	5
Schoenus ap.	1	10
Tricoryne simp.	1	10
Junc. usit	1	10
Laxmannia gra.	1	5
Glycine tab	1	10
Hypericum gram	1	10
Epilles Aust.	1	10

Exotic	F	Ab
Whisky G.	10	100
Fireweed	1	20
~~Cotula~~	~~10~~	~~100~~
Axonopus fissif	5	50
Pasp. dil. var	1	10
~~Hypericum~~	~~50~~	~~1000~~
~~Cotula. c~~	~~10~~	~~100~~
Sc. pimpenel	1	10
Plantago lance.	1	10
R. chardia stet	1	10

Senecio mad

R = Regeneration (for entire zone) **F** = Foliage Projective Cover (1-5%, then to nearest 5%)
Ab = Abundance Rating (no. of individuals or shoots. 1-10, 20, 50, 100, 500, 1000 (or specify a number greater than 100 if required; numbers > 20 are estimates only)

3 1 8 9 16

General Comments:

(37) NPS

Quadrat Number: Q9 Date: 30.11.16 Recorder: STEVE. L

	Number of Hits (Tally)	Foliage Cover (%)
O/S Cover		
MS Cover		2%
GC grasses		5%
GC shrub		82%
GC other		4%
Exotic (Ground)		12%
Exotic (Mid)		62%
Exotic (Canopy)		

Native over-storey cover (*):
Over-storey cover is estimated as per cent foliage cover, which is equivalent to the amount of shadow that would be cast on the ground if there were a light source directly overhead and can be estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover directly overhead using the images provided in Appendix 7. Divide the total by the number of points (i.e. 10) measured along transect

Native mid-storey cover:
Percent foliage cover of the mid-storey is estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-storey. Divide the total by the number of points (i.e. 10)

Native ground cover (grasses, shrubs and other):
Percent foliage cover of the ground stratum (grasses, shrubs and other) is estimated as follow:

- At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point. Divide the total of 'hits' by the number of points measured.

Exotic plant cover:
If the exotics are in the over-storey then measure using the same method as native over-storey cover (see above), if exotics are in the mid-storey then measure using the same method as native mid-storey cover (see above) and if exotics are in the ground stratum then measure using the same method as described for native ground cover (grasses)

Number of Hollow Bearing Trees within the 50mx20m plot	Total Length of fallen timber within the 20mx50m plot	Fauna habitat values (High, Medium, Low):			
		Caves/mines/tunnels	Yes		No
	1, 1.5, [illegible]	Presence Wet areas/water bodies	Yes		No
		Abundance of rocks/escarpments	High	Medium	Low
	2.5, 2, 2, 1.5 - [illegible]	Abundance of nectar resources	High	Medium	Low
		Abundance of fruit resources	High	Medium	Low
		Community part of wildlife corridor	Regional	Local	None
		Structural complexity of habitat	High	Medium	Low
Total Number =	Total Length = 9,5	Dense shrub or ground cover	High	Medium	Low
		Abundance of dead trees/stags	High	Medium	Low

Total length of fallen logs (50mx20m plot): This is the total length of logs at least 10cm diameter and at least 0.5m long. Only those parts of logs lying within the plot are measured.
Number of trees with hollows (50mx20m plot): This is a count of the number of living and dead trees within a 50mx20m plot with at least one hollow (note that the hollows do not have to be within the plot). A hollow is only recorded if: the entrance can be seen; the minimum entrance width is at least 5cm across; the hollow is at least 1m above the ground and the centre of the tree is within the plot. Tree should be examined from all angles.
Fauna Habitat Values: Subjective estimates of habitat value abundance used to assess habitat significance according to observed habitat attributes.

Quadrat Number: Q10 **Waypoint:** Q10 **Date:** 30/11/16 **Recorder:** AM

Vegetation Type: Spotted Gum-Ironbark Forest **Photo(s) ID and direction:** West

Overstorey Species	R	F	Ab	Midstorey Species	F	Ab	Ground Cover (Shrubs)	F	Ab	Ground Cover (Grasses)	F	Ab	Ground Cover (Other)	F	Ab	Exotic	F	Ab
Corymbia mac	✓	20	9	Dod triquetra	3	50	Daviesia ulicifolia	2	20	Themeda triandra	20	500	Lom longifolia	1	20	Lantana camara	5	10
E. fergusonii		3	2	Callistemon salignus	2	3	Persoonia linearis	1	5	A. vagans	2	100	Eustrephus latifolius	1	20	Senecio madagascariensis	1	3
E. crebra	✓	10	3	Bursaria spinosa	10	100	Acrotriche div	1	20	Poa lab	7	100	Pandorea pand	1	20			
E. punct	✓	5	3	Brachychiton pop	1	1	Hibbertia aspera	1	20	Ento stricta	2	100	Arthropodium milleflorum	1	2			
F. lenticorns	✓	1	1				Breynia oblongifolia	1	5	Cymbopogon refract	2	50	Opercularia diphylla	1	10			
							Leucopogon juniperinus	1	10	Eragrostis brownii	1	20	Pratia purpurascens	1	50			
							Acacia ulicifolia	1	5	I. cylindrica	2	100	Hardenbergia violacea	1	5			
							Acacia falcata	1	20	Echinopogon caespit	1	20	Dichondra repens	3	500			
							Zieria smithii	1	20	Microlaena stipoides	1	10	Desmodium gunnii	1	20			
										D. micrantha	2	50	Lom filiformis	1	20			
										Rytidosperma fulvum	1	20	Desmodium rhytidophyllum	1	10			
													Dianella caerulea	1	20			
													Brunoniella australis	1	20			
													Tricoryne elatior	1	10			
													Polymeria calycina	1	10			
													Cheilanthes sieberi	1	20			
													Lom multiflora	1	20			
													Bill scandens	1	10			
													Glycine clandestina	1	20			
													Vernonia cinerea	1	20			

R = Regeneration (for entire zone) **F** = Foliage Projective Cover (1-5%, then to nearest 5%)
Ab = Abundance Rating (no. of individuals or shoots. 1-10, 20, 50, 100, 500, 1000 (or specify a number greater than 100 if required; numbers > 20 are estimates only)

5 4 9 11 20

General Comments:

(49) NPS

Quadrat Number: Q10 **Date:** 30/11/16 **Recorder:** AM

	Number of Hits (Tally)										Foliage Cover (%)
O/S Cover	20	40	30	35	30	40	40	15	50	35	33.5%
MS Cover	–	–	10	–	–	20	5	10	10	15	7%
GC grasses	11	11	11	1	11	111	1	1	1	11	54%
GC shrub	11	1	1	11	11	1	111	111	1	1	22%
GC other	1	1	1	1	1	1	1	1	1	1	20%
Exotic (Ground)				1					1	1	2%
Exotic (Mid)				1							–
Exotic (Canopy)				1							–

Native over-storey cover (*):
Over-storey cover is estimated as per cent foliage cover, which is equivalent to the amount of shadow that would be cast on the ground if there were a light source directly overhead and can be estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover directly overhead using the images provided in Appendix 7. Divide the total by the number of points (i.e. 10) measured along transect

Native mid-storey cover:
Percent foliage cover of the mid-storey is estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-storey. Divide the total by the number of points (i.e. 10)

Native ground cover (grasses, shrubs and other):
Percent foliage cover of the ground stratum (grasses, shrubs and other) is estimated as follow:

- At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point. Divide the total of 'hits' by the number of points measured.

Exotic plant cover:
If the exotics are in the over-storey then measure using the same method as native over-storey cover (see above), if exotics are in the mid-storey then measure using the same method as native mid-storey cover (see above) and if exotics are in the ground stratum then measure using the same method as described for native ground cover (grasses)

Number of Hollow Bearing Trees within the 50m x 20m plot	Total Length of fallen timber within the 20mx 50m plot	Fauna habitat values (High, Medium, Low)			
	4, 7, 1, 3, 2,	Caves/mines/tunnels	Yes		No
		Presence Wet areas/water bodies	Yes		No
		Abundance of rocks/escarpments	High	Medium	Low
		Abundance of nectar resources	High	Medium	Low
		Abundance of fruit resources	High	Medium	Low
		Community part of wildlife corridor	Regional	Local	None
		Structural complexity of habitat	High	Medium	Low
Total Number =	Total Length = 17m	Dense shrub or ground cover	High	Medium	Low
		Abundance of dead trees/stags	High	Medium	Low

Total length of fallen logs (50mx20m plot): This is the total length of logs at least 10cm diameter and at least 0.5m long. Only those parts of logs lying within the plot are measured.

Number of trees with hollows (50mx20m plot): This is a count of the number of living and dead trees within a 50mx20m plot with at least one hollow (note that the hollows do not have to be within the plot). A hollow is only recorded if: the entrance can be seen; the minimum entrance width is at least 5cm across; the hollow is at least 1m above the ground and the centre of the tree is within the plot. Tree should be examined from all angles.

Fauna Habitat Values: Subjective estimates of habitat value abundance used to assess habitat significance according to observed habitat attributes.

Quadrat Number: Q11 **Waypoint:** Q11 **Date:** 30/11/16 **Recorder:** PF

Vegetation Type: **Photo(s) ID and direction:** 5

Overstorey Species	R	F	Ab	Midstorey Species	F	Ab	Ground Cover (Shrubs)	F	Ab	Ground Cover (Grasses)	F	Ab	Ground Cover (Other)	F	Ab	Exotic	F	Ab
C. nodosa		30	20	M. sodosa	10	10	Daviesia ulicifolia	1	10	A. virgen	2	100	lom. long.	1	5	Andropogon virg	1	5
E. fibrosa		50	4	G. floribunda	1	5	Hibbertia spicata	1	10	E. stricta	25	500	lep. lat.	5	100	Lantana	1	5
E. globoidea		5	3				Acrotriche	1	10	Dichelachne mic.	1	50	Cheilanthes sieb.					
E. cariuvulata		2	-				Leuc. jun.	1	10	[illegible]			[illegible]					
							[illegible]			[illegible]			Eustrephus lat	1	5			
							Ac. falcata	1	10	Panicum sim.	2	100	Opercularia di.	1	5			
							Breynia ob	1	5	A. warburgii	1	50	Dianella revol.	1	5			
							Pultn. pelaea	1	10	Echinopogon ces	1	50	Gono. teuc.	1	5			
							[illegible]			Imperata cyl	5	50	Hardenbergia viol	1	5			
							Acrotricle div	1	5	Rhytidopall. d.	5	50	Prati a pra	1	10			
							Pult. euchila	1	5	Microlaena st	1	50	Hibb. [illegible]	1	10	-pedunculosa		
							Notelaea long.	1	2	Rhytido. fulv.	1	50	Brunoniella aus	1	5			
							Pers. lin.	1	2	Themeda trian	5	50	Phyll. hirsellus	1	10			
							Jacksonia	1	1	Poa. lab.	1	50	Goodenia let.	1	5			
													Lom. obliqua	1	10			
													Lagenophora stip.	1	5			
													Schoenus ap.	1	10			
													Lom. glauca	1	2			

R = Regeneration (for entire zone) **F** = Foliage Projective Cover (1-5%, then to nearest 5%)
Ab = Abundance Rating (no. of individuals or shoots. 1-10, 20, 50, 100, 500, 1000 (or specify a number greater than 100 if required; numbers > 20 are estimates only)

4 2 12 12 17

General Comments:

(47) WPS

Quadrat Number: Q11 **Date:** 30.11.16 **Recorder:** STEVE.LI

	Number of Hits (Tally)										Foliage Cover (%)
O/S Cover	—	50	60	60	50	30	45	55	60	50	46%
MS Cover	—	—	—	—	—	—	30	—	45	20	9.5%
GC grasses											70%
GC shrub											8%
GC other											14%
Exotic (Ground)											—
Exotic (Mid)											4%
Exotic (Canopy)											—

Native over-storey cover (*):
Over-storey cover is estimated as per cent foliage cover, which is equivalent to the amount of shadow that would be cast on the ground if there were a light source directly overhead and can be estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover directly overhead using the images provided in Appendix 7. Divide the total by the number of points (i.e. 10) measured along transect

Native mid-storey cover:
Percent foliage cover of the mid-storey is estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-storey. Divide the total by the number of points (i.e. 10)

Native ground cover (grasses, shrubs and other):
Percent foliage cover of the ground stratum (grasses, shrubs and other) is estimated as follow:

- At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point. Divide the total of 'hits' by the number of points measured.

Exotic plant cover:
If the exotics are in the over-storey then measure using the same method as native over-storey cover (see above), if exotics are in the mid-storey then measure using the same method as native mid-storey cover (see above) and if exotics are in the ground stratum then measure using the same method as described for native ground cover (grasses)

Number of Hollow Bearing Trees within the 50m x 20m plot	Total Length of fallen timber within the 20mx 50m plot	Fauna habitat values (High, Medium, Low)			
1,1	1.5, 1, 2.5, 7, 1	Caves/mines/tunnels	Yes		No
		Presence Wet areas/water bodies	Yes		No
	1, 5, 14, 1, 1, 2.5	Abundance of rocks/escarpments	High	Medium	Low
		Abundance of nectar resources	High	Medium	Low
	1, 5, 1, 2, 4	Abundance of fruit resources	High	Medium	Low
		Community part of wildlife corridor	Regional	Local	None
Total Number = 2	Total Length = 32.5m	Structural complexity of habitat	High	Medium	Low
		Dense shrub or ground cover	High	Medium	Low
		Abundance of dead trees/stags	High	Medium	Low

Total length of fallen logs (50mx20m plot): This is the total length of logs at least 10cm diameter and at least 0.5m long. Only those parts of logs lying within the plot are measured.
Number of trees with hollows (50mx20m plot): This is a count of the number of living and dead trees within a 50mx20m plot with at least one hollow (note that the hollows do not have to be within the plot). A hollow is only recorded if: the entrance can be seen; the minimum entrance width is at least 5cm across; the hollow is at least 1m above the ground and the centre of the tree is within the plot. Tree should be examined from all angles.
Fauna Habitat Values: Subjective estimates of habitat value abundance used to assess habitat significance according to observed habitat attributes.

Quadrat Number Q12 Waypoint: Q12 Date: 30/11/16 Recorder: RF

Vegetation Type: Photo(s) ID and direction:

Overstorey Species	R	F	Ab	Midstorey Species	F	Ab	Ground Cover (Shrubs)	F	Ab	Ground Cover (Grasses)	F	Ab	Ground Cover (Other)	F	Ab	Exotic	F	Ab
E. fibrosa		2	1	M. nodosa	5	10	Dav. ulici	1	1	Era. brownii	1	10	Mirbelia rub.	1	10	Panicum repens	85	1000
C. maculata	✓	2	3	Ac. irrorata	2	1	Ac. ulici.	1	2	A. vagans	1	10	Glycine tab.	1	10	Briza max.	1	20
E. punctata		5	2				Breynia obl	1	1	Rhytido. fulv.	1	10	Opercularia di	1	10	Fireweed	1	20
E. teret.		1	1				Callistema lin	1	1	Dichel. mic.	1	10	Lom. multi	1	10	Gramxhaeton (cf)	1	10
										E. stricta	1	10	Hibb. (Ar)	1	5	[illegible]		
										Pasp. distans	1	5	Juncus usi. (Ar)	1	5	Bidens pilosa	1	5
													Rumex brownii	1	5	Sc. pimpernel	1	10
													Dianella car.	1	5	Solanum nigrum	1	10
													Pratia purp	1	5	[illegible]	1	10
													Cheilanthes sieb	1	5	Plantago lance.	1	20
													Epilles aust.	1	5	Moth vine	1	5
													Poranthera micro.	1	5	Pampas Grass	1	1
													Hypericum gram.	1	5	Whisky G.	1	10
													[illegible]	[illegible]		Briza minor	1	10
													Pomax umb.	1	5	Vulpia myuros	1	10
																Verbena bon.	1	5
																Asclepias cur.	1	5
																Centurium erythr.	1	5

R = Regeneration (for entire zone) **F** = Foliage Projective Cover (1-5%, then to nearest 5%)
Ab = Abundance Rating (no. of individuals or shoots. 1-10, 20, 50, 100, 500, 1000 (or specify a number greater than 100 if required; numbers > 20 are estimates only)

4 2 4 6 14

General Comments:

(30) NPS

Quadrat Number: Q12 Date: 30.11.16 Recorder: SSGVS LJ

	Number of Hits (Tally)	Foliage Cover (%)
O/S Cover	—	—
MS Cover	—	4%
GC grasses	40	—
GC shrub		14%
GC other		—
Exotic (Ground)		4%
Exotic (Mid)		56%
Exotic (Canopy)		22%

Native over-storey cover (*):
Over-storey cover is estimated as per cent foliage cover, which is equivalent to the amount of shadow that would be cast on the ground if there were a light source directly overhead and can be estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover directly overhead using the images provided in Appendix 7. Divide the total by the number of points (i.e. 10) measured along transect

Native mid-storey cover:
Percent foliage cover of the mid-storey is estimated as follows:

- At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-storey. Divide the total by the number of points (i.e. 10)

Native ground cover (grasses, shrubs and other):
Percent foliage cover of the ground stratum (grasses, shrubs and other) is estimated as follow:

- At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point. Divide the total of 'hits' by the number of points measured.

Exotic plant cover:
If the exotics are in the over-storey then measure using the same method as native over-storey cover (see above), if exotics are in the mid-storey then measure using the same method as native mid-storey cover (see above) and if exotics are in the ground stratum then measure using the same method as described for native ground cover (grasses)

Number of Hollow Bearing Trees within the 50m x 20m plot	Total Length of fallen timber within the 20mx 50m plot	Fauna habitat values (High, Medium, Low)			
	2, 5, 3, 2, 6, 5, 5, 2	Caves/mines/tunnels	Yes		No
	2,	Presence Wet areas/water bodies	Yes		No
		Abundance of rocks/escarpments	High	Medium	Low
		Abundance of nectar resources	High	Medium	Low
		Abundance of fruit resources	High	Medium	Low
		Community part of wildlife corridor	Regional	Local	None
		Structural complexity of habitat	High	Medium	Low
Total Number =	Total Length = 32m	Dense shrub or ground cover	High	Medium	Low
		Abundance of dead trees/stags	High	Medium	Low

Total length of fallen logs (50mx20m plot): This is the total length of logs at least 10cm diameter and at least 0.5m long. Only those parts of logs lying within the plot are measured.

Number of trees with hollows (50mx20m plot): This is a count of the number of living and dead trees within a 50mx20m plot with at least one hollow (note that the hollows do not have to be within the plot). A hollow is only recorded if: the entrance can be seen; the minimum entrance width is at least 5cm across; the hollow is at least 1m above the ground and the centre of the tree is within the plot. Tree should be examined from all angles.

Fauna Habitat Values: Subjective estimates of habitat value abundance used to assess habitat significance according to observed habitat attributes.

Site value:
Transect tally table

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
HCR		IMarriott	30.3.11

Proposal ID	Proposal name	Zone ID
410060	Eagleton Quarry	1

Vegetation formation

Vegetation class

Vegetation type Spotted Gum-Ironbark-Grey Gum-~~White~~ Stringybark-White Mahogany DSF.

Condition (low or mod/good)	**Zone descriptor** (optional)	**Geographic/habitat features** (tick after printing step 2 of Credit Calculator)
good.		

Transect number Eag Q1	Number of hits (tally)	%
Native over-storey cover (%)	40 40 50 40 50 40 40 50 50 50	45
Native mid-storey cover (%)	15 20 20 30 15 15 20 30 20 20	20.5
Native ground cover (grasses) (%)	11 111 1111 111 11 1 1111 111 11 11	54 (0.54)
Native ground cover (shrubs) (%)	11 11 111 11 1 111 11 1 111 11	42 (0.42)
Native ground cover (other) (%)	1111 1111 1111 1111 1111 111 111 111 1111	88 (0.88)
Exotic plant cover (%)	1 11 1 1 11	14 (0.14)

Transect number Eag Q2	Number of hits (tally)	%
Native over-storey cover (%)	30 40 40 40 40 50 40 40 30 40	39
Native mid-storey cover (%)	30 40 30 30 30 30 40 50 40 40	36
Native ground cover (grasses) (%)	111 111 11 1111 1111 111 11 111 11 111	60
Native ground cover (shrubs) (%)	11 11 11 1 1 111 11 111 1111 111	50
Native ground cover (other) (%)	1111 1111 1111 111 1111 111 11 1111 111 1111	84
Exotic plant cover (%)	1 11 11 1 11 1	18

Transect number Eag Q3	Number of hits (tally)	%
Native over-storey cover (%)	40 40 40 40 50 30 40 40 40 30	39
Native mid-storey cover (%)	30 30 40 40 40 30 30 20 30 40	33
Native ground cover (grasses) (%)	1111 111 11 111 11 111 11 1 1111 111	56
Native ground cover (shrub) (%)	111 11 1 11 1 11 11 11 111	36.
Native ground cover (other) (%)	1111 1111 111 1111 1111 1111 1111 1111 111 1111	88
Exotic plant cover (%)	1 11 1 1 1	12

Transect number Eag Q4	Number of hits (tally)	%
Native over-storey cover (%)	40 40 40 30 40 40 40 30 50 40	39
Native mid-storey cover (%)	20 30 30 30 20 20 15 30 20 20	23.5
Native ground cover grasses (%)	1 11 11 111 11 111 11 111 1111	42
Native ground cover shrubs (%)	1 11 1 11 1 1 11	20
Native ground cover other (%)	11 111 11 1111 11 11 1 1 111	40
Exotic plant cover (%)	111 1111 111 1111 11 111 11 111 111	54

Transect number [illegible]	Number of hits (tally)	%
Native over-storey cover (%)	[illegible] 50 40 40 40 50 50 50 50	50
Native mid-storey cover (%)	[illegible]	
Native ground cover (grasses) (%)	[illegible]	
Native ground cover (shrubs) (%)	[illegible]	
Native ground cover (other) (%)	[illegible]	
Exotic plant cover (%)	[illegible]	

Transect number Eq [illegible]	Number of hits (tally)	%
Native over-storey cover (%)	40 40 40 40 30 30 40 40 30 40	
Native mid-storey cover (%)	20 30 30 20 20 15 20 30 30 50	
Native ground cover (grasses) (%)	[illegible]	
Native ground cover (shrubs) (%)	[illegible]	
Native ground cover (other) (%)	[illegible]	
Exotic plant cover (%)	[illegible]	

Transect number [illegible]	Number of hits (tally)	%
Native over-storey cover (%)	[illegible]	
Native mid-storey cover (%)	[illegible]	
Native ground cover (grasses) (%)	[illegible]	
Native ground cover (shrubs) (%)	[illegible]	
Native ground cover (other) (%)	[illegible]	
Exotic plant cover (%)	[illegible]	

Transect number Eq Q8	Number of hits (tally)	%
Native over-storey cover (%)	40 40 40 30 50 40 50 40 40 40	
Native mid-storey cover (%)	40 30 40 30 30 50 50 30 30 40	
Native ground cover (grasses) (%)	[illegible]	
Native ground cover (shrubs) (%)	[illegible]	
Native ground cover (other) (%)	[illegible]	
Exotic plant cover (%)		

Transect number Eq Q9	Number of hits (tally)	%
Native over-storey cover (%)	40 40 40 30 40 50 50 40 40 30	
Native mid-storey cover (%)	30 40 40 30 30 30 10 10 30 20	
Native ground cover (grasses) (%)	[illegible]	
Native ground cover (shrubs) (%)	[illegible]	
Native ground cover (other) (%)	[illegible]	
Exotic plant cover (%)	[illegible]	

Transect number Eq Q10	Number of hits (tally)	%
Native over-storey cover (%)	20 30 50 30 30 30 30 30 30 20	
Native mid-storey cover (%)	50 60 60 60 70 70 60 60 70 70	
Native ground cover (grasses) (%)	[illegible]	
Native ground cover (shrubs) (%)	[illegible]	
Native ground cover (other) (%)	[illegible]	
Exotic plant cover (%)	[illegible]	

Transect number Tay Q11	Number of hits (tally)	%
Native over-storey cover (%)	50 50 50 40 40 50 50 50 50 50	
Native mid-storey cover (%)	20 15 30 30 40 30 20 20 30 20	
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number Tay Q12	Number of hits (tally)	%
Native over-storey cover (%)	15 20 20 15 15 15 20 20 20 20	
Native mid-storey cover (%)	30 20 30 30 40 30 30 30 30 35	
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number Tay Q13	Number of hits (tally)	%
Native over-storey cover (%)	30 40 40 40 40 50 50 40 40 30	
Native mid-storey cover (%)	15 30 30 40 40 50 50 30 60 60	
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number Tay Q14	Number of hits (tally)	%
Native over-storey cover (%)	40 50 30 40 40 30 40 40 40 40	
Native mid-storey cover (%)	30 20 30 30 30 20 30 30 40 40	
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: (Development) / BioBank **Proposal ID:** [illegible] **Date:** 30 · 3 · 11. **Recorder(s):** T.Hamott

Vegetation type: Spotted Gum - Grey Gum - White Stringybark DSF. **AMG Zone** 56 **Easting/Northing:** 386555; 6382865 (72.8 alt.) **Photos:** Egg C1

Native over-storey species list At 10 points along the 50-m transect	Regeneration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
Corymbia maculata	D ✓	Dodonaea viscosa	Oplismenus imbecillis.	Breynia oblongifolia.	Lepidosperma laterale	Lantana camara.	
Eucalyptus propinqua	D ✓	Acacia fimbriata	Imperata cylindrica var major	Cissus antarctica	Adiantum aethiopicum.		
Eucalyptus globoidea	D ✓	Nicholeia longifolia.	Poa sieberiana?	~~Dodonaea viscosa~~	Selaginella uliginosa		
E. piperita	MS ✓	Allocasuarina littoralis.	Microlaena stipoides.	Goodenia heterophylla	Desmodium varians		
E. acmenoides	MS. ✓	Notelaea sp. (ID) – Persoonia linearis.	Austrodanthonia sp. (no Secateurs)	ssp. eglandulosa	Viola hederacea.		
			Panicum simile	Leucopogon juniperinus	Pratia purpurascens		
			Echinopogon caespitosus	Pultenaea villosa	Dianella sp.		
				Pultenaea ret-sp.	Pandorea pandorana.		
				Hibbertia linearis.	Eustrephus latifolius.		
				Tetratheca thymifolia.	Goodeniaceae sp.		
				Acacia ulicifolia.	Hemarthria uncinata		
	5			Bursaria sp. (ID)	Lagenophora stipitata ~~var. latifolia~~ ssp. ~~latifolia~~		
Total number of species = 47				Hibbertia obtusifolia	Lomandra ~~longifolia ssp. longifolia~~		
Foliage cover (%) =					Lomandra sp. (ID)		
Benchmark value (%FC) =					Dianella revoluta ~~ssp.~~		
Average crown diameter =					Xanthorrhoea ~~johnsonii~~	(20.1 scrap spike)	
Average foliage cover (%) =					Cheilanthes sieberi		
Number of trees =					Lepidosperma ~~laterale~~? (ID)		
Sample area = 400 m²							
Whole zone							
Number of trees with hollows = 0							
Sample area = 0.1 ha							
Benchmark value =		Total no of species = 6	Total no of species = 7	Total no of species = 11	Total no of species = 18	Total no of species = 1	Total (m) = 90
		Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES: Egg Q1 South-facing upper/mid hillslope. Extensive rock outcropping.

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** _____ **Date:** 30.3.11 **Recorder(s):** Hannett

Vegetation type: Spotted Gum - Grey Ironbark - White Stringybark / Grey Gum DSF. **AMG Zone** 56 **Easting/Northing:** 386593 ; 6382756 76.9. 94. 54g Q2 **Photos:** _____

Native over-storey species list At 10 points along the 50-m transect	Regeneration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. paniculata	D ✓	Allocasuarina torulosa.	Aristida vagans.	Acrotriche divaricata.	Lepidosperma laterale	Lantana camara *	
E. punctata	D ✓	Dodonaea triquetra.	Entolasia stricta.	Zieria smithii.	Dianella caerulea sensu lato.		
E. globoidea	D ✓	Leptospermum polygalifolium	Aristida vagans	Leucopogon juniperinus.	Lomandra confertifolia pallida		
Corymbia maculata	D ✓	Casuarina cunninghamiana	Panicum simile.	Hakea sericea	Lomandra sp. (ID)		
E. acmenoides	D ✓	Syncarpia glomulifera.	Eragrostis brownei.	(Sapling)	Pteridium esculentum		
		Melaleuca linariifolia.	Imperata cylindrica var major.	Acacia ulicifolia.	Goodenia bellidifolia bellidifolia.		
		Persoonia linearis.	Pen. effusus? (ID)	Bursaria sp. (ID)	Pandorea pandorana		
		Hakea sericea.		Grevillea juniperina	Pseudoraphis variabilis		
				Pultenaea retusa	Lomandra obliqua		
					Eustrephus latifolius		
					Glycine clandestina.		
	5				Adiantum aethiopicum.		
Total number of species = 42					Cissus hypoglauca		
Foliage cover (%) =					Asplenium flabellifolium.		
Benchmark value (%FC) =					Cheilanthes sieberi		
Average crown diameter =							
Average foliage cover (%) =							
Number of trees =							
Sample area =							
Whole zone							
Number of trees with hollows = 1							
Sample area = 0.1 ha.							
Benchmark value =		Total no of species = 7	Total no of species = 7	Total no of species = 8	Total no of species = 15	Total no of species = 1	Total (m) = 110
		Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:

Mod. steep, S facing lower hillslope. Ext rock outcropping. Grey clay soils. Eag Q2

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: (Development) / BioBank **Proposal ID:** 41006 **Date:** 30.3.11 **Recorder(s):** MarcH

Vegetation type: Spotted Gum - Grey Ironbark - Large-fruited Grey Gum DSF **AMG Zone** 56 **Easting/Northing:** 386632 ; 6583016 75.6 mN **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regeneration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. paniculata paniculata D ✓		Allocasuarina torulosa.	Echinopogon caespitosus.	Bursaria vallosa.	Lepidosperma laterale	Lantana camara	
E. punctata ✓		Dodonaea triquetra.	Entolasia stricta.	Genoscopus leucoides	Lomandra longifolia longifolia.		
Corymbia maculata D ✓		Leptospermum polygalifolium	Cymbopogon refractus.	Daviesia ulicifolia.	Pomax umbellata.		
E. globoidea. D ✓		cismontanum.	Panicum simile.	Acacia ulicifolia.	Cheilanthes sieberi.		
E. crebra. mS ✓		Persoonia linearis.	Poa sieberiana ? (D).	Acrotriche divaricata.	Dianella caerulea sessilis.		
			Imperata cylindrica var major.	Leucopogon juniperinus.	Pandorea pandorana.		
			Cyperus sphaeroides.		Eustrephus latifolius.		
					Pseudoraphis spinescens.		
					Pteridium esculentum.		
					Cymbopogon refractus.		
					Geitonoplesium cymosum.		
	5				Hardenbergia violacea.		
Total number of species = (37)					Lomandra confertifolia pallida.		
Foliage cover (%) =					Cadellia heterophylla exclud. less.		
Benchmark value (%FC) =					Desmodium rhytidophyllum.		
Average crown diameter =							
Average foliage cover (%) =							
Number of trees =							
Sample area = 400 m²							
Whole zone							
Number of trees with hollows = 0							
Sample area = 0.1 ha.							
Benchmark value =							
		Total no of species = 4	Total no of species = 7	Total no of species = 6	Total no of species = 15	Total no of species = 1	Total (m) = 94
		Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:

Euc Q3 Mod slope NE facing hillslope - Ext. outcropping.

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** 410060 **Date:** 30.3.11 **Recorder(s):** IMamott

Vegetation type: Spotted Gum - Grey Ironbark - Large fruited Grey Gum - White Mahogany DSF. **AMG Zone** 56 **Easting/Northing:** 386611 ; 6383097 Eag Q4. 89.9 pts **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regeneration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. paniculata peniculata ✓		Pittosporum undulatum	Imperata cylindrica var. major	Leucopogon juniperinus.	Opercularia diphylla	Lantana camara.	
E. punctata.		Allocasuarina torulosa.	Digitaria ramularis (ID)		Lomandra multiflora multiflora.		
Corymbia maculata.	✓	Dodonaea triquetra.	Entolasia stricta	Bursaria spinosa sp. (ID)	Cheilanthes sieberi sieberi.		
E. acmenoides.	✓	Breynia oblongifolia.	Oplismenus imbecillis.		Pratia purpurascens.		
		Notelaea longifolia.	Cymbopogon refractus.		Desmodium varians.		
		Persoonia linearis.			Selaginella uliginosa.		
					Pandorea pandorana.		
					Smilax glycyphylla		
					Viola hederacea.		
	5						
Total number of species = 27							
Foliage cover (%) =							
Benchmark value (%FC) =							
Average crown diameter =							
Average foliage cover (%) =							
Number of trees = 400 m².							
Sample area =							
Whole zone							
Number of trees with hollows = 0							
Sample area = 0.1 ha.							
Benchmark value =							
		Total no of species = 6	Total no of species = 5	Total no of species = 2	Total no of species = 9	Total no of species = 1	Total (m) = 78
		Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER ~~NOTES~~: Eag Q4 mod-steep NE facing hillslope (lower hillslope). Lantana infestation > 30% cover in plot, sparse in the u/s.

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** 410060 **Date:** 31.3.11 **Recorder(s):** MamoH

Vegetation type: Spotted Gum-Ironbark - Grey Gum - White Stringybark DSF. **AMG Zone** 56 **Easting/Northing:** 386962; 6382836 Eag Q10. 72.7. **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regeneration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. punctata		Dodonea triquetra	Entolasia stricta.	Hibbertia aspera.	Eustrephus latifolius	Lantana camara,	
E. crebra.		Melaleuca styphelioides.	Cymbopogon refractus.	Acrotriche divaricata	Digitella caerulea var	prodvcta/aspera.	
E. globoidea		Persoonia linearis.	Echinopogon caespitosus	Leucopogon juniperinus.	lepidosperm neesii		
E. fibrosa.		Acacia falcata	Imperata cylindrica var	Breynia oblongifolia (ssp).	Oxalis perennans.		
Eupaniculata paniculata.		Acacia longifolia longifolia.	major.	Acacia longissima (ssp).	Lomandra multiflora multiflora.		
Corymbia maculata.		Notelaea longifolia.	Themeda australis.	Glochidion ferdinandi (ssp).	Geitonoplesium cymosum		
			Aristida vagans		Glycine clandestina		
			Oplismenus imbecillis.		Pratia purpurascens.		
			Microlaena stipoides.		Vernonia cinerea.		
				Bossiaea heterophylla.	Pseudognaphalium vaiabile		
					Lomandra confertifolia pallida		
					Rhytidosporum (basal rosette) sp.		
					forb (ID) small elliptic leaf sky stem.		
					Dichondra repens.		
					Chaetanthera sieberi sieberi.		
Total number of species =							
Foliage cover (%) =							
Benchmark value (%FC) =							
Average crown diameter =							
Average foliage cover (%) =							
Number of trees =							
Sample area = 400 m²,							
Whole zone							
Number of trees with hollows = 0							
Sample area = 0.1 ha.							
Benchmark value =							
		Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total (m) = 28
		Foliage cover (%) =	Foliage cover (%) = Eag Q10	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:

N facing upper hillslope - just 10m. downslope from central ridgeline. Just east of a minor gully headwater. Lantana > 10% cover.

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** 410060 **Date:** 31.3.11 **Recorder(s):** MamoH

Vegetation type: Spotted Gum-Ironbark - Grey Gum - White Stringybark DSF. **AMG Zone** 56 **Easting/Northing:** 386962; 6382836 EagQ10. 72.7. **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regeneration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. punctata		Dodonea triquetra	Entolasia stricta.	Hibbertia aspera.	Eustrephus latifolius	Lantana camara,	
E. crebra.		Melaleuca styphelioides.	Cymbopogon refractus.	Acrotiche divaricata	Dianella caerulea var	producta/aspera.	
E. globoidea		Persoonia linearis.	Echinopogon caespitosus	Leucopogon juniperinus.	lepidosperm neesii		
E. fibrosa.		Acacia falcata	Imperata cylindrica var	Breynia oblongifolia (ssp).	Oxalis perennans.		
Eucalyptus paniculata.		Acacia longifolia longifolia.	major.	Acacia longissima	Lomandra multiflora multiflora.		
Corymbia maculata.		Notelaea longifolia.	Themeda australis.	(ssp).	Geitonoplesium cymosum		
			Aristida vagans	Glochidion ferdinandi	Glycine clandestina		
			Oplismenus imbecillis.	(ssp).	Pratia purpurascens.		
			Microlaena stipoides.		Veronica cheeseii.		
				Bossiaea heterophylla.	Pseudognaphalium vaisbrie		
					Lomandra confertifolia pallida		
					Rhytidosporum (basal rosette) sp.		
					forb (ID) small elliptic leaf clay sp.		
					Dichondra repens.		
					Cheilanthes sieberi sieberi.		
Total number of species =							
Foliage cover (%) =							
Benchmark value (%FC) =							
Average crown diameter =							
Average foliage cover (%) =							
Number of trees =							
Sample area = 400 m².							
Whole zone							
Number of trees with hollows = 0							
Sample area = 0.1 ha.							
Benchmark value =							
		Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total (m) = 28
		Foliage cover (%) =	Foliage cover (%) = EagQ10	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:

N facing upper hillslope - just 10m. downslope from central ridgeline. Just east of a minor gully headwater. Lantana > 10% cover.

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** _____ **Date:** 31.3.11 **Recorder(s):** Mamott

Vegetation type: Spotted Gum - Ironbark - Grey Gum - White Stringybark - White Mahogany DSF. **AMG Zone** 56. **Easting/Northing:** 386857 / 6382627 Egg Q11 70.5q1f. **Photos:** _____

Native over-storey species list At 10 points along the 50-m transect	Regeneration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
Corymbia maculata.		Allocasuarina torulosa	Entolasia marginata.	Leucopogon juniperinus	Pratia purpurascens		
E. punctata.		Dodonea viscosa.	Oplismenus imbecillis.	Maytenus silvestris (sap).	Dianella caerulea var. producta / assera (ID)		
E. fibrosa.		Persoonia linearis	Entolasia stricta.		Lomandra multiflora multiflora		
E. globoidea.			Echinopogon caespitosus	Bursaria (spinosa?)	Cheilanthes sieberi sieberi		
E. acmenoides.			Cymbopogon refractus.	Goodenia heterophylla	Pandorea pandorana.		
			Imperata cylindrica	eglandulosa.	Brunoniella australis.	Lantana camara	
			var. major.	Breynia oblongifolia	Hypericum gramineum.		
			Panicum simile.	(sap).	Eustephus latifolius		
				Acacia ulicifolia.	Centella asiatica		
				Astrotricha divaricata.	Glycine clandestina.		
				Hibbertia linearis	Marsdenia (Pleurostelma?)	Rubus (fruticosus).	
				Goodenia heterophylla	Hardenbergia violacea		
				eglandulosa.	Lepidosperma (neesii?)		
				Phyllanthus hirtellus.	Tetrastigma nitens?		
				Notelaea longifolia.			
				longifolia.			
Total number of species =							
Foliage cover (%) =							
Benchmark value (%FC) =							
Average crown diameter =							
Average foliage cover (%) =							
Number of trees =							
Sample area = 400m²							
Whole zone							
Number of trees with hollows = 0							
Sample area = 0.1 ha.							
Benchmark value =		Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total (m) = 54
		Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:
Egg Q11 Headwater gully - just upslope.

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** 410060 **Date:** 1.4.11 **Recorder(s):** MMamott 65.9mAHt.

Vegetation type: _____ **AMG Zone** 56 **Easting/Northing:** 387037; 6382824 Eagle12 **Photos:** _____

Native over-storey species list At 10 points along the 50-m transect	Regeneration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
Corymbia maculata	–	Dodonea triquetra.	Cymbopogon refractus.	Leucopogon juniperinus	Geitonoplesium cymosum.	Lantana camara.	
E. globoidea.	–	Acacia falcata.	Eragrostis brownii	Breynia oblongifolia (sap).	Bonamiella australis.	Taraxacum	
E. punctata.	–	Bursaria spinosa.	Aristida vagans		Pratia purpurascens.		
E. beyeriana	1	Xerochloa linearis.	Imperata cylindrica var major.		Dianella revoluta var. prodigiosa.		
E. paniculata paniculata	–	Jacksonia scoparia.	Panicum simile	Acacia ulicifolia.	Cheilanthes sieberi sieberi.		
E. crebra			Entolasia stricta.	Acronychia oblongifolia.	Glycine clandestina		
E. fibrosa.			Themeda australis.	Notelaea longifolia.	Billardiera scandens.		
			Microlaena stipoides.		Desmodium rhytidophyllum		
			Dichelachne micrantha		Dichondra repens.		
			Eulalia marginata.		Oxalis perennans.		
			Echinopogon chaetophorus		Eustrephus latifolius.		
			Austrodanthonia (seedhead unidentifiable) sp. (too dried/decomposed).		Lomandra multiflora multiflora		
					Lomandra obliqua.		
					Lepidosperma laterale.		
					Pteridium esculentum (bracken).		
					Asperula (asthenes?)	ID	Tightly wound leaf shells. (2 tangle seen).
					Veronica plebeia plebeia		
					Lomandra confertifolia pallida.		
Total number of species =							
Foliage cover (%) =							
Benchmark value (%FC) =							
Average crown diameter =							
Average foliage cover (%) =							
Number of trees =							
Sample area =							
Whole zone							
Number of trees with hollows = 0							
Sample area = 0.1ha							
Benchmark value =							
		Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total (m) = 40
		Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:

Eag Q12. NE facing lower hillslope - upslope from 'circular' cleared patch. Rock outcropping.

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** 41060 **Date:** 10/4/11 **Recorder(s):** IMamott

Vegetation type: Spotted Gum - Grey Gum - White Mahogany DSF. **AMG Zone** 56 **Easting/Northing:** 386993; 6382650 62.19H. EagQ13 **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regeneration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
Corymbia maculata	D	~~Leptospermum polygalifolium~~	Aristida vagans.	Blechidium fluitans (ssp)	Pratia purpurascens.	Lantana camara.	
E. punctata.	D	Cremnophorum (Tunica? DD)	Oplismenus imbecillis		Pseudoraphis variabilis		
E. paniculata paniculata.		Notelaea longifolia	Cymbopogon refractus.	Brynia oblongifolia (ssp).	Rumex pulcherrimus		
E. umbra	D	Persoonia linearis.	Eragrostis brownii		Cynoglossum suaveolens.		
Exocarpoides		Dodonaea triquetra.	Microlaena stipoides	Leucopogon juniperinus.	Glycine (tomentella?)		
		Allocasuarina torulosa.	Entolasia stricta.	Bursaria spinosa.	Veronica plebeia.		
		Melaleuca styphelioides.	Echinopogon caespitosus.	Acacia ulicifolia.	Goodenia bellidifolia.		
		Ziera smithii	Digitaria (ramularis?)	Hibbertia dentata.	Cheilanthes sieberi		
			Imperata cylindrica var major.		Geitonoplesium cymosum		
			Austrodanthonia sp.		Dianella caerulea (var assera?)		
Total number of species =							
Foliage cover (%) =							
Benchmark value (%FC) =							
Average crown diameter =							
Average foliage cover (%) =							
Number of trees =							
Sample area = 400m².							
Whole zone							
Number of trees with hollows = 0							
Sample area = 0.1 ha.							
Benchmark value =							
		Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total (m) = 52
		Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:
EagQ13. Feral deer. Age cohorts = 3. Middle = 65cm (TC) 45% oldest = 1.96m (TC) 10%. Youngest = 34cm (TC) 45%.

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** 40060 **Date:** 1.4.11 **Recorder(s):**

Vegetation type: **AMG Zone** 56 **Easting/Northing:** Egg Q14 387159; 6382596 42.9 alt. **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regeneration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. fibrosa.		Kunzea ambigua	Imperata cylindrica var major	Hibbertia aspera	Eustrephus latifolius.	Lantana camara	
E. punctata.		Breynia oblongifolia	Entolasia stricta.	Leucopogon juniperinus.	Tricoryne elatior.		
Corymbia gummifera.		Glochidion ferdinandi	Eragrostis brownii		Cheilanthes sieberi		
Eucalyptoides.		Allocasuarina torulosa.	Panicum simile.		Opercularia varia.		
E. capitellata.		Zieria smithii	Aristida vagans.		Lomandra multiflora multiflora.		
E. moluccana.	(1)	Acacia irrorata.	Microlaena stipoides.		Gonocarpus tetragynus.		
		Leptospermum polygalifolium			Goodenia heterophylla eglandulosa.		
		Cismontanum.			Gonocarpus teucrioides.		
		Melaleuca nodosa.			Pteridium esculentum.		
		Notelaea longifolia.					
Total number of species =							
Foliage cover (%) =							
Benchmark value (%FC) =							
Average crown diameter =							
Average foliage cover (%) =							
Number of trees =							
Sample area = 400m²							
Whole zone							
Number of trees with hollows = 0							
Sample area = 0.1 ha.							
Benchmark value =							
		Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total (m) = 46
		Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:
Egg Q14 lower E/SE facing hillslope (120°). 5° slope. Lantana (1 mature plant). Upslope from gully.

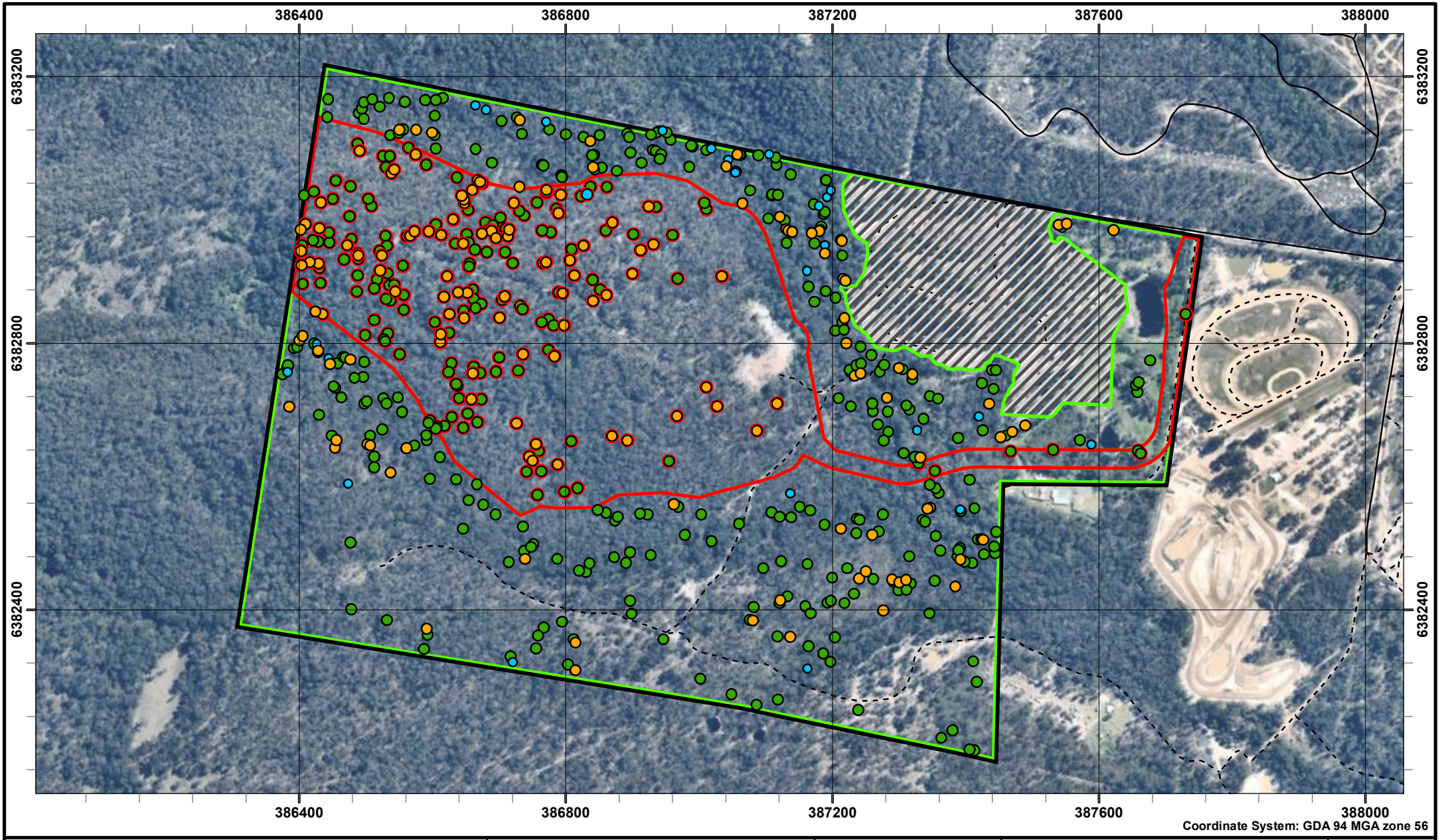
NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

APPENDIX 4: ADDITIONAL SURVEY INFORMATION

The proponent commissioned additional field surveys to collect further information on the density and location of hollow-bearing and habitat trees within the study area. The field survey was conducted on 18, 19, 29 and 30 May 2017 and was undertaken over 47.5 person hours via meander traverses of the study area.

A map showing the location of hollow-bearing and habitat trees recorded during the survey is provided in **Figure 10**.

The Assessment of Significance for the hollow-dependent threatened species known, or having the potential to occur, on site has been reviewed in the context of this new information and is presented in Appendix 6, Threatened Fauna, Hollow-dependent Arboreal Mammals.



- Study Area (100.94 ha)
- Development Site (33.68 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Dead Stag
- Dead Stag - Impacted
- Hollow Log (on ground) - Not Impacted
- Hollow Log (on ground) - Impacted
- Hollow Bearing Tree - Not Impacted
- Hollow Bearing Tree - Impacted

Metres
0 25 50 100 150 200 250

N

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PROJECT REFERENCE: 20173040
DATE DRAWN: 21-Jun-17 15:41 Version 1
DRAWN BY: amarshall
DATA SOURCE:
NSW Land and Property Information - 2011
nearmap - 2016

Habitat Tree Mapping

Eagleton Rock Syndicate Pty Ltd
Biodiversity Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
10

\\newcastle.kleinfelder.com\Newcastle-Data\Company\GIS FOLDER\00 CLIENT FILES\127626_EagleRockTrust\20173040_EagletonRockQuarry\GIS ONLY\MXDs\Figures\BAR\20173040_Fig10_HabTrees.mxd

APPENDIX 5: LIKELIHOOD OF OCCURRENCE

A list of threatened species, populations and ecological communities, and EPBC Act listed migratory species that have been reported or modelled to occur within the locality (i.e. five kilometre radius of the study area) was compiled from the following databases (updated searches undertaken in November 2016):

- NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife: (www.wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp);
- Department of the Environment's (DotE) Protected Matters search tool: (www.environment.gov.au/erin/ert/epbc/index.html);
- Predicted threatened species generated in the biobanking calculator: (ID: 167/2016/3995MP); and
- Threatened species and ecological communities listed in the SEARs.

An assessment was then made of the likelihood of the threatened species, populations, ecological communities, and EPBC Act listed migratory species reported or modelled to occur in the locality occurring within the site or using the habitat within the site as part of a foraging range. EPBC Act-listed marine species were omitted from the results due to lack of suitable habitat and proximity to the coastline. This assessment was based on available habitat requirement data for each threatened species, populations, and ecological communities using the following sources:

- Harden, G.J. (ed) (1992, 1993, 2000, 2002). Flora of New South Wales Volume 1-4. NSW University Press: Sydney;
- James, T., McDougall, L. and Benson, D. (1999). Rare Bushland Plants of Western Sydney. Royal Botanic Gardens Sydney;
- The Office of Environment and Heritage's threatened species website database http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx;
- Van Dyke, S. and Strahan, R. (eds) (2008). The Complete Book of Australian Mammals. Reed New Holland Publishers, Australia;
- Cogger, H.A (ed) (2000). Reptiles and Amphibians of Australia. Reed New Holland Publishers, Australia; and
- Higgins, P. J. *et al*. (1990-2007). Handbook of Australian, New Zealand & Antarctic Birds. Volumes 1 to 7. Oxford University Press Publishers, Melbourne.

Table 16 summarises the likelihood of threatened species, populations and ecological communities, and EPBC Act listed migratory species occurring within the site based on the habitat requirements of each species. A brief definition of the likelihood of occurrence criteria is provided below:

- Known – species identified within the site during surveys;
- High – species known from the area (NPWS Wildlife Atlas records in close proximity to the site), suitable habitat (such as roosting and foraging habitat) present within the site;
- Moderate – species may be known from the area, potential habitat is present within the site;
- Low – species not known from the area and/or marginal habitat is present within the site;
- Nil – habitat requirements not met for this species within the site.

An Assessment of Significance under section 5A of the EP&A was applied to all threatened species and ecological communities assessed as having a moderate, high or known likelihood of occurrence in the development site and which have the potential to be impacted by the proposal in **Appendix 5**. An assessment of species listed as threatened, migratory and/or marine under the EPBC Act 1999 is also provided in **Appendix 5**.

Table 16: Assessment of the likelihood of threatened species, populations, and ecological communities occurring within the study area

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Flora								
Allocasuarina defungens	Dwarf Heath Casuarina	E	E	-	PMST	Typically grows in tall heath on sand, but can also occur on clay soils and sandstone. The known distribution of this species is from north-west of Forster, to Byron Bay on the NSW north coast. **Unsuitable habitat and distribution. No records in the locality. Not detected during the surveys (species is detectable all year).**	Nil	No
Angophora inopina	Charmhaven Apple	V	V	-	PMST	Occurs most frequently in four main vegetation communities: (i) *Eucalyptus haemastoma–Corymbia gummifera–Angophora inopina* woodland/forest; (ii) *Hakea teretifolia–Banksia oblongifolia* wet heath; (iii) *E. resinifera–Melaleuca sieberi–A. inopina* sedge woodland; (iv) *E. capitellata–C. gummifera–A. inopina* woodland/forest. This species is endemic to the Central Coast region of NSW. The known northern limit is near Karuah where a disjunct population occurs; to the south populations extend from Toronto to Charmhaven with the main population occurring between Charmhaven and Morisset. **Marginal potential habitat in the study area. No records in the locality. Not detected during the surveys (detectable all year).**	Low	No
Asperula asthenes	Trailing Woodruff	V	V	1	Atlas, PMST	Typically occurs in damp sites, often along river banks. Found in scattered locations from Bulahdelah north to near Kempsey, with several records from the Port Stephens/Wallis Lakes area. **Potential habitat within the drainage lines and damp areas of the Spotted Gum – Ironbark Forest. Not detected during the targeted surveys which were conducted within the flowering period of this species (Sept-Nov).**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Asterolasia elegans	-	E	E	-	PMST	Occurs on Hawkesbury sandstone. Found in sheltered forests on mid- to lower slopes and valleys (i.e. in or adjacent to gullies which support sheltered forest). Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. **The study area does not contain suitable habitat for this species, and is well outside the known distribution of this species (no records from HCRCMA). Not detected during the surveys.**	Nil	No
Callistemon linearifolius	Netted Bottle Brush	V	-	-	BC	Grows in dry sclerophyll forest on the coast and adjacent ranges. Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. **Potential habitat within the study area. No records of this species in the locality. Not detected during the targeted searches which were undertaken within the flowering period of this species (Sept-Mar).**	Low	No
Commersonia prostrata	Dwarf Kerrawang	E	E	-	PMST	Occurs on sandy, sometimes peaty soils in a wide variety of habitats. In the lower hunter region, this species is found in Scribbly Gum / Swamp Mahogany Ecotonal Forest on the Tomago Sandbeds. **The study area does not contain suitable habitat for this species. Not detected during the surveys.**	Low	No
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	-	PMST, BC	This species does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. **Marginal habitat in the Spotted Gum-Ironbark Forest. No records of this species in the locality. Not detected during 2013 surveys which were conducted within the flowering period of this species (Nov-Feb).**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Cynanchum elegans	White-flowered Wax Plant	E	E	-	BC	Usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree *Leptospermum laevigatum –Banksia integrifolia* subsp. *integrifolia* coastal scrub; *Eucalyptus tereticornis* aligned open forest and woodland; *Corymbia maculata* aligned open forest and woodland; and *Melaleuca armillaris* scrub to open scrub. **Potential marginal habitat within the study area, primarily within the wetter drainage lines. No records in the locality. Not detected during the surveys which were undertaken within the flowering period of this species (Aug-May).**	Low	No
Diuris pedunculata	Small Snake Orchid	E	E	-	BC	Grows on grassy slopes or flats, often on peaty soils in moist areas. Also occurs on shale and trap soils, on fine granite, and among boulders. Confined to north east NSW. It was originally found scattered from Tenterfield south to the Hawkesbury River, but is now mainly found on the New England Tablelands, around Armidale, Uralla, Guyra and Ebor. **Unsuitable distribution. No records in the locality. Not detected during the surveys which were undertaken within the flowering period of this species (Sept-Nov).**	Low	No
Diuris praecox	Sand Doubletail	V	V	-	GHD (2012)	Grows on hills and slopes of near-coastal districts, in open heathy forests which have a grassy to fairly dense understorey between Ourimbah and Nelson Bay in NSW. **While the study area contains potentially suitable habitat, there are no records of this species in the locality. The nearest records occur > 10km to the east of the study area. All records of this species in the Port Stephens LGA occur within approximately 2km of the coastline. Similarly, all records of this species on the central coast occur within 5km of the coastline. As such, it is considered unlikely that the species would occur in the study area. Surveys were undertaken outside the flowering period of this species (Jul-Aug).**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Eucalyptus camfieldii	Camfield's Stringybark	V	V	-	PMST	Occurs on poor coastal country in shallow sandy soils overlying Hawkesbury sandstone typically in coastal heath, mostly on exposed sandy ridges. The species has a restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. **The study area does not contain suitable habitat for this species. Not detected during the surveys (detectable all year).**	Low	No
Eucalyptus glaucina	Slaty Red Gum	V	V	-	BC	Grows in grassy woodland and dry eucalypt forest on deep, moderately fertile and well-watered soils. **Potential habitat within the study area. No records of this species in the locality. Not detected during the surveys (species is detectable all year).**	Low	No
Eucalyptus parramattensis subsp. decadens	Earp's Gum	V	V	-	PMST	The species occurs in dry sclerophyll woodland with a dry heath understory. Essential habitat identified as deep, low-nutrient sands. **The study area does not contain suitable habitat for this species. No records of this species in the locality. Not detected during the surveys (species is detectable all year).**	Low	No
Grevillea guthrieana	Guthrie's Grevillea	E	E	-	BC	Grows along creeks and cliff lines in eucalypt forest, on granitic or sedimentary soil. **Potential marginal habitat within the study area, primarily within the drainage lines. No records in the locality. Not detected during the surveys which were undertaken within the flowering period of this species (Sept-Nov).**	Low	No
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	6	Atlas, PMST, BC	Grows in sandy or light clay soils usually over thin shales where it occurs in a range of vegetation types from heath and shrubby woodland to open forest. **Potential habitat across the study area. Not detected during the targeted surveys which were conducted within the flowering period of this species (Jul-Dec).**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Maundia triglochinoides	-	V	-	2	Atlas	Grows in swamps or shallow freshwater on heavy clay; north from southern Sydney. **Marginal habitat in the 3rd order drainage line in the study area. Not detected during the targeted surveys which were conducted within the flowering period of this species (Nov-Jan).**	Low	No
Melaleuca biconvexa	Biconvex Paperbark	V	V	-	PMST	Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. This species is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. **Potential marginal habitat within the wetter drainage lines in the study area. No records in the locality. Not detected during the surveys (species is detectable all year).**	Low	No
Persicaria elatior	Knotweed	V	V	-	PMST	Rare with very scattered occurrences along coastal NSW and in SE Qld. In damp places, usually on the margin of standing water. **Potential marginal habitat within the drainage lines in the study area. No records in the locality. Not detected during the surveys which were conducted within the flowering period of this species (Dec-Feb).**	Low	No
Phaius australis	Lesser Swamp-orchid	E	E	-	PMST	Occurs in swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas. Occurs in Qld and north-east NSW as far south as Coffs Harbour. **While potential habitat may occur in the study area within the drainage lines and damp areas of the Spotted Gum-Ironbark Forest, the site is well outside the known distribution of this species (no records from HCRCMA). Not detected during the 2016 surveys which were undertaken within the flowering period of this species (Sept-Oct).**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Pterostylis chaetophora	-	V	-	1	Atlas, SEARs	Specific details on its habitat and distribution are poorly known, though it is known to occur in seasonally moist, dry sclerophyll forest with a grass and shrub understorey. The species is known from scattered records between Taree and Kurri Kurri, extending west into the Upper Hunter. **The study area contains potential habitat for this species. Targeted searches were undertaken in October 2016. A known reference population located within approximately 2 km of the study area (location provided by OEH) was surveyed immediately prior to undertaking the searches, which confirmed that the species was flowering in the locality at the time of the survey. The species was not detected during the targeted searches.**	Low	No
Rhizanthella slateri	Eastern Underground Orchid	V	E	-	BC	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed. **Potential habitat across the study area. No records of this species in the locality. Not detected during the 2016 surveys which were undertaken within the flowering period of this species (Sept-Nov).**	Low	No
Tetratheca juncea	Black-eyed Susan	V	V	-	PMST, BC	Usually found in low open forest/woodland with a mixed shrub understory and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. The preferred substrates are sandy skeletal soil on sandstone, sandy-loam soils, low nutrients; and clayey soil from conglomerates, pH neutral. **Marginal potential habitat in the Spotted Gum-Ironbark Forest in the study area. No records of this species in the locality. Not detected during the 2016 targeted searches undertaken within the peak flowering period of this species (Sept-Oct).**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Thesium australe	Austral Toadflax	V	V	-	PMST	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. **Marginal potential habitat in the study area. No records in the locality. Not detected during the 2013 surveys which were undertaken within the flowering period of this species (mid-summer).**	Low	No
Threatened Ecological Communities								
Central Hunter Valley eucalypt woodland forest (EPBC Act)		-	CE	-	PMST	This ecological community is a eucalypt woodland/open forest. It occurs in the Hunter Region—in north-eastern New South Wales, mainly in the Central Hunter Valley—in the Muswellbrook, Singleton and Cessnock LGAs. It typically occurs on lower hillslopes and low ridges, or valley floors in undulating country; on soils derived from finer grained sedimentary rocks. The woodland or forest canopy is dominated by one or more of the following four eucalypt species: *Eucalyptus crebra*, *Corymbia maculata*, *Eucalyptus dawsonii* and *Eucalyptus moluccana*. **The Spotted Gum-Ironbark Forest community in the study area is not consistent with the key diagnostic characteristics of this CEEC as described in the Approved Conservation Advice (Threatened Species Scientific Committee (2015). The relatively consistent distribution of *Eucalyptus fibrosa, E. acmenoides* and *Allocasuarina torulosa* throughout the site is inconsistent with this CEEC. Additionally, the study area occurs on Carboniferous sediments, whereas this CEEC is associated with Permian geology.**	Nil	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (TSC Act) / *Lowland Rainforest of Subtropical Australia* (EPBC Act)		E	CE	-	PMST	This ecological community is a subtropical rainforest and some related, structurally complex forms of dry rainforest, excluding Littoral Rainforest. Lowland Rainforest may be associated with a range of high-nutrient geological substrates, notably basalts and fine-grained sedimentary rocks, on coastal plains and plateau, foot slopes and foothills. A range of plant growth forms are present in Lowland Rainforest, including palms, vines and vascular epiphytes. Scattered eucalypt emergent including; *Eucalyptus grandis* and *E. saligna* may occasionally be present. In disturbed stands of this community the canopy continuity may be broken, or the canopy may be smothered by exotic vines. **No vegetation in the study area is consistent with this EEC/CEEC.**	Nil	No
Amphibians								
Litoria aurea	Green and Golden Bell Frog	E	V	-	PMST, BC	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. **The dams and riparian areas in the study area represent potential marginal habitat for this species. However, there are no records of this species in the locality. There is only one record of this species in the last 20 years in the Port Stephens LGA from 2000 near Tomago, >15km to the south-west of the study area. This species was not detected in the study area during the surveys.**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Litoria brevipalmata	Green-thighed Frog	V	-	-	BC	Breeding typically takes place after heavy summer rains in rainforest and wet sclerophyll forest but also around temporary and semi-permanent ponds, flooded ditches and swamps. In a study by Lemckert *et al.* (2006) it was found that over 90% of breeding sites consisted of ephemeral pools, partly or wholly within rainforest or wet sclerophyll forest. There are however some records from around permanent, artificial ponds within dry sclerophyll forest, and a small number from coastal forests and swamps. Natural depressions adjacent to streams (e.g. old billabongs) are the most commonly used calling sites. The species occurs in isolated localities along the coast and ranges from just north of Wollongong to SE Qld. **The riparian areas in the study area represent potential marginal habitat for this species. However, there are no records of this species in the locality, or the Port Stephens LGA. This species was not detected in the study area during the surveys.**	Low	No
Mixophyes balbus	Stuttering Frog	E	V	-	PMST	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Breed in streams during summer after heavy rain. Outside the breeding season adults live in deep leaf litter and thick understory vegetation on the forest floor. **No suitable habitat in the study area. No records of the species in the locality. This species was not detected during the surveys.**	Low	No
Reptiles								
Hoplocephalus bitorquatus	Pale-headed Snake	V	-	-	BC	Found mainly in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest. Shelters during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees. The species has a patchy distribution from north-east Queensland to the north-eastern quarter of NSW. **While the study area occurs within the known distribution of this species, no records for this species occur within the Port Stephens LGA (nearest records approximately 15 km to north-west near Paterson from 1994). This species was not detected in the study area during the surveys.**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Hoplocephalus bungaroides	Broad-headed Snake	E	V	-	PMST	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 crevices or hollows in large trees within 500m of escarpments in summer. **No suitable habitat for this species identified in the study area (i.e. sandstone rocks and cliffs). No records of this species in the locality.**	Low	No
Aves								
Anthochaera phrygia	Regent Honeyeater	CE	CE, M	-	PMST, BC	Mostly recorded in box-ironbark eucalypt associations. At times of food shortage, the species also uses other woodland types and wet lowland coastal forest dominated by Swamp Mahogany or Spotted Gum. **Potential foraging habitat in the Spotted Gum-Ironbark Forest. Not recorded during the surveys. Habitat usage in the study area is likely to be infrequent as the site is not within a known breeding area and as there are no records of the species in the locality, and only two records in the last 20 years of this species in the Port Stephens LGA.**	**Low-moderate**	**Yes**
Botaurus poiciloptilus	Australasian Bittern	E	E	-	PMST	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.). Hides during the day amongst dense reeds or rushes and feed mainly at night. In NSW they may be found over most of the state except for the far north-west. **No preferred habitat in the study area. Marginal potential habitat in the dams within the study area, although these lack key habitat requirements (i.e. dense aquatic vegetation). No records of this species in the locality.**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Calidris ferruginea	Curlew Sandpiper	E	CE	-	PMST	Generally occupies littoral and estuarine habitats, and in NSW is mainly found on intertidal mudflats of sheltered coasts. **The study area does not contain suitable habitat for this species (estuarine vegetation or mudflats) and is therefore considered unlikely to occur in the study area. No records of this species in the locality.**	Low	No
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	16	Atlas	Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak, Forest She-oak, or Drooping She-oak occur. Uncommon although widespread in suitable forest and woodland habitats, from the central Qld coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW. **The study area contains suitable habitat for this species. Species not detected in the study area during the surveys.**	**Moderate**	**Yes**
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	2	Atlas	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. The species is sedentary and considered to be resident in many locations throughout its range. **Suitable habitat in the study area. Species detected in the study area during the surveys (GHD 2012).**	**Known**	**Yes**
Circus assimilis	Spotted Harrier	V	-	-	PDA (2012)	Occurs in grassy open woodland, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. The species occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges. **Suitable foraging habitat in the study area. Species detected near the study area during the surveys (Debus 2011).**	**High**	**Yes**

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Daphoenositta chrysoptera	Varied Sittella	V	-	1	Atlas	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. **The study area contains suitable habitat for this species. Species not detected in the study area during the surveys.**	**Moderate**	**Yes**
Dasyornis brachypterus	Eastern Bristlebird	E	E	-	PMST	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-east Australia: (1) Northern (southern Qld/northern NSW, (2) Central (Barren Ground NR, Budderoo NR, Woronora Plateau, Jervis Bay NP, Booderee NP and Beecroft Peninsula) and (3) Southern (Nadgee NR and Croajingalong NP in the vicinity of the NSW/Victorian border). In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone. **Unsuitable habitat and distribution. No records of the species in the locality. Not detected in the study area during the surveys.**	Low	No
Dromaius novaehollandiae - endangered population	Emu population, NSW North Coast Bioregion and Port Stephens LGA	EP	-	-	BC	This species occupies a range of predominantly open habitats, including plains, grasslands, woodlands and shrubs, and may occur occasionally in forest. **The forest vegetation across the study area is considered to be unsuitable for this species. This species was not detected in the study area during the surveys.**	Low	No
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	9	Atlas	Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW. Inhabits wetlands and vicinity, prefers open freshwater environs, including margins of billabongs, swamps, shallow floodwaters over grassland, dams, adjacent grassland and savannah woodlands. **The dams in the study area are largely unsuitable for these species due to surrounding forest vegetation and small size. No records in close proximity (<2km) to the study area. Species not detected during the surveys.**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Erythrotriorchis radiatus	Red Goshawk	V	V	-	PMST	Inhabits open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water. Often found in riparian habitats. In NSW, preferred habitats include mixed subtropical rainforest, *Melaleuca* swamp forest and riparian *Eucalyptus* forest of coastal rivers. The species is very rare in NSW, extending south to about 30°S, with most records north of this, in the Clarence River Catchment, and a few around the lower Richmond and Tweed Rivers. Formerly, it was at least occasionally reported as far south as Port Stephens. **While potential habitat is present, the study area occurs outside the current known distribution of the species (north from around Nambucca Heads). No records of the species in the locality. No detected during the surveys.**	Low	No
Falco subniger	Black Falcon	V	-	-	GHD (2012)	Typically inhabits woodland, shrubland and grassland in the arid and semi-arid zones. Nests in riparian woodland remnants. The Black Falcon is widely, but sparsely, distributed in NSW, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of NSW are likely to be referable to the Brown Falcon. In NSW there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres. **Suitable foraging habitat in the study area. Species detected in the study area during the surveys (GHD 2012).**	**Known**	**Yes**
Glossopsitta pusilla	Little Lorikeet	V	-	1	Atlas	Inhabits forests, woodlands, trees along watercourses and paddock trees. **The study area contains suitable habitat for this species. Species not detected in the study area during the surveys.**	**Moderate**	**Yes**

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Grantiella picta	Painted Honeyeater	V	V	-	PMST	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. The greatest concentrations of the species and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. **The study area contains potential marginal habitat for this species. However, there are no records for this species in the locality or the Port Stephens LGA.**	Low	No
Lathamus discolor	Swift Parrot	E	E	-	PMST	This species has been recorded on the mainland from a variety of habitat types including dry and wet sclerophyll forest, forested wetlands, coastal swamp forests and heathlands. **Potential foraging habitat in the study area. No records in the locality. Species not detected during the surveys.**	**Low-moderate**	**Yes**
Lophoictinia isura	Square-tailed Kite	V	-	-	GHD (2012)	Found in a variety of timbered habitats including dry woodlands and open forests, showing a particular preference for timbered watercourses. **Suitable habitat in the study area. Species detected in the study area during the surveys (GHD 2012).**	**Known**	**Yes**
Neophema pulchella	Turquoise Parrot	V	-	1	Atlas	Inhabits the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Prefers eucalypt and cypress-pine open forests and woodlands (commonly box or box-ironbark) with native grasses, sometimes with a low shrubby understorey, often in undulating or rugged country, or on footslopes. The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. **The study area contains potential habitat for this species. However, there are no records of this species within the last 20 years in the Port Stephens LGA. This species was not detected in the study area during the surveys.**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Ninox strenua	Powerful Owl	V	-	2	Atlas	Preferred habitat is tall, moist, productive eucalypt forests with a tall shrub layer and abundant hollows supporting high densities of arboreal mammals. **The study area contains suitable habitat for this species. The species was not detected in the study area during the surveys.**	**Moderate**	**Yes**
Numenius madagascariensis	Eastern Curlew	-	CE, M	-	PMST	Most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. **No suitable habitat in the study area. No records of this species in the locality.**	Low	No
Pandion cristatus	Eastern Osprey	V	M	-	PMST	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. **No suitable habitat in the study area. No records of this species in the locality.**	Low	No
Petroica boodang	Scarlet Robin	V	-	1	Atlas	Inhabits forests, woodlands, denser vegetation when breeding, more open and cleared habitat in Autumn and Winter. **Potential habitat in the study area. Species not detected in the study area during the surveys.**	**Moderate**	**Yes**
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	7	Atlas	Inhabits open forests, woodlands, road verges with grassy groundcover, sparse shrubs. Typically occurs in open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. In NSW, the species occurs on the western slopes of the Great Dividing Range, and on the western plains. It also occurs in woodlands in the Hunter Valley and in several locations on the NSW north coast. **Suitable habitat in the study area. Species detected in the study area during the surveys (GHD 2012).**	**Known**	**Yes**

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Rostratula australis	Australian Painted Snipe	E	E	-	PMST	Inhabits shallow, vegetated, temporary or infrequently filled wetlands. In NSW many records are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys. **No suitable habitat in the study area for this species. No records of the species in the locality. Species not detected during the surveys.**	Low	No
Turnix maculosus	Red-backed Button-quail	V	-	-	BC	This species typically inhabits grasslands, open and savannah woodlands with grassy ground layer, pastures and crops of warm temperate areas. **The vegetation in the study area is considered to be suboptimal for this species. Additionally, there are no records of this species in the locality or the Port Stephens LGA. This species was not detected in the study area during the surveys.**	Low	No
Mammals								
Cercartetus nanus	Eastern Pygmy-possum	V	-	1	Atlas	Found in a broad range of habitats from rainforest through sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. **There is one record for this species within 2km to the north of the study area from 2005. This is also the only record of this species within the Port Stephens LGA. The species is typically associated with an understorey containing heath, banksias or myrtaceous shrubs including Leptospermum spp. As such, the habitat within the development site is considered to be marginally suitable for this species, as the vegetation predominately consists of a grassy understorey with a relatively low abundance of shrubs and midstorey trees. This species was not detected in the study area during the surveys, which used a range of suitable methods including terrestrial and arboreal trapping, hair tubes, and spotlighting.**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	1	Atlas, PMST	Prefers dry forest close to sandstone ridgelines. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands **Suitable foraging habitat in the study area. Species recorded in the study area during the surveys.**	**Known**	**Yes**
Dasyurus maculatus	Spotted-tailed Quoll	V	E	9	Atlas, PMST	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. **Potential habitat in the study area. Species not detected in the study area during the surveys.**	**Moderate**	**Yes**
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	5	Atlas	Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. **Suitable habitat in the study area. Species recorded in the study area during the surveys.**	**Known**	**Yes**
Kerivoula papuensis	Golden-tipped Bat	V	-	-	BC	Found in rainforest and adjacent sclerophyll forest up to 1000 m. Also recorded in tall open forest, *Casuarina*-dominated riparian forest and coastal *Melaleuca* forests. Roost mainly in rainforest gullies on small first- and second-order streams, and will forage within two kilometres of roost sites. **The study area contains potential habitat for this species. However, there are no records of this species in the locality, with only one record in the Port Stephens LGA approximately 7km to the north-west of the study area. This species was not detected in the study area during the surveys.**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Miniopterus australis	Little Bentwing-bat	V	-	68	Atlas	Inhabits moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Roosts in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings. **Suitable foraging habitat in the study area. Species recorded in the study area during the surveys.**	**Known**	**Yes**
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	6	Atlas	Forages in forested habitats. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. **Potential foraging habitat in the study area. Records of the species in the locality. Species not detected in the study area during the surveys.**	**Moderate**	**Yes**
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	5	Atlas	Inhabits dry sclerophyll forest and woodland, where it hunts for insects above the canopy or within clearings at forest edges. This species normally roosts in tree hollows or under loose bark on a variety of tree species. **Suitable habitat in the study area. Species recorded in the study area during the surveys.**	**Known**	**Yes**
Myotis macropus	Southern Myotis	V	-	6	Atlas	Generally roost close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface. **Suitable habitat in the study area. Species recorded in the study area during the surveys.**	**Known**	**Yes**

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Petauroides volans	Greater Glider	-	V	-	PMST	Largely restricted to eucalypt forests and woodlands. It is primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. The distribution may be patchy even in suitable habitat. The greater glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. **Potential marginal habitat in the study area. No records of the species in the locality. Species not detected in the study area during the surveys.**	Low	No
Petaurus australis	Yellow-bellied Glider	V	-	1	Atlas	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Den, often in family groups, in hollows of large trees. Very mobile and occupy large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources. **Potential habitat in the study area. Species not detected in the study area during the surveys.**	**Moderate**	**Yes**
Petaurus norfolcensis	Squirrel Glider	V	-	18	Atlas	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or *Acacia* mid-storey. **Potential habitat in the study area. Species not detected in the study area during the surveys.**	**Moderate**	**Yes**
Planigale maculata	Common Planigale	V	-	-	BC	Inhabits rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. **As this species inhabits a broad range of habitats, the study area contains potential habitat for this species. However, there are no records of this species in the locality or the Port Stephens LGA. This species was not detected in the study area during the surveys.**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Potorous tridactylus	Long-nosed Potoroo	V	V	-	PMST	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. **The vegetation in the study area is largely unsuitable for this species as it prefers a dense understorey. No records of the species in the locality. Species not detected in the study area.**	Low	No
Petrogale penicillata	Brush-tailed Rock Wallaby	-	V	-	PMST	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. **No suitable habitat in the study area. No records of the species in the locality. Species not detected in the study area during the surveys.**	Low	No
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	9	Atlas, BC	Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west of the divide. **The study area contains suitable habitat for this species. There are nine records of this species in the locality, including several within one kilometre to the north of the study area from 2005. This species was not detected in the study area during the surveys, which used a range of suitable methods including terrestrial and arboreal trapping, hair tubes, and spotlighting.**	**Moderate**	**Yes**
Phascolarctos cinereus	Koala	V	V	105	Atlas, PMST, BC	Inhabit eucalypt woodlands and forests with suitable feed tree species. **Suitable habitat in the study area (SEPP 44 listed feed tree species; *Eucalyptus punctata* and *E. tereticornis*). Species detected in the study area during the surveys.**	**Known**	**Yes**
Pseudomys novaehollandiae	New Holland Mouse	V	V	2	Atlas, PMST	Known from coastal dune, heaths and heathy woodlands. **No suitable habitat in the study area for this species. This species was not detected in the study area during the surveys.**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	2	Atlas, PMST	Occurs across a wide range of habitat types along the eastern seaboard of Australia, depending on food availability. Nectar and fruit from myrtaceous and rainforest trees form the major components of their diet. **Suitable foraging habitat in the study area. Species not detected in the study area during the surveys.**	**Moderate**	**Yes**
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	3	Atlas	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. **Potential habitat in the study area. Species not detected in the study area during the surveys.**	**Moderate**	**Yes**
Vespadelus troughtoni	Eastern Cave Bat	V	-	3	Atlas	A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings. **Suitable foraging habitat in the study area. Species detected in the study area during the surveys (Kleinfelder 2013).**	**Known**	**Yes**
Migratory								
Anthochaera phrygia	Regent Honeyeater	CE	CE, M	-	PMST	Mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. The range of this species has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria, and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. **Potential foraging habitat in the Spotted Gum-Ironbark Forest. Not recorded during the surveys. Habitat usage in the study area is likely to be infrequent as the site is not within a known breeding area and as there are no records of the species in the locality, and only two records in the last 20 years of this species in the Port Stephens LGA.**	**Low-moderate**	**Yes**

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Apus pacificus	Fork-tailed Swift	-	M	-	PMST	Forages in low to very high airspace over varied habitat types. **May aerially forage over the study area. Species not detected in the study area during the surveys. No records of the species in the locality.**	Low	No
Ardea ibis	Cattle Egret	-	M	4	Atlas	Inhabits moist pastures, shallow open wetlands. **Potential marginal habitat in the exotic grassland areas and dams in the north-east of the study area. Species not detected in the study area during the surveys.**	Low	No
Cuculus optatus	Oriental Cuckoo	-	M	-	PMST	The species uses a range of vegetated habitats such as monsoon rainforest, wet sclerophyll forest, open woodlands and appears quite often along edges of forests, or ecotones between forest types. **Potential foraging habitat in the study area. Not detected in the study area.**	**Low-moderate**	**Yes**
Gallinago hardwickii	Latham's Snipe	-	M	-	PMST	Inhabits a variety of freshwater wetland types. **Potential marginal habitat in the dams in the north-east of the study area. Species not detected in the study area during the surveys.**	Low	No
Hirundapus caudacutus	White-throated Needletail	-	M	-	Atlas, PMST	Forages in high open spaces over varied habitat types. **May aerially forage over the study area. Species not detected in the study area during the surveys. No records of the species in the locality.**	Low	No
Merops ornatus	Rainbow Bee-eater	-	M	-	PMST	Most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels. **Potential foraging habitat in the study area. Not detected in the study area.**	**Low-moderate**	**Yes**

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Lathamus discolour	Swift Parrot	-	M	-	PMST	The Swift Parrot breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW, this species mostly occurs on the coast and south west slopes. **Potential foraging habitat in the study area. No records in the locality. Species not detected during the surveys.**	**Low - moderate**	**Yes**
Monarcha melanopsis	Black-faced Monarch	-	M	-	PMST	Found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. **Potential foraging habitat in the study area. Not detected in the study area.**	**Low-moderate**	**Yes**
Monarcha trivirgatus	Spectacled Monarch	-	M	-	PMST	The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves. **Potential marginal habitat in the study area. No records in the locality. Species not detected during the surveys.**	Low	No
Motacilla flava	Yellow Wagtail	-	M	-	PMST	Habitat requirements for the Yellow Wagtail are highly variable, but typically include open grassy flats near water. Habitats include open areas with low vegetation such as grasslands, airstrips, pastures, sports fields; damp open areas such as muddy or grassy edges of wetlands, rivers, irrigated farmland, dams, waterholes; sewage farms, sometimes utilise tidal mudflats and edges of mangroves. **Potential foraging habitat in the study area. Not detected in the study area.**	**Low-moderate**	**Yes**
Myiagra cyanoleuca	Satin Flycatcher	-	M	-	PMST	Found in tall forests, preferring wetter habitats such as heavily forested gullies. **Potential foraging habitat in the study area. Not detected in the study area.**	**Low-moderate**	**Yes**

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Numenius madagascariensis	Eastern Curlew	-	CE, M	-	PMST	Most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. **No suitable habitat in the study area. No records of this species in the locality. Not detected during the surveys.**	Low	No
Pandion cristatus	Eastern Osprey	V	M	-	PMST	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. **No suitable habitat in the study area. No records of this species in the locality. Not detected during the surveys.**	Low	No
Rhipidura rufifrons	Rufous Fantail	-	M	-	PMST	Found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. **Suitable habitat in the study area. Species recorded in the study area during the surveys.**	**Known**	**Yes**
Rostratula benghalensis s. lat.	Painted Snipe	-	M	-	PMST	The Australian Painted Snipe's distribution is restricted to Australia. Most records are from the south east, particularly the Murray-Darling Basin, with scattered records across northern Australia and historical records from around the Perth region in Western Australia. In NSW many records are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River and the Clarence and Lower Hunter Valleys. **No suitable habitat in the study area. No records of this species in the locality. Not detected during the surveys.**	Low	No

Scientific Name	Common Name	Legal Status		No. of records	Source	Habitat Preferences	Likelihood of Occurrence	Potential for Impact?
		TSC Act	EPBC Act					
Tringa nebularia	Common Greenshank	-	M	-	PMST	The species occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. **No suitable habitat in the study area. No records of this species in the locality. Not detected during the surveys.**	Low	No

CE = Critically Endangered; E = Endangered; EP = Endangered Population; V = Vulnerable (NSW TSC & Commonwealth EPBC Acts). PMST = EPBC Protected Matters Search; Atlas = NSW Wildlife Atlas; BC = Biobanking Calculator

APPENDIX 6: ASSESSMENTS OF SIGNIFICANCE

Assessments of Significance (TSC Act)

Factors of Assessment

The seven factors considered in the assessment of significance (s5A of EP&A Act) are shown in **Table 17**. The assessments of significance for all threatened species, populations and ecological communities known or considered likely to occur within the study area are provided in the following sub-sections.

Table 17: Factors addressed in the assessment of significance

Factor		Species	Population	Ecological Community
(a)	*in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*	X		
(b)	*in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*		X	
(c)	*in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:* *(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or* *(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction*			X
(d)	*in relation to the habitat of a threatened species, population or ecological community:* *(iii) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and* *(iv) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and* *(v) 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*	X	X	X
(e)	*whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly.*	NA	NA	NA
(f)	*whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan*	X	X	X
(g)	*whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process*	X	X	X

Threatened Fauna

Woodland Birds

- Regent Honeyeater (*Anthochaera phrygia*)
- Glossy Black Cockatoo (*Calyptorhynchus lathami*)
- Brown Treecreeper - eastern subspecies (*Climacteris picumnus victoriae*)
- Varied Sittella (*Daphoenositta chrysoptera*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Swift Parrot (*Lathamus discolor*)
- Scarlet Robin (*Petroica boodang*)
- Grey-crowned Babbler – eastern subspecies (*Pomatostomus temporalis temporalis*)

The Regent Honeyeater was once widespread throughout southeast Australia. Now it is mainly found in limited areas of northeast Victoria and central-east NSW. It has been observed breeding in several areas in north-eastern Victoria (Chiltern district, Killawarra State Forest, Benalla district), and along the western slopes of the Great Dividing Range in NSW (Bundarra-Barraba district, Capertee Valley). Regent Honeyeaters are nomadic feeders and can be found elsewhere throughout its previous range where there is suitable blossom occurring (Franklin *et al.* 1989). This species is mostly recorded in box-ironbark eucalypt associations. They prefer the wettest, most fertile sites within these associations, such as along creek flats, broad river valleys and foothills. In NSW, riparian forests of River Oak (*Casuarina cunninghamiana*), those with Needle-leaf Mistletoe (*Amyema cambagei*), are also important for feeding and breeding. At times of food shortage the birds also use other woodland types and wet lowland coastal forest dominated by Swamp Mahogany (*E. robusta*) or Spotted Gum (*E. maculata*) (Franklin *et al.* 1989; Ley and Williams 1992; Geering and French 1998; Oliver *et al.* 1999). Nectar is the principal food, but sugary exudates from insects are also used (Oliver 1998, 2000).

The Glossy Black-cockatoo is an obligate granivore, feeding exclusively on the seeds of *Allocasuarina* (Clout 1989; Pepper 1996, Pepper *et al.* 2000). The breeding season is through the cooler months of February to July with one egg only being laid (Garnett & Crowley 2000). Habitat includes woodlands dominated by *Allocasuarina*, open sclerophyll forests and woodlands with a midstorey of *Allocasuarina* that are dominated by Eucalyptus or Angophora species (Higgins 1999). Consequently this bird requires a forest habitat containing these trees in sufficient numbers (NPWS 1999; Garnett & Crowley 2000) along with old-growth trees having suitable nesting hollows.

The Brown Treecreeper is a temperate forest and woodland bird species occupying Eucalypt woodland and adjoining vegetation in subcoastal environments and the slopes of the Great Dividing Range (Garnett & Crowley 2000). It is sedentary within permanent territories, breeding in pairs or communally in small groups (Noske 1991). The Brown Treecreeper is an obligate insectivore and forages for insects on the trunks of live trees as well as fallen logs. The species nests most often in hollows (Noske 1991; Blakers *et al.* 1984). The Brown Treecreeper requires mature Eucalypt vegetation with the presence of fallen logs (for foraging) and hollows (for nesting) in dry open forest comprised of fairly sparsely distributed native understorey grasses. The species is generally absent from sites with a dense understorey (Noske 1991; Ekert 2004).

The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands, with a nearly continuous distribution in NSW from the coast to the far west (Higgins and Peter 2002; Barrett *et al.* 2003). It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. It builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and

often re-uses the same fork or tree in successive years. Generation length is estimated as 5 years (Debus and Soderquist 2008).

Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands and have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes (Higgins, 1999).

The Swift Parrot is small migratory parrot (25cm) that breeds in Tasmania and migrates to south-eastern Australia for the winter months. In Tasmania, the species is dependent on Blue Gums (*Eucalyptus globulus*) for both flower nectar and for nesting hollows, of which there has been large scale clearing of these trees in Tasmania over many years (Brereton 1997). On the mainland, the Swift Parrot feed trees include winter flowering species such as Swamp Mahogany (*E. robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*). Commonly used lerp infested trees include Grey Box (*E. macrocarpa*), Grey Box (*E. moluccana*) and Blackbutt (*E. pilularis*) (Brown 1989). Following winter they return to Tasmania where they breed from September to January, nesting in old trees with hollows and feeding in forests dominated by Tasmanian Blue Gum (Barrett *et al.* 2003).

The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. The Scarlet Robin inhabits dry eucalypt forests and woodlands of which the understorey is usually open and grassy with few scattered shrubs. This species may also occasionally occur in mallee or wet forest communities, or in wetlands and tea-tree swamps (OEH, 2016).

The Grey-crowned Babbler is a temperate forest and woodland and tropical woodland bird species (Garnett & Crowley 2000). The Grey-crowned Babbler inhabits open forests and woodlands, requiring an open shrub layer with sparse ground cover and fallen timber and leaf litter (Blakers *et al.* 1984). The species builds and maintain several conspicuous, dome-shaped stick nests. A nest is used as a dormitory for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts. Territories range from one to fifty hectares (usually around ten hectares) and are defended all year (OEH 2016).

(a) Effect on life cycle	The Spotted Gum-Ironbark Forest vegetation in the study area is suitable foraging and/or nesting habitat for these species. The study area also contains hollow-bearing trees with small to medium sized hollows, which would provide potential nesting habitat for the Little Lorikeet and Brown Treecreeper. Two threatened woodland bird species (Brown Treecreeper and Grey-crowned Babbler) were recorded in the study area by GHD (2012). The remaining species (Varied Sittella, Little Lorikeet, Swift Parrot, Regent Honeyeater, Glossy Black-cockatoo and Scarlet Robin) were not detected during the surveys. The proposal would remove approximately 32.03 ha of suitable habitat for these species. The proposal has the potential to reduce the viability of these species in the locality through loss of suitable foraging and/or breeding habitat, particularly the Brown Treecreeper and Grey-crowned Babbler which were both recorded in the study area and are sedentary species. However, considering these species inhabit a variety of vegetation types, and the relatively large areas of similar habitat for these species adjoining the development site, it is considered unlikely that the proposal would have an adverse effect on the life cycle of this species such that a viable local population would be placed at risk of extinction. Based on available vegetation mapping (Sivertsen *et al.* 2011) and aerial photo interpretation, the proposed development would remove a relatively small proportion (estimated <5%; at least 700 ha of Spotted Gum-Ironbark Forest vegetation mapped in outer assessment circle) of suitable forest habitat for these species that is contiguous with the study area.

(d) (i) Habitat Removal	The proposal would result in the removal of approximately 32.03 ha of suitable habitat for these species. The removal of this small area of vegetation for the proposal does not represent a significant reduction in the extent of similar forest habitat contiguous with the development site for these species such that their local occurrence would be placed at risk of extinction.
(d) (ii) Habitat Fragmentation	The proposed development site forms part of a larger forested corridor that runs north-south between the Pacific Highway to the east, and cleared grassland/wetlands to the west adjacent to the Williams River. While the proposal would reduce habitat connectivity for these species in the study area, it would not reduce the overall east-west width of this corridor. The proposal would also maintain vegetation connectivity through the north-east part of the site. Considering these woodland bird species are highly mobile, and as connectivity of the remaining vegetation in the study area with adjoining vegetation would be maintained, the proposal is considered unlikely to substantially fragment or isolate habitat in the locality for these species.
(d) (iii) Habitat importance	Considering the relatively large areas of similar habitat on adjacent lands which are contiguous with the study area, the removal of the 32.03 ha of forest vegetation for the proposal does not represent a significant reduction in important potential available habitat for these species. In relation to the Brown Treecreeper and Grey-crowned Babbler which were previously recorded in the study area (GHD 2012), the habitat in the development site is not considered critical to the survival of these species in the locality considering the large areas of similar habitat adjoining the site, and given widespread distribution of records for these species in the lower hunter region.
(f) Recovery Plan	In respect of the objectives of the National Recovery Plan for the Regent Honeyeater (Geering and Ingwersen 2009), the proposed development is inconsistent as it involves further reduction in the availability of potential foraging habitat. For the remaining threatened woodland bird species, there was no draft or final recovery plan in place at the time of survey and none of the threat abatement plans are relevant to these species.
(g) KTP	The proposal would contribute to three key threatening processes relevant to these species: 'Clearing of native vegetation', 'Removal of dead wood and dead trees', and 'Loss of hollow-bearing trees'.
Conclusion	The proposal is considered unlikely to have a significant impact on a local population of these species as: • Approximately 63% of habitat in the study area for these species would be retained. • The area of habitat to be removed is relatively small in the context of the extent of similar habitat that is contiguous with the development site (estimated <5%). • The proposal would not isolate or substantially fragment habitat for these species in the study area or locality.

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Forest Owls

- Powerful Owl (*Ninox strenua*)

The Powerful Owl is a large (60 cm) forest owl that inhabits forest and woodlands of the coastal, escarpment, tablelands and western slopes in NSW (Kavanagh 2002). Habitat for the Powerful Owl comprises tall, moist productive eucalypt forests and a mosaic of wet and dry sclerophyll occurring on undulating, gentles terrain near the coast. Optimal habitat includes a tall, shrub layer and abundant hollows supporting high densities of arboreal mammals (DEC 2006). The Powerful Owl roosts in dense mid-canopy trees or tall shrubs in sheltered gullies, while nesting occurs in hollows of old eucalypts in unlogged, unburnt gullies and lower slopes within 100m of streams or minor drainage lines (DEC 2006). The home range of the Powerful Owl is variable, depending on habitat productivity, however, is generally between 300 and 1500 ha (Kavanagh 1997).

(a) Effect on life cycle	The Spotted Gum-Ironbark Forest vegetation in the study area represents suitable foraging and roosting habitat for this species. The study area also contains a low abundance of hollow-bearing trees with large-sized hollows which would provide potential nesting habitat for this species. The proposal would remove approximately 32.03 ha of suitable habitat for this species. Considering this species was not recorded in the study area during the surveys, and as there are relatively large areas of similar habitat for this species adjoining the development site, it is considered unlikely that the proposal would have an adverse effect on the life cycle of this species such that a viable local population would be placed at risk of extinction. Based on available vegetation mapping (Sivertsen *et al.* 2011) and aerial photo interpretation, the proposed development would remove a relatively small proportion (estimated <5%; at least 700 ha of Spotted Gum-Ironbark Forest vegetation mapped in outer assessment circle) of similar forest habitat for this species that is contiguous with the study area.
(d) (i) Habitat Removal	The proposal would result in the removal of approximately 32.03 ha of suitable habitat for this species. The removal of this small area of vegetation for the proposal does not represent a significant reduction in the extent of similar forest habitat contiguous with the development site for this species such that its local occurrence would be placed at risk of extinction.
(d) (ii) Habitat Fragmentation	The proposed development site forms part of a larger forested corridor that runs north-south between the Pacific Highway to the east, and cleared grassland/wetlands to the west adjacent to the Williams River. While the proposal would reduce habitat connectivity for this species in the study area, it would not reduce the overall east-west width of this corridor. The proposal would also maintain vegetation connectivity through the north-east part of the site. Considering this species is highly mobile and occupies a large home range, and as connectivity of the remaining vegetation in the study area with adjoining vegetation would be maintained, the proposal is considered unlikely to substantially fragment or isolate habitat in the locality for this species.
(d) (iii) Habitat importance	Considering the relatively large areas of similar habitat on adjacent lands which are contiguous with the study area, the removal of the 32.03 ha of forest vegetation for the proposal does not represent a significant reduction in important potential available habitat for this species.
(f) Recovery Plan	In respect of the objectives of the recovery plan for the Powerful Owl (DEC 2006), the proposed development would further contribute to the loss of foraging habitat for this species. No threat abatement plan is relevant to this species.
(g) KTP	The proposal would contribute to three key threatening processes relevant to this species: 'Clearing of native vegetation', 'Removal of dead wood and dead trees', and 'Loss of hollow-bearing trees'.

Conclusion	The proposal is considered unlikely to have a significant impact on a local population of this species as: • The species was not recorded in the study area during the surveys. • Approximately 63% of forest habitat in the study area for this species would be retained. • The area of habitat to be removed is relatively small in the context of the extent of similar habitat that is contiguous with the development site (estimated <5%). • The proposal would not fragment or isolate habitat for this species in the study area or locality.

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Raptors

- Spotted Harrier (*Circus assimilis*)
- Black Falcon (*Falco subniger*)
- Square-tailed Kite (*Lophoictinia isura*)

The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania (Barrett *et al.* 2003). Individuals disperse widely in NSW and comprise a single population. The Spotted Harrier occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods) (Marchant and Higgins 1993; Aumann 2001). It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. The species builds a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months. Generation length is estimated as 10 years (Debus and Soderquist 2008).

The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring.

The Square-tailed Kite is a large raptor that occurs in temperate and tropical forest and woodlands including the coastal regions across Australia. This species has been recorded in most parts of Australia

with the exception of the extremely arid centre (Barrett *et al.* 2003). The species prefers ridge and gully forests dominated by *Eucalyptus*, *Angophora* and *Acacia* scrub and patches of low open eucalypt woodland and coastal heath. The Square-tailed Kite usually nests along or near watercourses or in forest gullies. Nests are large platforms of sticks usually situated in the fork or limb of a large tree. The species prefers to hunt singly in *Eucalypt* open forest and woodland (Debus and Czechura 1989), where it feeds on small birds, foliage insects and sometimes on small mammals and lizards.

(a) Effect on life cycle	The Spotted Gum-Ironbark Forest vegetation in the study area represents suitable habitat for these species. Both the Black Falcon and Square-tailed Kite were recorded in the study area by GHD (2012). The Spotted Harrier was observed nearby the study area by Debus (2011). No nests of these species were observed in the study area during the surveys. The proposal would remove approximately 32.03 ha of suitable foraging and potential nesting habitat for these species. Considering these species are highly mobile, and the relatively large areas of similar habitat for these species adjoining the development site, it is considered unlikely that the proposal would have an adverse effect on the life cycle of these species such that a viable local population would be placed at risk of extinction. Based on available vegetation mapping (Sivertsen *et al.* 2011) and aerial photo interpretation, the proposed development would remove a relatively small proportion (estimated <5%; at least 700 ha of Spotted Gum-Ironbark Forest vegetation mapped in outer assessment circle) of similar forest habitat for these species that is contiguous with the study area.
(d) (i) Habitat Removal	The proposal would result in the removal of approximately 32.03 ha of suitable foraging habitat and potential nesting habitat for these species. The removal of this small area of vegetation for the proposal does not represent a significant reduction in the extent of similar forest habitat contiguous with the development site for these species such that their local occurrence would be placed at risk of extinction.
(d) (ii) Habitat Fragmentation	The proposed development site forms part of a larger forested corridor that runs north-south between the Pacific Highway to the east, and cleared grassland/wetlands to the west adjacent to the Williams River. While the proposal would reduce habitat connectivity for these species in the study area, it would not reduce the overall east-west width of this corridor. The proposal would also maintain vegetation connectivity through the north-east part of the site. Considering these species are highly mobile, and as connectivity of the remaining vegetation in the study area with adjoining vegetation would be maintained, the proposal is considered unlikely to substantially fragment or isolate habitat in the locality for these species.
(d) (iii) Habitat importance	Considering the relatively large areas of similar habitat on adjacent lands which are contiguous with the study area, the removal of the 32.03 ha of forest vegetation for the proposal does not represent a significant reduction in important potential available habitat for these species.
(f) Recovery Plan	No recovery plans had been prepared for these species at the time of reporting. No threat abatement plans are relevant to these species.
(g) KTP	The proposal would contribute to one key threatening process relevant to these species: 'Clearing of native vegetation'.
Conclusion	The proposal is considered unlikely to have a significant impact on a local population of this species as: • Approximately 63% of forest habitat in the study area for these species would be retained. • The area of habitat to be removed is relatively small in the context of the extent of similar forest habitat that is contiguous with the development site (estimated <5%). • The proposal would not fragment or isolate habitat for these species in the study area or locality.

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Tree-roosting Insectivorous Bats

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Southern Myotis (*Myotis macropus*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)

Preferred habitat for the Eastern False Pipistrelle appears to be moist habitats, with trees taller than 20 m (Churchill 1998). Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. It hunts beetles, moths, weevils and other flying insects above or just below the tree canopy. It is a bat that hibernates in the colder winter period of the southern part of its range (Phillips 1995). Females are pregnant in late spring to early summer.

The Eastern Freetail Bat occurs in a thin coastal band between the Sydney district and Brisbane. Little is known of the habits or the preferred habitat of this species, although it is apparent that it does inhabit dry sclerophyll forest and woodland, where it hunts for insects above the canopy or within clearings at forest edges. This species normally roosts in tree hollows or under loose bark on a variety of tree species (Churchill 1998; Allison & Hoye 1995).

The Southern Myotis (also known as the Fishing Bat) can be found within 100 km of the coast from the Kimberly in Western Australia to south-eastern South Australia. Foraging is commonly over water with the bats skimming the surface and using their large hind feet to scoop aquatic insects and even small fish. They can be found roosting in a variety of locations that include caves, bridges, tree hollows, and even dense foliage (Churchill 1998, Richards 1995). This species particularly favours large, moving streams at low altitudes (Anderson *et al.* 2006).

The Greater Broad-nosed Bat occurs along the coast and ranges of eastern Australia, from northern Queensland to the New South Wales/Victorian border. This bat appears to be most frequent in the river systems draining the Great Dividing Range. Tree-lined creeks, and the junctions of woodland and cleared paddocks, are favoured hunting areas for the Greater Broad-nosed Bat, although it may also forage in rainforest environments, flying as low as one metre above the surface of a creek. The species normally roosts in tree hollows, but roosting records in the ceilings of old buildings also exist (Churchill 1998; Hoye & Richards 1995).

(a) Effect on life cycle	The Spotted Gum-Ironbark Forest vegetation in the study area represents suitable foraging and/or roosting habitat (i.e. hollow-bearing trees) for these species. Three of these species, Eastern False Pipistrelle, Eastern Freetail-bat and Southern Myotis, were recorded in the study area during the surveys. The Greater Broad-nosed Bat was not detected in the study area during the surveys. The proposal would remove approximately 32.03 ha of suitable habitat for the Eastern False Pipistrelle, Eastern Freetail-bat and Greater Broad-nosed Bat, and 16.46 ha of suitable habitat for the Southern Myotis (see Section 1.4.2.3 for details). Considering these species inhabit a variety of vegetation types, are highly mobile, and the relatively large areas of similar habitat for these species adjoining the development site, it is considered unlikely that the proposal would have an adverse effect on the life cycle of these species such that a viable local population would be placed at risk of extinction. Based on available vegetation mapping (Sivertsen *et al.* 2011) and aerial photo interpretation, the proposed development would remove a relatively small proportion (estimated <5%; at least 700 ha of Spotted Gum-Ironbark Forest vegetation mapped in outer assessment circle) of suitable forest habitat for these species that is contiguous with the study area.
(d) (i) Habitat Removal	The proposal would result in the removal of approximately 32.03 ha of suitable habitat for these species (16.46 ha of the Southern Myotis). The removal of this small area of vegetation for the proposal does not represent a significant reduction in the extent of similar forest habitat contiguous with the development site for these species such that their local occurrence would be placed at risk of extinction.
(d) (ii) Habitat Fragmentation	The proposed development site forms part of a larger forested corridor that runs north-south between the Pacific Highway to the east, and cleared grassland/wetlands to the west adjacent to the Williams River. While the proposal would reduce habitat connectivity for these species in the study area, it would not reduce the overall east-west width of this corridor. The proposal would also maintain vegetation connectivity through the north-east part of the site. Considering these species are highly mobile, and as connectivity of the remaining vegetation in the study area with adjoining vegetation would be maintained, the proposal is considered unlikely to substantially fragment or isolate habitat in the locality for these species.
(d) (iii) Habitat importance	Considering the relatively large areas of similar habitat on adjacent lands which are contiguous with the study area, and the widespread distribution of records for these species in the lower hunter, the removal of the 32.03 ha of forest vegetation for the proposal does not represent a significant reduction in important potential available habitat for these species.
(f) Recovery Plan	No recovery plans had been prepared for these species at the time of reporting. No threat abatement plans are relevant to these species.
(g) KTP	The proposal would contribute to three key threatening processes relevant to these species: 'Clearing of native vegetation', 'Removal of dead wood and dead trees', and 'Loss of hollow-bearing trees'.
Conclusion	The proposal is considered unlikely to have a significant impact on a local population of these species as: • Approximately 63% of habitat in the study area for the Eastern False Pipistrelle, Eastern Freetail-bat and Greater Broad-nosed Bat would be retained. • Approximately 69% of habitat in the study area for the Southern Myotis would be retained. • The area of habitat to be removed is relatively small in the context of the extent of similar habitat that is contiguous with the development site (estimated <5%). • The proposal would not isolate or substantially fragment habitat for these species in the study area or locality.

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Cave-dwelling Microchiropteran Bats

- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Little Bentwing-bat (*Miniopterus australis*)
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)
- Eastern Cave Bat (*Vespadelus troughtoni*)

The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands (Hoye and Dwyer 1995; Parnaby 1992). It is generally rare with a very patchy distribution in NSW. This species inhabits moderately well-wooded habitats, where daytime roosts have been recorded in caves, mine tunnels and the abandoned mud nests of Fairy Martins (*Petrochelidon ariel*) (Hoye & Dwyer 1995; Pennay 2008).

The Little Bentwing-bat occurs along the east coast of Australia from Cape York south to coastal northern NSW. The species also occurs in New Caledonia, New Guinea, the Philippines, and the Indo-Malayan archipelago. The Little Bent-wing Bat generally occupies well-wooded habitats throughout its range, roosting during the day in caves and similar locations. As with other Bentwing-bats, this species depends on specific nursery sites in which to raise its young, and only five of these sites were known of in 1983. In central Queensland one of these nursery colonies numbers 100,000 adult bats. They forage for insects in generally well-wooded habitat of a variety of forms from swamp forest, dry forest to rain forest (Churchill 1998, Dwyer 1995a).

The Eastern Bentwing-bat is widely distributed on the coast and ranges of eastern Australia, from Cape York Peninsula, south to Victoria and eastern South Australia. The species is also present in northern Western Australia and the Northern Territory. Within New South Wales, it extends from the coast to the western slopes of the Great Dividing Range. These bats roost in caves and man-made structures such as culverts, mine shafts and farm sheds. They are territorial, moving within a 300 km radius of a maternity cave. They forage for insects in generally well-wooded habitat of a variety of forms from swamp forest, dry forest to rain forest (Churchill 1998, Dwyer 1995b).

The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW (Parnaby 1995; Menkhorst & Knight 2001; Churchill). It is a cave-dwelling species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs but is occasionally found along cliff-lines in wet eucalypt forest and rainforest. The Eastern Cave Bat has been recorded roosting near the entrances of relatively well-lit sandstone overhangs, caves, disused mine workings and infrequently in buildings. It is usually recorded roosting in small groups but occasionally occurs in colonies of up to 500 individuals (Parnaby 1995; Churchill 1998).

(a) Effect on life cycle	The Spotted Gum-Ironbark Forest vegetation in the study area represents suitable foraging habitat for these species. Three of these species, Large-eared Pied Bat, Little Bentwing-bat and Eastern Cave Bat, were recorded in the study area during the surveys. The Eastern Bentwing-bat was not detected in the study area during the surveys. The proposal would remove approximately 32.03 ha of suitable foraging habitat for these species. Considering these species inhabit a variety of vegetation types, are highly mobile, and the relatively large areas of similar foraging habitat for these species adjoining the development site, it is considered unlikely that the proposal would have an adverse effect on the life cycle of these species such that a viable local population would be placed at risk of extinction. Based on available vegetation mapping (Sivertsen *et al.* 2011) and aerial photo interpretation, the proposed development would remove a relatively small proportion (estimated <5%; at least 700 ha of Spotted Gum-Ironbark Forest vegetation mapped in outer assessment circle) of suitable forest habitat for these species that is contiguous with the study area.
(d) (i) Habitat Removal	The proposal would result in the removal of approximately 32.03 ha of suitable foraging habitat for these species. The removal of this small area of vegetation for the proposal does not represent a significant reduction in the extent of similar forest habitat contiguous with the development site for these species such that their local occurrence would be placed at risk of extinction.
(d) (ii) Habitat Fragmentation	The proposed development site forms part of a larger forested corridor that runs north-south between the Pacific Highway to the east, and cleared grassland/wetlands to the west adjacent to the Williams River. While the proposal would reduce habitat connectivity for these species in the study area, it would not reduce the overall east-west width of this corridor. The proposal would also maintain vegetation connectivity through the north-east part of the site. Considering these species are highly mobile, and as connectivity of the remaining vegetation in the study area with adjoining vegetation would be maintained, the proposal is considered unlikely to substantially fragment or isolate habitat in the locality for these species.
(d) (iii) Habitat importance	Considering the relatively large areas of similar habitat on adjacent lands which are contiguous with the study area, and the widespread distribution of records for these species in the lower hunter, the removal of the 32.03 ha of forest vegetation for the proposal does not represent a significant reduction in important potential available habitat for these species.
(f) Recovery Plan	In respect of the national recovery plan for the Large-eared Pied Bat (DERM 2011), the proposed development would not contravene the objectives of this plan. For the remaining species, no recovery plans had been prepared for these species at the time of reporting. No threat abatement plans are relevant to these species.
(g) KTP	The proposal would contribute to one key threatening process relevant to these species: 'Clearing of native vegetation'.
Conclusion	The proposal is considered unlikely to have a significant impact on a local population of these species as: • No roosting or breeding habitat for these species is present in the development site. • Approximately 63% of foraging habitat in the study area for these species would be retained. • The area of habitat to be removed is relatively small in the context of the extent of similar habitat that is contiguous with the development site (estimated <5%). • The proposal would not isolate or substantially fragment habitat for these species in the study area or locality.

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Grey-headed Flying-fox (*Pteropus poliocephalus*)

The Grey-headed Flying-fox occurs along the eastern seaboard of Australia roosting in large communal aggregations known as 'camps'. These camps are used permanently, annually, or occasionally, varying in size from hundreds to many thousands of individuals, fluctuating according to food resources (Ebby and Law, 2008; Parry-Jones & Augee, 1991; Tidemann, 1995). This species forages on nectar and pollen from flowers of canopy trees (particularly *Eucalyptus, Melaleuca* and *Banksia*) and fleshy fruits from rainforest trees and vines. This species is highly mobile, dispersing to sites as far as 40 km to forage and returning to the camp in one night, and seasonally they may move hundreds of kilometres in response to variation in food resource productivity which largely explains the extensive migration movement of this species (Ebby and Law, 2008).

(a) Effect on life cycle	The Spotted Gum-Ironbark Forest vegetation in the study area represents suitable foraging habitat for this species. This species was not detected in the study area during the surveys, and no Grey-headed Flying-fox camps were identified. The proposal would remove approximately 32.03 ha of suitable foraging habitat for this species. Considering this species inhabits a variety of vegetation types, is highly mobile, and the relatively large areas of similar foraging habitat for this species adjoining the development site, it is considered unlikely that the proposal would have an adverse effect on the life cycle of this species such that a viable local population would be placed at risk of extinction. Based on available vegetation mapping (Sivertsen *et al.* 2011) and aerial photo interpretation, the proposed development would remove a relatively small proportion (estimated <5%; at least 700 ha of Spotted Gum-Ironbark Forest vegetation mapped in outer assessment circle of suitable forest habitat for this species that is contiguous with the study area.
(d) (i) Habitat Removal	The proposal would result in the removal of approximately 32.03 ha of suitable foraging habitat for this species. The removal of this small area of vegetation for the proposal does not represent a significant reduction in the extent of similar forest habitat contiguous with the development site for this species such that its local occurrence would be placed at risk of extinction.

(d) (ii) Habitat Fragmentation	The proposed development site forms part of a larger forested corridor that runs north-south between the Pacific Highway to the east, and cleared grassland/wetlands to the west adjacent to the Williams River. While the proposal would reduce habitat connectivity for this species in the study area, it would not reduce the overall east-west width of this corridor. The proposal would also maintain vegetation connectivity through the north-east part of the site. Considering this species is highly mobile, and as connectivity of the remaining vegetation in the study area with adjoining vegetation would be maintained, the proposal is considered unlikely to substantially fragment or isolate habitat in the locality for this species.
(d) (iii) Habitat importance	Considering the relatively large areas of similar habitat on adjacent lands which are contiguous with the study area, and the widespread distribution of records for this species in the lower hunter, the removal of the 32.03 ha of forest vegetation for the proposal does not represent a significant reduction in important potential available habitat for this species.
(f) Recovery Plan	A Draft National Recovery Plan (DECCW 2008) has been prepared for this species. The proposed removal of foraging habitat is not consistent with Objective 2; "*To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes*". No threat abatement plans are relevant to this species.
(g) KTP	The proposal would contribute to one key threatening process relevant to this species: 'Clearing of native vegetation'.
Conclusion	The proposal is considered unlikely to have a significant impact on a local population of this species as: • This species was not detected in the study area. • Approximately 63% of foraging habitat in the study area for this species would be retained. • The area of habitat to be removed is relatively small in the context of the extent of similar habitat that is contiguous with the development site (estimated <5%). • The proposal would not isolate or substantially fragment habitat for this species in the study area or locality.

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Spotted-tailed Quoll (*Dasyurus maculatus*)

The Spotted-tailed Quoll has been reported from a wide range of habitat types, including rainforest, wet and dry sclerophyll forest, woodland, coastal heathland, as well as along riparian forests in the inland. Spotted-tailed Quolls are generally solitary, nocturnal, and semi-arboreal species, occupying home-ranges of between 750 and 3,500 ha. Den and nest sites for the Spotted-tailed Quoll have been recorded in caves, rock crevices, tree hollows, and hollow logs (Edgar & Belcher 1995; Lunney & Matthews 2001). The Spotted-tailed Quoll is mostly nocturnal, although will hunt during the day, and consumes a variety of prey including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects; also eats carrion and takes domestic fowl.

(a) Effect on life cycle	The Spotted Gum-Ironbark Forest vegetation in the study area represents suitable foraging habitat for this species. The study area also contains a low abundance of hollow-bearing trees with large-sized hollows which would provide potential den sites for this species. The proposal would remove approximately 32.03 ha of potential habitat for this species. Considering this species was not recorded in the study area during the surveys, and as there are relatively large areas of similar habitat for this species adjoining the development site, it is considered unlikely that the proposal would have an adverse effect on the life cycle of this species such that a viable local population would be placed at risk of extinction. Based on available vegetation mapping (Sivertsen *et al.* 2011) and aerial photo interpretation, the proposed development would remove a relatively small proportion (estimated <5%; at least 700 ha of Spotted Gum-Ironbark Forest vegetation mapped in outer assessment circle) of similar forest habitat for this species that is contiguous with the study area.
(d) (i) Habitat Removal	The proposal would result in the removal of approximately 32.03 ha of potential habitat for this species. The removal of this small area of vegetation for the proposal does not represent a significant reduction in the extent of similar forest habitat contiguous with the development site for this species such that its local occurrence would be placed at risk of extinction.
(d) (ii) Habitat Fragmentation	The proposed development site forms part of a larger forested corridor that runs north-south between the Pacific Highway to the east, and cleared grassland/wetlands to the west adjacent to the Williams River. While the proposal would reduce habitat connectivity for this species in the study area, it would not reduce the overall east-west width of this corridor. The proposal would also maintain vegetation connectivity through the north-east part of the site. Considering this species occupies a large home range, and as connectivity of the remaining vegetation in the study area with adjoining vegetation would be maintained, the proposal is considered unlikely to substantially fragment or isolate habitat in the locality for this species.
(d) (iii) Habitat importance	Considering this species was not recorded in the study area, and the relatively large areas of similar habitat on adjacent lands which are contiguous with the study area, the removal of the 32.03 ha of forest vegetation for the proposal does not represent a significant reduction in important potential available habitat for this species.
(f) Recovery Plan	A draft national recovery plan has been prepared for this species (Long and Nelson 2008). The proposal would not contravene the objectives of this plan. No threat abatement plan is relevant to this species.
(g) KTP	The proposal would contribute to three key threatening processes relevant to this species: 'Clearing of native vegetation', 'Removal of dead wood and dead trees', and 'Loss of hollow-bearing trees'.
Conclusion	The proposal is considered unlikely to have a significant impact on a local population of this species as: • The species was not recorded in the study area during the surveys. • Approximately 63% of forest habitat in the study area for this species would be retained. • The area of habitat to be removed is relatively small in the context of the extent of similar habitat that is contiguous with the development site (estimated <5%). • The proposal would not fragment or isolate habitat for this species in the study area or locality.

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Hollow-dependent Arboreal Mammals

- Yellow-bellied Glider (*Petaurus australis*)
- Squirrel Glider (*Petaurus norfolcensis*)
- Brush-tailed Phascogale (*Phascogale tapoatafa*)

The Yellow-bellied Glider can be found in mid dense to closed forest in which the trees are of sufficient age to have developed suitable hollows for the gliders to nest in. In undisturbed habitat these gliders will maintain their presence in the same area for many years. The diet of the Yellow-bellied Glider consists of invertebrates, nectar and pollen from blossoming eucalypts in particular, although they are primarily exudate feeders feeding on sap from selected trees, which they obtain by gnawing grooves in the bark of the tree. The home range of these gliders has been estimated at 35 hectares and they will travel up to 2 kilometres in a night of foraging (Carthew *et al.* 1999; Russell 1995).

The Squirrel Glider inhabits dry sclerophyll forest and woodland, and is generally absent from the dense coastal ranges. The Squirrel Glider has a specialised diet comprised of nectar, pollen and gum exudates particularly from wattles. The Squirrel Glider requires hollows in standing trees for roosting and nesting purposes and has a home range of 2-3ha to 13ha (Quinn 1995; Rowston 1998; Suckling 1995).

The Brush-tailed Phascogale prefers dry sclerophyll open forest with a sparse groundcover of herbs, grasses, shrubs or leaf litter. However, it is also known to inhabit heath, swamps, rainforest and wet sclerophyll forest. The Brush-tailed Phascogale nests and shelters in tree hollows with entrances 2.5 - 4 cm wide and use many different hollows over a short time span. Females have exclusive territories of approximately 20 - 40 ha, while males have overlapping territories often greater than 100 ha. This species feeds mostly on arthropods but will also eat other invertebrates, nectar and sometimes small vertebrates (OEH 2016).

(a) Effect on life cycle	The Spotted Gum-Ironbark Forest vegetation in the study area represents suitable habitat for these species. The study area contains a low to moderate abundance of hollow-bearing trees that would provide potential nesting/sheltering habitat for these species. Records for both the Squirrel Glider and Brush-tailed Phascogale occur within 2km of the site. However, none of these species were recorded in the study area during the surveys. The results of the hollow-bearing tree survey (Appendix 4) indicate that the loss of hollow-bearing trees (live trees and dead stags) is estimated at 38% of the total hollow-bearing tree resource available within the study area (Figure 10). The average density of hollow-bearing trees within the development site is estimated at 6 trees/ha, which is the same as the mapped density within the proposed offset area. The proposal would remove approximately 32.03 ha of suitable habitat for these species. Considering these species were not detected in the study area, and the relatively large areas of similar habitat for these species adjoining the development site, it is considered unlikely that the proposal would have an adverse effect on the life cycle of these species such that a viable local population would be placed at risk of extinction. Based on available vegetation mapping (Sivertsen *et al.* 2011) and aerial photo interpretation, the proposed development would remove a relatively small proportion (estimated <5%; at least 700 ha of Spotted Gum-Ironbark Forest vegetation mapped in outer assessment circle) of suitable forest habitat for these species that is contiguous with the study area.

(d) (i) Habitat Removal	The proposal would result in the removal of approximately 32.03 ha of suitable habitat for these species including 38% of the mapped hollow-bearing tree resource within the study area. The removal of this small area of vegetation for the proposal does not represent a significant reduction in the extent of similar forest habitat contiguous with the development site for these species such that their local occurrence would be placed at risk of extinction.
(d) (ii) Habitat Fragmentation	The proposed development site forms part of a larger forested corridor that runs north-south between the Pacific Highway to the east, and cleared grassland/wetlands to the west adjacent to the Williams River. While the proposal would reduce habitat connectivity for this species in the study area, it would not reduce the overall east-west width of this corridor. The proposal would also maintain vegetation connectivity through the north-east part of the site. Squirrel Gliders are agile climbers and typical gliding distances range between 20-30 m (and up to 50 m) (Goldingay and Taylor 2009). Based on average glide angle, it is predicted that trees beside roads would need to be approximately 13 m tall to facilitate glider movement across a 20 m gap (Goldingay and Taylor 2009). Yellow-bellied Gliders can also glide larger distances, up to 140 m (NPWS 2003). Given the areas of potential habitat for this species adjoining the proposed haul road typically have a canopy of approximately 10-15 m tall and as the proposed road width would be approximately 15m it is considered unlikely that the proposal would substantially fragment or isolate habitat, or significantly impede movement of these glider species across the study area. The Brush-tailed Phascogale is also an agile species that can traverse short distances of cleared areas (e.g. road) between patches of forest habitat. As this species is nocturnal and the proposed quarry will not be operational at night, vehicle strike is considered unlikely. Considering connectivity of the remaining vegetation in the study area with adjoining vegetation to the north, south and west would be maintained, the proposal is considered unlikely to fragment or isolate habitat in the locality for this species such that its movement in the locality would be impeded.
(d) (iii) Habitat importance	Considering these species were not detected in the study area, and the relatively large areas of similar habitat on adjacent lands which are contiguous with the study area, the removal of the 32.03 ha of forest vegetation for the proposal is unlikely represent a significant reduction in important potential available habitat for these species.
(f) Recovery Plan	A recovery plan has been prepared for the Yellow-bellied Glider (NPWS 2003). This proposal would not contravene the objectives of this plan. For the Squirrel Glider and Brush-tailed Phascogale, no recovery plans had been prepared for these species at the time of reporting. No threat abatement plans are relevant to these species.
(g) KTP	The proposal would contribute to three key threatening processes relevant to these species: 'Clearing of native vegetation', 'Removal of dead wood and dead trees', and 'Loss of hollow-bearing trees'.
Conclusion	The proposal is considered unlikely to have a significant impact on a local population of these species as: • These species were not recorded in the study area during the surveys. • Approximately 63% of forest habitat in the study area for these species would be retained. • The area of habitat to be removed is relatively small in the context of the extent of similar forest habitat that is contiguous with the development site (estimated <5%). • The proposal would not isolate habitat and is unlikely to impede movement and dispersal of these species in the study area or locality.

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Koala (*Phascolarctos cinereus*)

The Koala generally occurs from the Townsville district in northern Queensland, south along the coast and ranges into Victoria and part of South Australia. Within New South Wales and Queensland, this distribution extends into the western slopes and plains. The Koala lives entirely on a diet of leaves of both eucalypt and non-eucalypt trees and it has been shown that within its range there are local and regional preferences for the tree species used for feeding. Examples of eucalypts used as feed trees are *E. camuldulensis; E. viminalis; E. ovata; E. teretecornis; E. microcorys; E. punctata*. Non-eucalypts recorded have been *Allocasuarina torulosa; Melaleuca quinquenervia*; and *Lophostemon confertus*. Throughout its range the Koala suffers from either a lack of numbers or severe over-population where problems such as eye disease and reproductive tract bacterial disease caused by *Chlamydia psittaci* become prevalent (Martin & Handasyde 1995; Moore & Foley 2000; Phillips & Callaghan 2000; Phillips *et al.* 2000).

(a) Effect on life cycle	Within the Port Stephens area, *Eucalyptus robusta, E. parramattensis* and *E. tereticornis* were identified as preferred feed trees by Lunney *et al.* (1998) and in the CKPoM (PSC 2002). The vegetation in the study area contains one of these feed tree species (*E. tereticornis*). Additionally, one SEPP 44 listed Koala feed tree species (*E. punctata*) was also identified in the study area. As such, the methodology to define suitable Koala habitat under SEPP 44 was used to map Koala habitat across the study area. The species is generally solitary (OEH 2015), but they have a complex social hierarchy, living in breeding aggregations comprising the territory of a dominant male overlapping a small number of mature females, also juveniles of various ages occur (DECC 2008; OEH 2015). Across their range, adult Koalas generally exhibit long-term fidelity to their individual home range. Within the Port Stephens area studies have established home ranges of 0.2 ha to 500 ha, with an average of 80-90 ha (DECC 2008). There is evidence that the population within the Port Stephens area is in decline. The mortality rate in 1995 was estimated to be 5 – 10% of the population. Since 1995 this rate has declined linearly to less than half that level. As trends in road mortality rates of animals can provide a good surrogate for animal abundance, this may indicate a substantial decline in the population at Port Stephens (TSSC 2012). Modelling of the impacts of fire and dogs on the Port Stephens population conducted by Lunney *et al.* (2007) also identified that these two pressures are impacting on the local population. The research estimated the population to be between 350 and 800 individuals, and modelled that under basic assumptions (impacts from dogs and fire), the population was unlikely to survive 50 years (Lunney *et al.* 2007).

	The study area occurs within the Balickera Koala Management Unit (KMU); PSC 2002) in the Port Stephens LGA. A relatively large number of records of this species occurs within a 5km radius, which suggests that the area is important for the population. However, the density of records in close proximity to the site are relatively low in comparison to other parts of the Port Stephens LGA, with a higher density of records occurring to the south and east of Grahamstown dam on the Tomaree and Tilligerry peninsulas. The majority of the Balickera KMU is mapped as marginal Koala habitat under the CKPoM. Two Koalas were sighted in the south-western part of the study area during the surveys. SAT tests also detected Koala activity on the south-west, central, and north-east parts of the study area. The SAT tests indicate the average Koala activity level across the study area is 8%, with the highest activity level recorded at 13%. Both the average and highest activity levels recorded are considered to be within the low use range, whereby this "level of use by *P. cinereus* is likely to be transitory" (Phillips and Callaghan 2011, p.777). However, a precautionary approach is recommended when interpreting low use results, as "low activity levels recorded in what might otherwise be med-high carrying capacity *P. cinereus* habitat may be a result of contemporary population dynamics, landscape configuration and/or historical disturbances including logging, mining, fire, agricultural activities and/or urban development" (Phillips and Callaghan 2011, p.777). During clearing there is the potential for displacement of an individual if the development site forms part of its home-range. The removal of an area of an individual's home range may force it to move, potentially impeding on the home range of another individual. This could result in conflicts in the local area due to the high fidelity the species exhibit to their home range. Based on the assessment of an average home range in the Port Stephens area of 80 – 90 ha (DECC 2008), the proposal has the potential to impact on part of the home range of one adult Koala. While there is the potential to displace one individual, this impact is unlikely to be significant due to the large area of available habitat adjoining the development site. Lunney *et al*. (2007) modelled the carrying capacity of the Port Stephens area to be a maximum of 2,500 individuals. However, the population within the same area was estimated to be only 350 – 800 individuals (Lunney *et al.* 2007). Based on this assessment, habitat availability is not the limiting factor for the Koala population in Port Stephens area and it is likely that there is a large amount of available habitat within the locality that is either un-occupied, or could potentially support a higher density of Koalas. The decline of the Koala population has historically been attributed to habitat loss; however, impacts from fires, dogs (Lunney *et al.* 2007) and motor vehicles (Phillips *et al*. 1996) have been identified as significant threats to the species. The habitat loss due to the proposal (11.19 ha) has been assessed as minor in the context of the large expanse of forest vegetation adjoining the study area that is also likely to contain suitable Koala feed tree species. The Seaham Spotted Gum – Ironbark Forest (NPWS 2000) has been largely attributed as marginal Koala habitat in the CKPoM mapping; however this community often contains SEPP44 listed feed tree species (*E. tereticornis, E. punctata*) that are locally dominant or co-dominant, as well as tree species that may be locally important in the LGA (*E. acmenoides, E. crebra, C. maculata*) as listed in the CKPoM. The proposal also has the potential for increased impact to the species from vehicle strikes as there will be an increase in traffic. The proposed development is to incorporate traffic calming measures to reduce the risk of vehicle strike (see Section 2.1.3.2). The proposal would not increase dog numbers in the locality. Based on this information, it is considered unlikely that the proposal would impact on the life cycle of the local population, such that it would place it at the risk of extinction.
(d) (i) Habitat Removal	The proposal would remove 11.19 ha of Koala habitat as defined under SEPP44. This equates to 20% of the Koala habitat within the study area. The CKPoM Koala habitat mapping suggests that the majority of forest vegetation in the Balickera KMU is marginal habitat (including the study area). However, it is considered that a large portion of this vegetation is likely to constitute Koala habitat as defined under SEPP 44 due the presence *E. punctata* and *E. tereticornis* as co-dominants. The proposed development would remove a relatively small proportion of the large expanse of similar Spotted-Gum Ironbark Forest vegetation that is contiguous with the study area.

(d) (ii) Habitat Fragmentation	The proposed development site forms part of a larger forested corridor that runs north-south between the Pacific Highway to the east, and cleared grassland/wetlands to the west adjacent to the Williams River. While the proposal would reduce habitat connectivity for this species in the study area, it would not reduce the overall east-west width of this corridor. Within the study area, Koala habitat as defined under SEPP44 extends from the south-west corner to the north-east part of the study area. The proposed development would impact on the northern part of this mapped habitat. However, the proposal would also maintain vegetation connectivity through the north-east part of the site via two corridors (one along Seven Mile Creek and one along the north-east boundary). Considering the connectivity of the Koala habitat to be retained in the study area with adjoining vegetation would be largely maintained, the proposal is considered unlikely to substantially fragment or isolate habitat in the locality for this species.
(d) (iii) Habitat importance	The proposal would result in the removal of a relatively low proportion of similar forest habitat for this species that is contiguous with the study area. Resident individuals occurring within the study area would form part of a larger population occurring within the north-south corridor due to high vegetation connectivity in this area. The proposal would retain the majority (80%) of suitable Koala habitat in the study area, and would also maintain vegetated corridors on the eastern part of the site to allow movement of this species to adjoining habitat to the north-east. In consideration of the above, the removal of 11.19 ha of suitable habitat for this species is considered unlikely represent a significant reduction in important available habitat for this species in the locality.
(f) Recovery Plan	The Approved Recovery Plan for the Koala (*Phascolarctos cinereus*) (DECCW 2008) identifies mechanisms to conserve Koala habitat and increase our understanding of the biology and ecology of this species. The proposal does not contravene the objectives of the plan. None of the threat abatement plans are relevant to this species in the context of the proposal.
(g) KTP	The proposal would contribute to one key threatening process relevant to this species: "Clearing of native vegetation".
Conclusion	The proposal is considered unlikely to have a significant impact on a local population of these species as: • Approximately 80% of suitable Koala habitat in the study area as defined under SEPP 44 would be retained. • The area of habitat to be removed is relatively small in the context of the extent of similar forest habitat that is contiguous with the development site (estimated <5%). • The proposal would not isolate habitat and is unlikely to impede movement and dispersal of this species in the study area or locality.

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EPBC Act Assessments

Critically Endangered and Endangered Species

Birds

- Regent Honeyeater (*Anthochaera phrygia*)
- Swift Parrot (*Lathamus discolor*)

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*

Regent Honeyeater and Swift Parrot feed tree species are present within the proposed development area (i.e. Spotted Gum – Ironbark Forest). Approximately 32.03 ha of open forest containing suitable foraging habitat for these species would be removed. Due to the nomadic nature of the Regent Honeyeater's movements and the migratory nature of the Swift Parrot, no local populations would be present and it is therefore unlikely that the proposal would lead to a long-term decrease in the size of their populations.

The proposed development area will be progressively rehabilitated, as such there is the potential for these species to utilise the area as foraging habitat once the rehabilitation reaches a suitable age. Proposed offset measures will include both the provision and long-term protection of habitat containing feed tree species.

- *reduce the area of occupancy of the species*

Neither species is known to occupy the study area. The action will lead to the removal of up to 32.03 ha of potential foraging habitat for these species. The proposed development area will be progressively rehabilitated, as such there is the potential for these species to utilise the area as foraging habitat once

the rehabilitation reaches a suitable age. Proposed offset measures will also secure 57.2 ha of similar open forest habitat surrounding the development site in-perpetuity.

- *fragment an existing population into two or more populations*

The proposal would reduce habitat connectivity for these species within the study area. However, the proposed development will incorporate corridors in the central and north-east parts of the study area to maintain connectivity. The vegetation to be retained in the southern part of the study area will remain well connected to adjoining vegetation. As both of these species are highly mobile, the proposed action will not fragment any populations of these species.

- *adversely affect habitat critical to the survival of a species*

The National Recovery Plan for the Regent Honeyeater identifies that any breeding or foraging areas where the species is likely to occur is habitat critical to their survival (Commonwealth of Australia 2016). As such, in the region the 'important bird area' around Cessnock (Birdlife International 2016) is likely to be the only area critical to the survival of the species.

The National Recovery Plan for the Swift Parrot (Saunders and Tzaros 2011) outlines that 'habitat critical to the survival of the Swift Parrot includes; those areas of priority habitat for which the Swift Parrot has a level of site fidelity or possess phenological characteristics likely to be of importance to the Swift Parrot, or are otherwise identified by the recovery team'. As such, in this region the 'important bird area' around Cessnock (Birdlife International 2016) is likely to be the only known area critical to the survival of the species.

The vegetation within the study area likely provides opportunistic foraging habitat and supplementary foraging areas in times of low nectar resources in core foraging areas. As such, it is unlikely that the 32.03 ha of potential foraging habitat within the development site is critical to the survival of these species.

- *disrupt the breeding cycle of a population*

The Swift Parrot is only known to breed in Tasmania. The Regent Honeyeater is known to breed in three key areas: two of them in NSW i.e. Bundarra-Barraba and Capertee Valley. There have been some historical breeding records from within the Hunter Region but these have occurred in the Kurri – Cessnock area. Therefore, the proposed action is unlikely to disrupt the breeding cycle of either species.

- *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

As outlined above, the study area may provide opportunistic foraging habitat and supplementary foraging areas for both of these species. There is a large amount of suitable foraging habitat for these species to be retained within the study area and in the wider locality. As such, the removal of 32.03 ha of foraging habitat within the development area is unlikely to lead to the decline of these species.

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

The proposed action would not result in any invasive species becoming established in areas of potential habitat for these species. The majority of the vegetation to be retained in the study area is proposed to be secured under a biobanking agreement. Implementation of a vertebrate pest management plan is required under this agreement, which would ensure potential impacts from vertebrate pests in the study area are managed.

- *introduce disease that may cause the species to decline*

Provided mitigation measures within a Landscape and Rehabilitation Management Plan are adhered to, the action will not result in the establishment of invasive species into the rehabilitation area or surrounding habitat.

- *interfere with the recovery of the species*

The proposed development is unlikely to interfere with the recovery of these species.

References

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Mammals

- Spotted-tailed Quoll (*Dasyurus maculatus*)

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*

This species utilises a range of coastal forest and heath habitats that possess mature trees, old-growth elements and/or dense understoreys, typical of vegetation found in the study area. Given the relatively small area of suitable habitat for the Spotted-tailed Quoll that will be removed compared to the extent of suitable habitat in the study area and surrounding lands, the minor impediment the development would pose to movement of this species and the management actions proposed, it is unlikely that the proposal would lead to a long-term decrease in the size of a local population.

- *reduce the area of occupancy of the species*

The action will lead to the removal of up to 32.03 ha of suitable foraging and marginal denning habitat for this species. The proposed development area will be progressively rehabilitated, as such there is the potential for this species to utilise the area as foraging habitat once the rehabilitation reaches a suitable age. Proposed offset measures will also secure 57.2 ha of similar open forest habitat surrounding the development site in perpetuity.

- *fragment an existing population into two or more populations*

The proposal would reduce habitat connectivity for this species within the study area. However, the proposed development will incorporate corridors in the central and north-east parts of the study area to maintain connectivity. The vegetation to be retained in the southern part of the study area will remain well connected to adjoining vegetation. As this species is highly mobile and occupies large home ranges, the proposed action is unlikely to fragment any populations of this species.

- *adversely affect habitat critical to the survival of a species*

The native vegetation proposed for removal is not considered to represent critical habitat for this species.

- *disrupt the breeding cycle of a population*

The proposal is unlikely to disrupt the breeding cycle of this species.

- *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

There is a large amount of suitable foraging habitat for this species to be retained within the study area and in the wider locality. As such, the temporary removal of 32.03 ha of potential habitat is unlikely to lead to the decline of this species.

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

The proposed action would not result in any invasive species becoming established in areas of potential habitat for this species. The majority of the vegetation to be retained in the study area is proposed to be secured under a biobanking agreement. Implementation of a vertebrate pest management plan is required under this agreement, which would ensure potential impacts from vertebrate pests in the study area are managed.

- *introduce disease that may cause the species to decline*

Provided mitigation measures within a Landscape and Rehabilitation Management Plan are adhered to, the action will not result in the establishment of invasive species into the rehabilitation area or surrounding habitat.

- *interfere with the recovery of the species*

The proposed development is unlikely to interfere with the recovery of this species.

Vulnerable Species

- Koala (*Phascolarctos cinereus*)

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

- *lead to a long-term decrease in the size of an important population of a species*

The Koala was recorded on site during field surveys. Two Koalas were sighted in the south-western part of the study area during the surveys. SAT tests also detected Koala activity on the south-west, central, and north-east parts of the study area. The SAT tests indicate the average Koala activity level across the study area is 8%, with the highest activity level recorded at 13%. During clearing there is the potential for displacement of an individual if the development site forms part of its home-range. The removal of an area of an individual's home range may force it to move, potentially impeding on the home range of another individual. This could result in conflicts in the local area due to the high fidelity the species exhibit to their home range. Based on the assessment of an average home range in the Port Stephens area of 80 – 90 ha (DECC 2008), the proposal has the potential to impact part of the home range of one adult Koala. While there is the potential to displace one individual, this impact is unlikely to be significant due to the large area of similar forest habitat that is contiguous with the study area.

Given the relatively small area of suitable habitat for this species that will be removed compared to the extent of suitable habitat in the study area and surrounding lands, the minor impediment the development would pose to movement of this species and the management actions proposed, it is unlikely that the proposal would lead to a long-term decrease in the size of a local population. Proposed offset measures will include both the provision and long-term protection of habitat containing key feed tree species (for the Koala).

- *reduce the area of occupancy of an important population*

The action will lead to the removal of up to 11.19 ha of foraging habitat for this species. The proposed disturbance area will be progressively rehabilitated, as such there is the potential for this species to utilise the area as foraging habitat once the rehabilitation reaches a suitable age.

- *fragment an existing important population into two or more populations*

The proposal would reduce habitat connectivity for this species within the study area. However, the proposed development will incorporate corridors in the central and north-east parts of the study area to maintain connectivity. The vegetation to be retained in the southern part of the study area will remain well connected to adjoining vegetation. As this species is highly mobile and occupies large home ranges, the proposed action is unlikely to fragment any local populations.

- *adversely affect habitat critical to the survival of a species*

The *EPBC Act Referral Guidelines for the Vulnerable Koala Combined populations of Queensland, New South Wales and the Australian Capital Territory,* Commonwealth of Australia 2014, outline a Koala habitat assessment tool to determine if a site contains critical Koala habitat. The habitat within the extraction area has been assessed against the criteria, and is detailed in **Table 18** (the site occurs within a coastal area, as such these criterion have been used).

Table 18: Assessment of habitat critical to the survival of the Koala

Attribute	Score	Discussion
Koala Occurrence	+1	Two Koalas were sighted in the south-western part of the study area during the 2013 surveys. SAT tests also detected Koala activity on the south-west, central, and north-east parts of the study area. The SAT tests indicate the average Koala activity level across the study area is 8%, with the highest activity level recorded at 13%.SAT surveys indicated low activity levels (up to 13%) within the study area surrounding the development site. The SAT surveys were completed in 2013, which is within the last 5 years.
Vegetation Composition	+2	The forest in the study area contains *Eucalyptus punctata*, which is a SEPP 44 food tree species. Within the study area, there is also low numbers of *Eucalyptus tereticornis*, which is a SEPP 44 and CKPoM food tree species.
Habitat Connectivity	+2	The patch size of the development site was determined to be >1,000 ha through aerial photo analysis, as identified in the BAR (section 1.2.2).
Key Existing Threats	+1	Vehicle strikes and dog attacks have been identified as a key threat to the Port Stephens population. The study area is located on freehold land that has not been developed for residential or rural land use. The forest is largely intact and no evidence of koala mortality from vehicle strike or dog attack was recorded.
Recovery Value	+1	Uncertain whether the habitat is important for achieving the interim recovery objectives, as it is not known if the habitat is: • Of sufficient size to be genetically robust/operate as a viable sub-population, or • Free of disease or have low incidence of disease, or • Breeding.

Attribute	Score	Discussion
		The SAT surveys indicated low activity levels (7%) within the development site. The SAT surveys indicate that koalas are moving through the lower-lying areas of the study area (such as along creeklines) rather than through the elevated ridgeline and upper slopes where the development site is situated. The Seven Mile Creek corridor (creekline and associated riparian habitat) is likely acting as the main movement corridor for koalas to move through the study area and will not be cleared for the development. The contiguous habitat surrounding the development site will be retained and protected under a Biobanking Agreement.
Total Score	**7**	**As such the impact area is classified as habitat critical to the survival of the species.**

The impacts of the proposed action were assessed against the factors detailed in Figure 2 (Assessing adverse effects on habitat critical to the survival of the Koala) of the EPBC Act Referral Guidelines (detailed in the following sections). The assessment concluded that while the extraction area was assessed as critical habitat, the impacts of the proposal are unlikely to adversely affect habitat critical to the survival of the species due to the large area of habitat, with similar characteristics, occurring in the locality.

The EPBC Act koala guidelines state that the upper and lower 'thresholds' in the assessment flowchart provides an indication of the level of impact that is likely to be significant and provides the following example: a significant impact would be expected if 25 ha of habitat scoring 6 or 7 was being completely cleared. The study area occurs within the Balickera Koala Management Unit (KMU); (PSC 2002) in the Port Stephens LGA. A relatively large number of records of the Koala occur within a 5 km radius, which suggests that the area is important for the local population. However, the density of records in close proximity to the site are relatively low in comparison to other parts of the Port Stephens LGA, with a higher density of records occurring to the south and east of Grahamstown dam on the Tomaree and Tilligerry peninsulas. On this basis, the proposed development (involving removal of 11.19 ha of Koala habitat within the development area) would be considered unlikely to adversely affect habitat critical to the survival of the koala and a referral is unlikely to be required.

It is also noted that:

- Approximately 79% of suitable Koala habitat in the study area as defined under SEPP 44 would be retained.
- The area of habitat to be removed is relatively small in the context of the extent of similar forest habitat that is contiguous with the development site (estimated <5%).
- The proposal would not isolate habitat and is unlikely to impede movement and dispersal of this species in the study area or locality.

During clearing there is the potential for displacement of an individual if the development site forms part of its home-range. The removal of an area of an individual's home range may force it to move, potentially impeding on the home range of another individual. This could result in conflicts in the local area due to the high fidelity the species exhibit to their home range. Based on the assessment of an average home

range in the Port Stephens area of 80 – 90 ha (DECC 2008), the proposal has the potential to impact part of the home range of one adult Koala. While there is the potential to displace one individual, this impact is unlikely to be significant due to the large area of similar forest habitat that is contiguous with the study area.

- *disrupt the breeding cycle of an important population*

The proposal is unlikely to disrupt the breeding cycle of this species.

- *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

There is a large amount of suitable foraging habitat for these species to be retained within the study area and in the wider locality. As such, the removal of 11.19 ha of foraging habitat is unlikely to lead to the decline of this species.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

The proposed action would not result in any invasive species becoming established in areas of habitat for this species. The majority of the vegetation to be retained in the study area is proposed to be secured under a biobanking agreement. Implementation of a vertebrate pest management plan is required under this agreement, which would ensure potential impacts from vertebrate pests in the study area are managed.

- *introduce disease that may cause the species to decline*

Provided mitigation measures within a Landscape and Rehabilitation Management Plan are adhered to, the action will not result in the establishment of invasive species into the rehabilitation area or surrounding habitat and is unlikely to introduce disease that may cause the species to decline.

- *interfere with the recovery of the species*

The proposed action was assessed against the impacts detailed in Section 8 of the *EPBC Act Referral Guidelines* to determine if it is likely that the action will substantially interfere with the recovery of the species (detailed in the following sections). The assessment concluded that it is unlikely that the action will substantially interfere with the recovery of the Koala.

Increasing Koala fatalities in habitat critical to the survival of the Koala due to dog attacks to a level that is likely to result in multiple, ongoing mortalities.

The proposed action is unlikely to lead to the increase in dog attacks in the locality as it does not involve the construction of residential dwellings and associated pet ownership. Additionally, the proposed action will implement a vertebrate pest control program within the Subject Land, with wild dogs as one of the target species.

Increasing Koala fatalities in habitat critical to the survival of the Koala due to vehicle-strikes to a level that is likely to result in multiple, ongoing mortalities.

The proposal has the potential for increased impact to the species from vehicle strikes as there will be an increase in traffic. However, traffic assessments concluded that the proposal will only cause a minor increase in traffic volume. It is also worth noting the frequency of traffic on the haul road (10 per hour) reduces potential for obstructing koala passage, especially as haulage is suspended between 10 pm and 5 am where koala movement is higher than during the day.

The proposed action will implement recognised mitigation measures including installing an underground culvert along the access road and restrict speed limits along internal roads to 40 km/hour in relevant locations. It is recognised that this control is only applicable to the Subject Land.

Facilitating the introduction or spread of disease or pathogens (e.g. Chlamydia or *Phytophthora cinnamomi*) that are likely to significantly reduce the reproductive output of Koalas or reduce the carrying capacity of the habitat.

As outlined above (response to introduce disease criteria), it is unlikely that the proposed action will introduce or spread a disease or pathogen that is harmful to the species or its habitat. As such, the potential for the proposed action to reduce the reproductive output of the species is unlikely.

Creating a barrier to movement to, between or within habitat critical to the survival of the Koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the Koala.

As outlined above (response to habitat fragmentation criteria), the proposal would not isolate habitat and is unlikely to impede movement and dispersal of this species in the study area or locality.

As such, it is unlikely that the proposed action will lead to the long-term reduction in genetic fitness or access to habitat critical to the survival of the Koala.

Change the hydrology which degrades habitat critical to the survival of the Koala to the extent that the carrying capacity of the habitat is reduced in the long-term.

The final landform will be monitored throughout the life of the quarry, to ensure that the level above the maximum predicted groundwater level is maintained. Additionally, no extraction of groundwater is proposed as part of the action. As such, the proposal is unlikely to substantially modify the hydrological regime in the area.

References

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Bats

- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*)

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

- *lead to a long-term decrease in the size of an important population of a species*

The Large-eared Pied Bat was recorded on site during field surveys.

The Large-eared Pied Bat is a cave-dwelling species (with roosts also recorded in crevices in cliffs, old mine workings and the disused, bottle-shaped mud nest of the Fairy Martin) which forages in well-timbered areas containing gullies. The development area does not contain roosting habitat for this species.

The Grey-headed Flying-fox was not recorded roosting or foraging within the study area during field surveys, however, eucalypt species within the development area are likely to provide opportunistic foraging resources.

Given the relatively small area of suitable habitat for these species that will be removed compared to the extent of suitable habitat in the study area and surrounding lands, the minor impediment the development would pose to movement of these species and the management actions proposed, it is unlikely that the proposal would lead to a long-term decrease in the size of any local populations. Proposed offset measures will include both the provision and long-term protection of habitat containing foraging resources for these bat species.

- *reduce the area of occupancy of an important population*

The action will lead to the removal of up to 32.03 ha of foraging habitat for these species. The proposed disturbance area will be progressively rehabilitated, as such there is the potential for these species to utilise the area as foraging habitat once the rehabilitation reaches a suitable age.

- *fragment an existing important population into two or more populations*

The proposal would reduce habitat connectivity for these species within the study area. However, the proposed development will incorporate corridors in the central and north-east parts of the study area to maintain connectivity. The vegetation to be retained in the southern part of the study area will remain well connected to adjoining vegetation. As these species are highly mobile and occupy large home ranges, the proposed action is unlikely to fragment any local populations.

- *adversely affect habitat critical to the survival of a species*

The habitat present within the development area is not considered critical to the survival of either bat species.

- *disrupt the breeding cycle of an important population*

The proposal is unlikely to disrupt the breeding cycle of these species.

- *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

As outlined above, the study area provides foraging habitat for these species. There is a large amount of suitable foraging habitat for these species to be retained within the study area and in the wider locality. As such, the removal of 32.03 ha of foraging habitat is unlikely to lead to the decline of these species.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

The proposed action would not result in any invasive species becoming established in areas of habitat for these species. The majority of the vegetation to be retained in the study area is proposed to be secured under a biobanking agreement. Implementation of a vertebrate pest management plan is

required under this agreement, which would ensure potential impacts from vertebrate pests in the study area are managed.

- *introduce disease that may cause the species to decline*

Provided mitigation measures within a Landscape and Rehabilitation Management Plan are adhered to, the action will not result in the establishment of invasive species into the rehabilitation area or surrounding habitat.

- *interfere with the recovery of the species*

The proposed development is unlikely to interfere with the recovery of these species.

Migratory Bird Species

- Oriental Cuckoo (*Cuculus optatus*)
- Rainbow Bee-eater (*Merops ornatus*)
- Black-faced Monarch (*Monarcha melanopsis*)
- Yellow Wagtail (*Motacilla flava*)
- Satin Flycatcher (*Myiagra cyanoleuca*)
- Rufous Fantail (*Rhipidura rufifrons*)

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*

One migratory species (Rufous Fantail) was recorded in the study area during the surveys. The remaining migratory bird species were not detected in the study area. The Spotted Gum – Ironbark Forest in the study area represents suitable foraging habitat for these species. The proposed action will directly impact on 32.03 ha of foraging habitat for these species. The proposed action would not substantially modify the ground or surface water hydrology within the vegetation to be retained in the study area, and it is unlikely that there will be modification to any areas of retained habitat for this species due to the proposed action.

The proposal would reduce habitat connectivity for these species within the study area. However, the proposed development will incorporate corridors in the central and north-east parts of the study area to maintain connectivity. The vegetation to be retained in the southern part of the study area will remain well connected to adjoining vegetation. As such, the proposal is considered unlikely to isolate or substantially fragment any important habitat for these species in the study area.

- *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*

The proposed action would not result in any invasive species becoming established in areas of important habitat for these migratory species. The majority of the vegetation to be retained in the study area is proposed to be secured under a biobanking agreement. Implementation of a vertebrate pest

management plan is required under this agreement, which would ensure potential impacts from vertebrate pests in the study area are managed.

- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) or an ecologically significant proportion of the population of a migratory species.*

Given the relatively large areas of habitat adjoining the study area and as the majority of vegetation in the study area will be retained, including corridors to facilitate movement to the north, it is unlikely that the proposed action will disrupt the lifecycle of an ecologically significant proportion of the population of these species.

APPENDIX 7: GROUNDWATER DEPENDENT ECOSYSTEM ASSESSMENT

Where present potential impacts to Groundwater Dependent Ecosystems during the construction and operation phases may include:

- Changes to water quantity include draw down of groundwater as a result of dewatering activities during the construction and operation of the proposed development; this may result in increased fluctuation of groundwater levels and affect the rate of groundwater recharge and evapotranspiration during mining operations in the locality. Alteration of surface flow regimes through constructed diversion banks, excavation and detention basins may also affect groundwater levels.

- Potential impacts on water quality include changes in chemical properties of groundwater such as pH, salinity, nutrient levels or other chemical constituents through exposure and disturbance of subsurface materials during the operations. Additionally, there is potential for contamination from petrochemical spills and from polluted stormwater runoff from the proposal.

It is likely that there will be changes to groundwater levels within the study area. However, it is also anticipated that surface water management principles will be implemented to prevent contamination of surface (and therefore groundwater) quality.

For more details, refer to the Water Resources Assessment prepared by Umwelt in Appendix M of the Environmental Impact Statement (JBA Urban Planning Consultants Pty Ltd 2016).

The rapid assessment methodology developed by DLWC (2002) has been used to identify, attribute a value and assess the vulnerability of GDEs within the study area. The assessment steps and responses are given in the following sections.

1. Identify Geographical Area

The study area is identified in **Figure 1, Section 1.1.2**.

2. List GDEs Present

The groundwater dependency of each of the vegetation community variants that occur within the study area was reviewed as listed in **Table 19**. The dependency of the vegetation within the study area was determined through a combination of topographical analysis and site observations. The groundwater dependence of each vegetation community variant was classified into one of the following three categories:

- Obligate: ecosystems entirely or highly dependent on groundwater;
- Facultative: ecosystems with proportional dependence on groundwater or which may only use groundwater opportunistically or to a very limited extent;
- Non-Groundwater Dependent Ecosystem: ecosystems with no apparent dependence on groundwater.

One vegetation community variant was identified as ground water dependent. The ecosystem identified is typically associated with Shallow Alluvial Groundwater Systems which are associated with the drainage lines and creeks. The distribution of the vegetation community variant in the study area is shown in **Figure 11**.

Table 19: Review of groundwater dependency of vegetation in the study area.

Plant Community Type	Vegetation Community variant	Ecosystem Type	Groundwater System	Groundwater Dependency
HU804 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Seaham Spotted Gum – Ironbark Forest	Terrestrial Vegetation	N/A	Non-GDE
	Hunter Valley Moist Forest	Terrestrial Vegetation	Shallow Alluvial	Facultative

3. Assess the Vulnerability of GDEs

The groundwater dependent ecosystem identified within the study area has been assessed as facultative and is considered to use groundwater opportunistically or to a very limited extent based on the underlying geology and species composition within this community. Therefore, it is not expected that the proposal will influence groundwater levels or quality such that there will be any significant impact on areas of this GDE (outside of the development footprint) within the study area, during both the construction and operation phases provided appropriate controls are implemented.

4. Assess the Value of the Ecosystems

The Hunter Valley Moist Forest community variant within the study area, while having undergone historical modification still holds important values, such as:

- Biodiversity value – the system adds to the ecological diversity of the region;
- They system and its associated vegetation may play an important role in river health; and
- The system is connected to other non-groundwater dependent ecosystems and integrated into the broader environment.

5. List Management Tools to be used

Management tools proposed for the project area are designed to protect and enhance water features and riparian zones:

- Control and treat stormwater runoff; and
- Impose appropriate conditions on groundwater licences.

6. Prioritise Management Actions

Both are equally important.

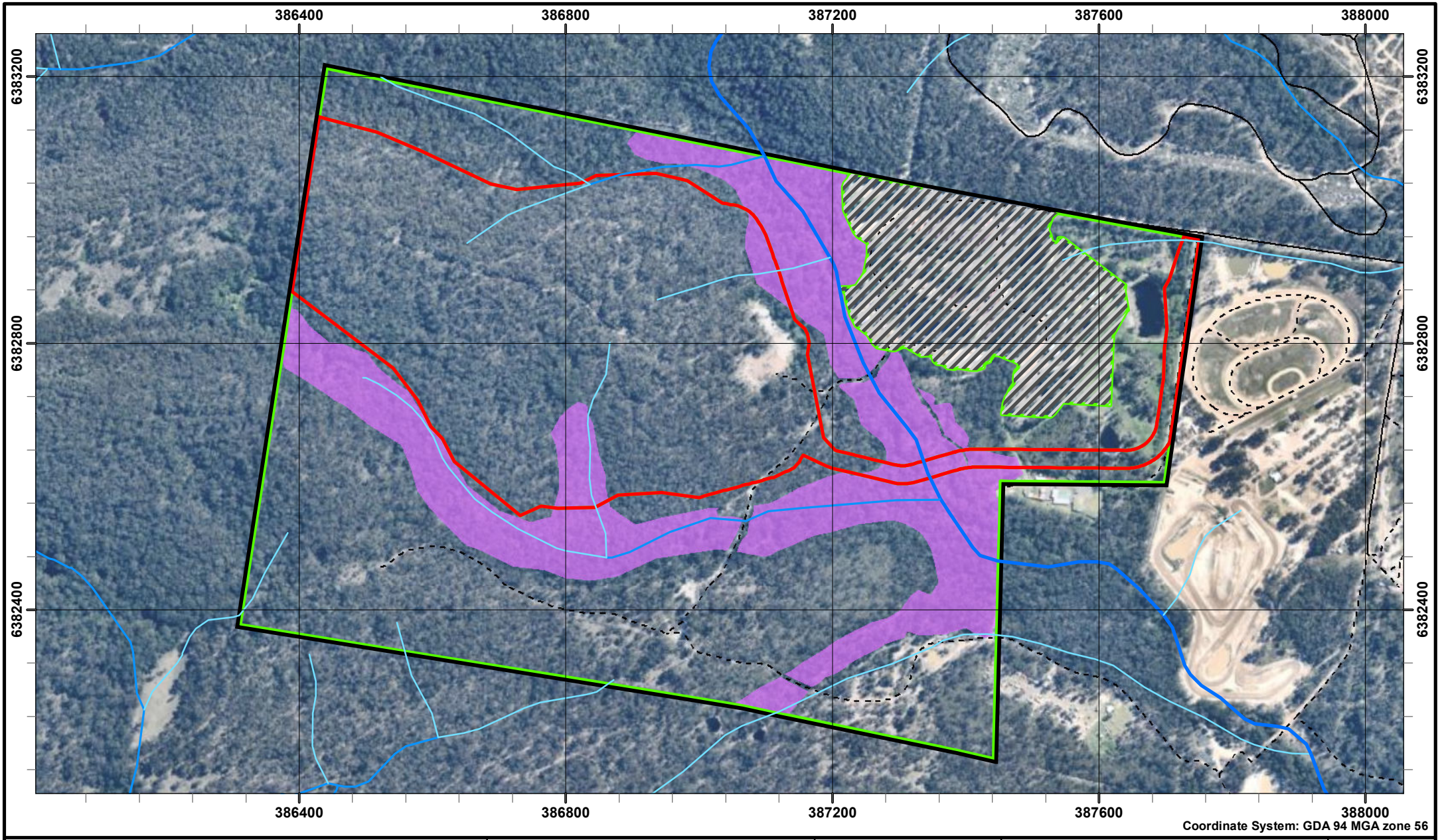
7. Implement Management Actions

A Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP) to be prepared for the project must include guidelines for storm water management and erosion and sedimentation control to prevent and minimise impacts on the adjoining GDE areas.

8. Review Process and Outcomes

The groundwater dependent ecosystem identified within the study area has been assessed as facultative and is considered to use groundwater opportunistically or to a very limited extent based on the underlying geology and species composition within these communities. Therefore, it is not expected that the proposal will influence groundwater levels or quality such that there will be any significant impact on the GDE's (outside of the project disturbance) within the study area, during both the construction and operation phases provided appropriate controls are implemented.

Details for monitoring of management actions will be contained within the above management plans.



Coordinate System: GDA 94 MGA zone 56

- Study Area (100.94 ha)
- Development Site (33.68 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Local Road
- Track
- Ground Water Dependent Ecosystem – Facultative

Hunter CMA Stream Order

- 1
- 2
- 3

Metres
0 25 50 100 150 200 250

N

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DATA SOURCE:
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nearmap - 2016

Distribution of facultative GDE vegetation in the study area

Eagleton Rock Syndicate Pty Ltd
Biodiveristy Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
11

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APPENDIX 8: AQUATIC HABITAT ASSESSMENT

This assessment addresses the relevant Aquatic Habitat Protection Requirements detailed in the SEARs (requirements from NSW Department of Industry, Resources and Energy).

Initial Assessment

Field surveys were undertaken in January 2016 to identify and assess aquatic and riparian habitats within the study area. Prior to undertaking field surveys, mapped watercourses and aerial photos were examined to enable surveys to be targeted in areas most likely to contain aquatic habitat.

Aquatic habitat within the study area was determined to consist of riparian areas associated with six 1st order streams, two 2nd order streams, and one 3rd order stream. The 3rd order stream runs north-west to south-east through the study area. Several constructed dams were also identified in the study area. The locations of the riparian areas and dams in relation to the proposed quarry are shown on **Figure 12**.

Riparian Habitat Condition Assessment

Methods

The condition of the riparian habitat in the study area was assessed using a modified version of AUSRIVAS habitat assessment (Turak *et al*. 2004; Parsons *et al.* n.d.). A combination of Australian Rivers Assessment System (AUSRIVAS) habitat assessments as developed by Victorian and NSW state agencies was used. Parameters included; riparian complexity and width, instream condition, stream substrate complexity, local land use, sources of local and catchment level pollution, shading and water quality were considered as potentially influencing the local aquatic community structure and composition as well as overall river function.

To assist in understanding the main drivers of site condition, HABSCORE was also used. HABSCORE was originally developed by the United States Environmental Protection Agency and has been adapted for Australian conditions by the Environmental Monitoring Unit at the Environment Protection Authority of Victoria (Barbour *et al*. 1999, Barbour and Stribling 1991). It classifies stream habitat condition based on the variety and quality of substrate, channel morphology, bank structure and riparian vegetation (Barbour *et al*. 1999).

It is noted that benchmarked AUSRIVAS assessments were not conducted for the aquatic habitat surveys. Such assessments require macroinvertebrate and water quality sampling as well as macroinvertebrates identifications and AUSRIVAS calculations. The benchmarked assessments were not considered necessary for this assessment.

Results

The majority of the riparian habitat within the study area is intact and is occasionally dissected by access tracks. The riparian areas consist of the forest vegetation as described in Section 1.3.2**.** Vegetation coverage in most areas was relatively high (50-60% PFC). The ground cover vegetation is relatively low in some areas along the 3rd order stream as result of past disturbance (i.e. Hunter Valley Paintball previously operated in this area).

The stream substrate of the riparian area is comprised mainly of sand and silt although some areas contained large cobbles. Finer substrate and detrital accumulations were moderate although these may have been washed out due to a large rainfall event which occurred a week before the assessment was conducted. The stream banks were relatively stable in most areas, with low levels of erosion of the banks occurring in some areas (particularly at bends in the stream).

During sampling, the 3rd order stream was flowing above the water mark. The water was grey and turbid due to high silt levels but no odour was evident. The proportion of organic material was moderate in most areas and mostly comprised of leaves and twigs.

It is likely that water levels within the creek are much lower at other times of the year and is likely to consist of a series of disconnected pools (as observed during previous ecological surveys). Some macroinvertebrates were observed including Water Striders (Gerridae) and Whirligig Beetles (Gyrinidae), which suggests that the creek rarely dries up entirely. No fish or crustaceans were observed. These species are likely to be largely absent due to the ephemeral characteristics of the habitat.

Terrestrial fauna habitat within the riparian zone includes the associated vegetation, hollow bearing trees, rocks, woody debris and a range of substrates.

No infestation of aquatic weeds or other Macrophytes were observed. No evidence of pollution was observed.

Threatened Species

Database searches were undertaken to compile a list of threatened species, endangered populations and endangered ecological communities listed under the *Fisheries Management Act 1994* which may be present in the study area using the following databases:

- NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife: (www.wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp); and
- Department of the Environment's (DotE) Protected Matters search tool: (www.environment.gov.au/erin/ert/epbc/index.html).

No threatened freshwater species, endangered populations and endangered ecological communities listed under the FM Act have been recorded within the locality (5km radius of the study area). Following the database searches and habitat assessment, it is considered unlikely that any threatened aquatic species would occur in the study area.

Photo Monitoring Points

Four photo monitoring points were established at locations within the riparian zones during the surveys in January 2016 (**Figure 12**). Two photo monitoring points were placed adjacent to 1st order streams occurring centrally within the study area. One monitoring point was placed adjacent to a 2nd Order stream to the north east of the development site boundary. The fourth monitoring point was placed adjacent to the 3rd order stream on the eastern side of the development site boundary.

All of the photographs (included below) show that the riparian vegetation is healthy condition. No dieback was evident and no major weed infestations were present during the assessment.

Assessment of Likely Impacts

The proposed development would directly impact on riparian habitat associated with three 1st order streams occurring within the footprint. The project also has the potential to have indirect impacts on other drainage lines adjoining the development site during the construction and operation phases through erosion, sedimentation and contaminants in stormwater run-off.

The proposal would also involve construction of a new bridge across the 3rd order stream (Seven Mile Creek) for the haul road. This would directly impact a small section of riparian vegetation during construction, and has the potential to have indirect impacts downstream during the construction phase through erosion and sedimentation, and introduction of weeds. While the assessment indicated that the occurrence of fish species is unlikely given the creek is ephemeral, the bridge will be designed so as to maintain connectivity and ensure movement of aquatic fauna would not be impeded.

Ameliorative Measures

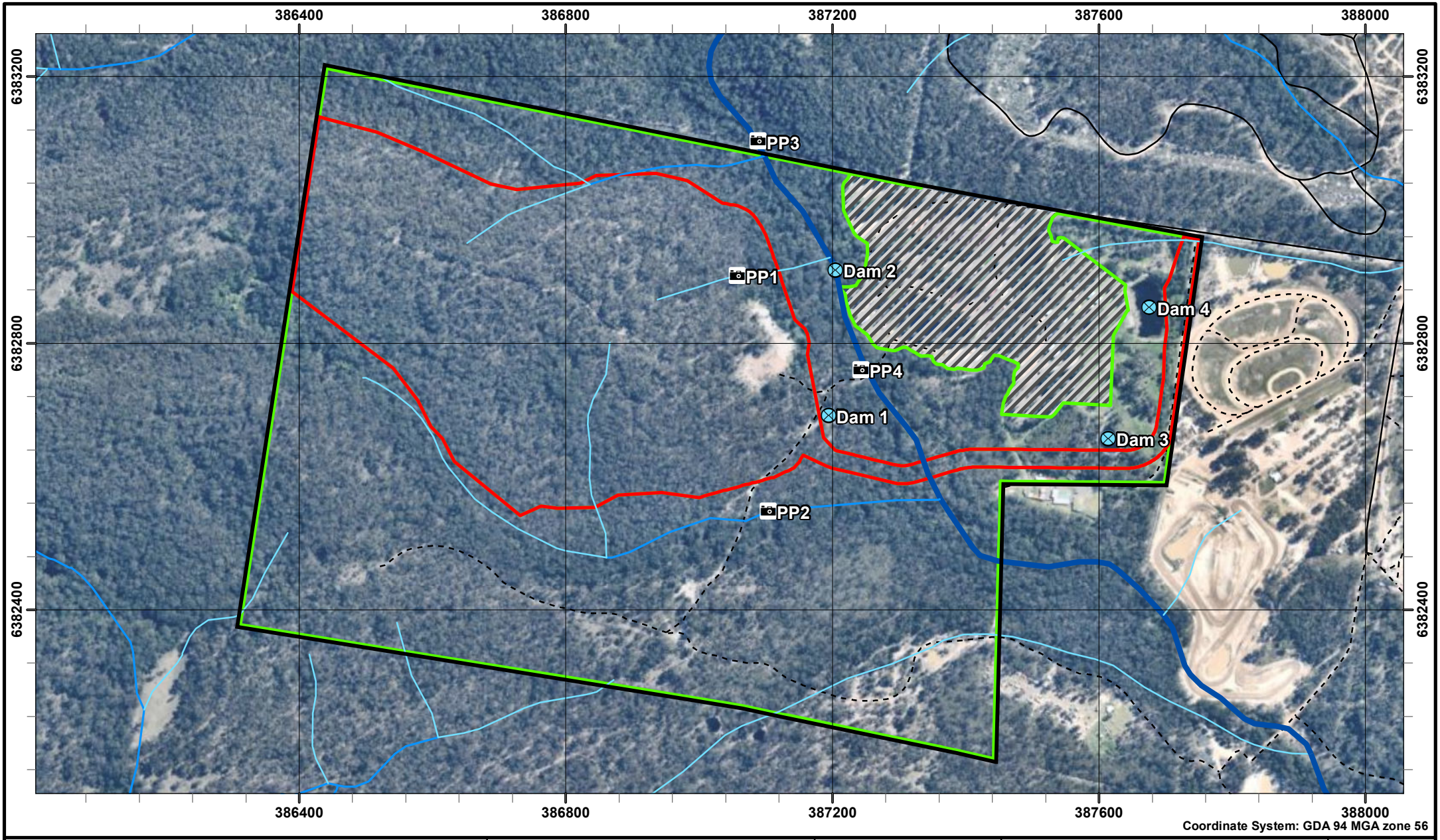
Details of proposed ameliorative measures are provided in Section 2.1.3 of the BAR. In summary, a number of management plans would be prepared and implemented for the proposed development to minimise impacts on adjoining terrestrial and aquatic habitats during the construction and operation phases. Additionally, the retained riparian habitat adjoining the development site in the study area is proposed to be secured under a biobanking agreement, which involves the implementation of a range of management actions to improve biodiversity values across the site.

Plate 1: **Riparian Photo Monitoring Point 1**

Plate 2: **Riparian Photo Monitoring Point 2**

Plate 3: Riparian Photo Monitoring Point 3

Plate 4: Riparian Photo Monitoring Point 4



Coordinate System: GDA 94 MGA zone 56

- Study Area (100.94 ha)
- Local Road
- Track
- Development Site (33.68 ha)
- Offset Site (57.2 ha)
- Gardenland (Excluded - 10.05 ha)
- Dam
- Photo Point

Hunter CMA Stream Order

- 1
- 2
- 3

Metres
0 25 50 100 150 200 250

N

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Riparian Habitat Assessment - Development & Offset Sites

Eagleton Rock Syndicate Pty Ltd
Biodiversity Assessment Report
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:
12

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APPENDIX 9: FAUNA SPECIES RECORDED IN THE STUDY AREA (2013)

	Scientific Name	Common Name
Amphibians		
1	*Limnodynastes peronii*	Striped Marsh Frog
2	*Litoria fallax*	Dwarf Green Tree Frog
3	*Litoria latopalmata*	Broad Palmed Frog
4	*Litoria peronii*	Peron's Tree Frog
5	*Pseudophryne coriacea*	Red Backed Toadlet
6	*Uperoleia laevigata*	Smooth Toadlet
Birds		
1	*Acanthiza lineata*	Striated Thornbill
2	*Acanthiza pusilla*	Brown Thornbill
3	*Acanthorhynchus tenuirostris*	Eastern Spinebill
4	*Anas castanea*	Chestnut Teal
5	*Anas superciliosa*	Pacific Black Duck
6	*Aquila audax*	Wedge- tailed Eagle
7	*Aviceda subcristata*	Pacific Baza
8	*Chenonetta jubata*	Australia Wood duck
9	*Climacteris picumnus*	Brown Treecreeper
10	*Colluricincla harmonica*	Grey Shrike-thrush
11	*Cormobates leucophaea*	White- throated Treecreeper
12	*Corvus coronoides*	Australian Raven
13	*Cracticus tibicen*	Australian Magpie
14	*Cracticus torquatus*	Grey Butcherbird
15	*Dacelo novaeguineae*	Laughing Kookaburra
16	*Dicaeum hirundinaceum*	Mistletoebird
17	*Eopsaltria australis*	Eastern Yellow Robin
18	*Eurystomus orientalis*	Dollarbird
19	*Geopelia humeralis*	Bar- shouldered Dove
20	*Gerygone olivacea*	White- throated Greygone
21	*Grallina cyanoleuca*	Magpie-lark
22	*Greygone mouki*	Brown Greygone
23	*Leucosarcia melanoleuca*	Wonga Pigeon
24	*Lichenostomus chrysops*	Yellow Faced Honeyeater
25	*Malurus cyaneus*	Superb Fairy-wren
26	*Manorina melanocephala*	Noisy Miner
27	*Meliphaga lewinii*	Lewin's Honeyeater

	Scientific Name	Common Name
28	*Melithreptus lunatus*	White-naped Honeyeater
29	*Myiagra rubecula*	Leaden Flycatcher
30	*Myzomela sanguinolenta*	Scarlet Honeyeater
31	*Neochmia temporalis*	Red- browed Finch
32	*Ocyphaps lophotes*	Crested Pigeon
33	Oriolus sagittatus	Olive- backed Oriole
34	*Pachycephala rufiventris*	Rufous Whistler
35	*Pardalotus punctatus*	Spotted Pardalote
36	*Pelecanus conspicillatus*	Australian Pelican
37	*Petroica boodang*	Scarlet Robin
38	*Philemon corniculatus*	Noisy Friarbird
39	*Platycercus eximius*	Eastern Rosella
40	*Podargus strigoides*	Tawny Frogmouth
41	*Psophodes olivaceus*	Eastern Whipbird
42	*Ptilonorhynchus violaceus*	Satin Bowerbird
43	*Rhipidura albiscapa*	Grey Fantail
44	*Rhipidura leucophrys*	Willie Wagtail
45	*^Rhipidura rufifrons*	^Rufous Fantail
46	*Sericornis frontalis*	White-browed Scrubwren
47	*Strepera graculina*	Pied Currawong
48	*Trichoglossus haematodus*	Rainbow Lorikeet
49	*Vanellus miles*	Masked Lapwing
50	*Zosterops lateralis*	Silvereye
Mammals		
1	*Antechinus stuarti*	Brown Antechinus
2	**Cervus timorensis*	*Deer
3	*#+Chalinolobus dwyeri*	#+Large-eared Pied Bat
4	*Chalinolobus gouldii*	Gould's Wattled Bat
5	*Chalinolobus morio*	Chocolate Wattled Bat
6	*#Falsistrellus tasmaniensis*	# Eastern False Pipistrelle
7	**Felis catus*	*Cat
8	*Macropus rufogriseus*	Red- necked Wallaby
9	*#Miniopterus australis*	# Little Bentwing-bat
10	*#Mormopterus norfolkensis*	# Eastern Freetail-bat
11	*#Myotis macropus*	# Large-footed Myotis
12	*Nyctophilus sp.*	Unidentified Long-eared Bat
13	*Petaurus breviceps*	Sugar Glider
14	*#+Phascolarctos cinereus*	#+Koala
15	*Rattus fuscipes*	Bush Rat

	Scientific Name	Common Name
16	*Rattus lutreolus*	Swamp Rat
17	**Rattus rattus*	*Black Rat
18	*Tadarida australis*	White-striped Freetail-bat
19	*Tarida australis*	White Striped Mastif Bat
20	*Trichosurus vulpecula*	Common Brushtail Possum
21	*Vespadelus pumilus*	Eastern Forest Bat
22	*#Vespadelus troughtoni*	# Eastern Cave Bat
23	*Vespadelus vulturnus*	Little Forest Bat
Reptiles		
1	*Dendrelaphis punctulata*	Green Tree Snake
2	*Lampropholis delicata*	Delicate Skink
3	*Physignathus lesueurii*	Eastern Water Dragon
4	*Pseudonaja textilis*	Eastern Brown Snake
5	*Tiliqua scincoides scincoides*	Blue Tongue Lizard

# denotes a threatened species listed as Vulnerable under the TSC Act
+ denotes a threatened species listed as Vulnerable under the EPBC Act
^ denotes an EPBC Act-listed migratory species
* denotes an introduced species

APPENDIX 10: BRUSH-TAILED PHASCOGALE HABITAT MAPPING

The information detailed below is provided due to questions raised by Port Stephens Council in their submission regarding the proposed development. Council "noted that important habitat for the Brush-tailed Phascogale is known within Kings Hill, located to the south of the proposed development. Accordingly, potential cumulative impacts should be assessed".

In response to Council's submission, the cumulative impact on Brush-tailed Phascogale habitat within a 10 km radius of the study area has been estimated using data available to Kleinfelder. This includes data from the EcoBiological (2010) study of the Kings Hill development, LHCCREMS vegetation map data and Port Stephens Council zoning maps. It is acknowledged that more recent studies have been completed for the Kings Hill development; however, this data is not publicly available. As such, the values calculated by Kleinfelder for the 10 km locality is acknowledged to be broad and is likely to over-estimate the cumulative impacts on Phascogale habitat.

The LHCCREMS vegetation communities treated as Phascogale habitat in this assessment are listed in **Table 20**. These LHCCREMs communities have been matched with vegetation types listed on the OEH threatened species profile page for the Brush-tailed Phascogale within the Hunter – Central Rivers CMA (link provided below).

http://www.environment.nsw.gov.au/threatenedspeciesapp/profileData.aspx?id=10613&cmaName=Hunter-Central+Rivers

The Council zones that are considered to retain Phascogale habitat include:

- E1 – National Parks and Nature Reserves
- E2 – Environmental Conservation
- E3 – Environmental Management
- RE1 – Public Recreation
- RE2 – Private Recreation
- SP1 – Special Activities (Hunter Water Land)
- W1 – Natural Waterways

- W2 – Recreational Waterways

The vegetation within these zones is protected by the zone objectives and by the associated restrictions on development in that zone. With respect to Hunter Water land, the retention of native vegetation is a key part of the management of the catchment's water supply and is unlikely to be cleared on any substantial scale.

Table 20: Brush-tailed Phascogale Habitat Mapping results

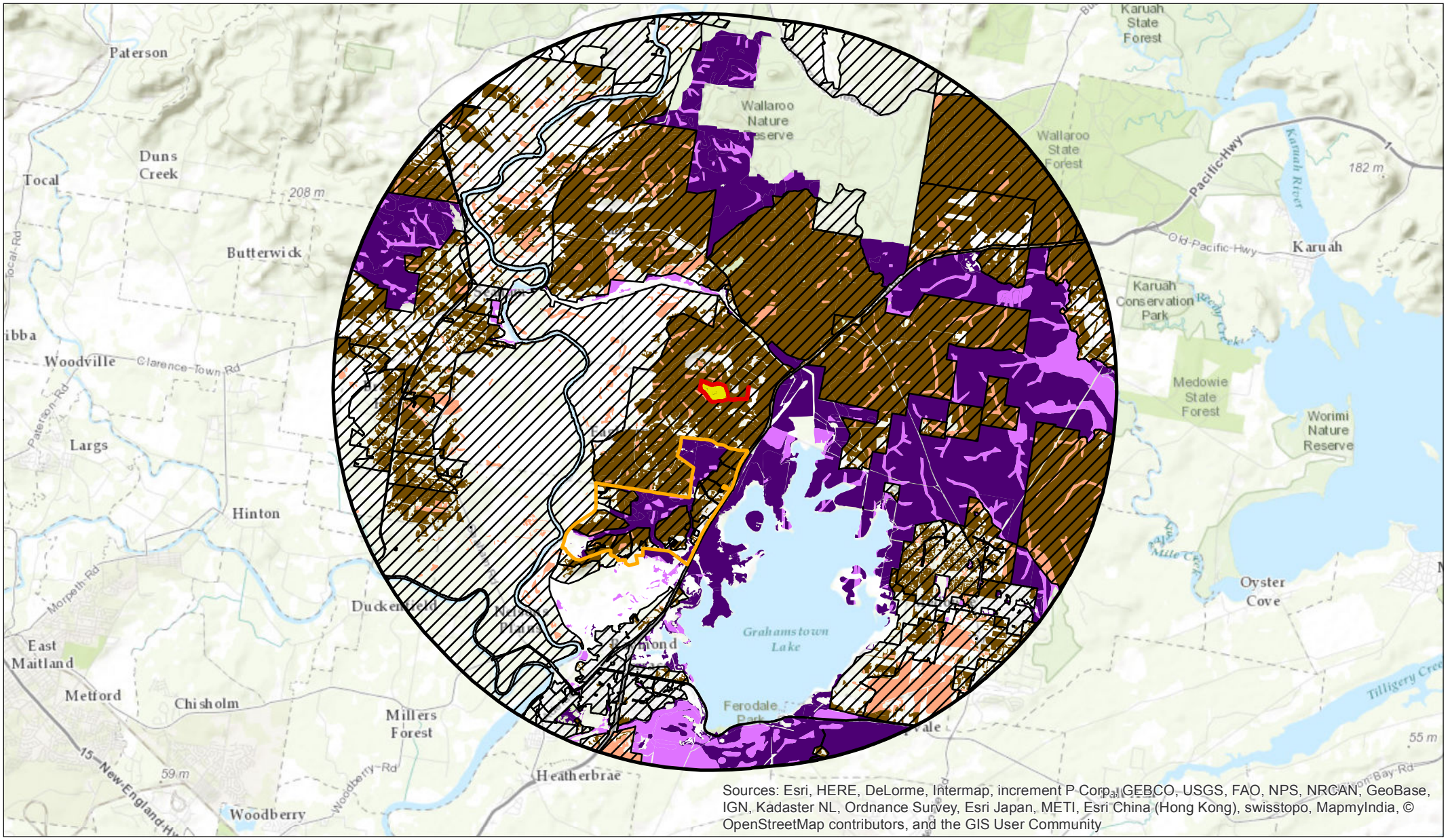
Brush-tailed Phascogale Habitat Classification / Community	Area (ha) within Conservation Zoning	Area (ha) within Development Zoning	Totals (ha)
Marginal			
Alluvial Tall Moist Forest	17	142	159
Coastal Narrabeen Moist Forest	17	21	38
Coastal Ranges Open Forest	1	120	121
Coastal Sand Wallum Woodland - Heath	241	8	249
Coastal Sheltered Apple - Peppermint Forest	1	4	5
Dry Rainforest Canopy Dominant	27	3	30
Hunter Valley Dry Rainforest	144	221	365
Riparian Melaleuca Swamp Woodland	569	295	864
Swamp Mahogany - Paperbark Forest	251	288	539
Swamp Oak Rushland Forest	23	57	80
Swamp Oak Sedge Forest	42	127	169
Sub-total	**1333**	**1286**	**2619**
Optimal			
Coastal Plains Scribbly Gum Woodland	4	96	100
Coastal Plains Smooth-barked Apple Woodland	3077	4636	7713
Coastal Sand Apple - Blackbutt Forest	449	45	494
Hunter Lowland Redgum Forest	23	165	188
Hunter Valley Moist Forest	771	1063	1834
Lower Hunter Spotted Gum - Ironbark Forest	41	695	736
Seaham Spotted Gum Ironbark Forest	861	3155	4016
Sub-total	**5226**	**9855**	**15081**
Grand Total	**6559**	**11141**	**17700**

The total mapped Optimal habitat within 'conservation' zonings within a 10 km radius of the study area was 5,226 ha compared with 9,855 ha within 'development' zonings, resulting in a grand total of 15,081 ha of Optimal Brush-tailed Phascogale habitat in the locality (**Figure 13**, **Table 20**).

The cumulative area of impact on Phascogale habitat (based on the current development proposal and the Kings Hills development (ecobiological (2010) development footprint)) is estimated to be 281 ha of optimal habitat (dry sclerophyll forest and woodland types) (**Figure**

13). This represents approximately 3% of the mapped optimal habitat within current 'development' zonings and 2% of the total optimal habitat available in the locality. Currently, the area of optimal and marginal Brush-tailed Phascogale habitat in reserves or retained under conservation zoning provisions is 6,559 ha (or 37%).

Therefore, it is concluded that cumulative impacts (NB: restricted to assessing the current proposal and the Kings Hills development – as details of any other development applications within adjoining lands are not known) on the local Brush-tailed Phascogale population are unlikely to be significant.



- Project Footprint
- Kings Hill Proposed Development
- 10km Buffer around Footprint
- Habitat in Development Area
- Development Zoning
- Marginal Habitat
- Optimal Habitat
- Marginal Habitat in development zoning
- Optimal Habitat in development zoning

Kilometres
0 0.5 1 2

GDA 94 MGA zone 56

1:140,000

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DATA SOURCE:
NSW Land and Property Information - 2016
Hunter CMA - 2013
nearmap - 2016

Brush-tailed Phascogale Habitat within 10km

Eagleton Rock Syndicate Pty Ltd
Biodiversity Offset Strategy
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:

13

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APPENDIX 11: STAFF CONTRIBUTIONS

The qualifications, title, and contribution of each staff member involved in this assessment are outlined in the following table.

Name	Qualification	Title/Experience	Contribution
Adam Blundell	B. Env Sc. (Hons)	Principal Ecologist	Report review (2016)
Aaron Mulcahy	BEnv Sc & Mgt MScStud (Botany) Accredited Biobanking Assessor (no. 172)	Senior Ecologist	Vegetation surveys, credit calculations, and report writing (2016)
Dan Pedersen	BSc (Biology)	Senior Ecologist	Targeted threatened flora surveys, vegetation mapping and report review (2013)
Gayle Joyce	BSc (Forestry) (Hons)	GIS Specialist	GIS and figure preparation
Gilbert Whyte	PhD	Senior Ecologist	Riparian Habitat Assessment
Kristy Peters	B. ParkMgt (Hons)	Senior Ecologist	Report review (2016) and report update (2017)
Luke Foster	B. Sc. Env & Mgt M. Env Sci	Ecologist	Fauna trapping and nocturnal surveys, anabat analysis, SAT Tests and report writing (2013)
Philippa Fagan	BBioCons	Ecologist	Vegetation surveys (2016)
Samara Schulz	B. Env Sc. & Mgt (Hons) Accredited Biobanking Assessor (no. 167)	Senior Ecologist	Targeted threatened flora surveys, vegetation mapping, SAT Tests and report writing (2013)
Steve Williams	BSc (Ecology)	Ecologist	Vegetation surveys (2016)