BIODIVERSITY ASSESSMENT REPORT

PREPARED FOR
MARTINS CREEK QUARRY

STATION STREET
MARTINS CREEK

AUGUST 2016
REF: 6016

BIODIVERSITY ASSESSMENT REPORT

PREPARED FOR
MARTINS CREEK QUARRY

STATION STREET
MARTINS CREEK

AUGUST 2016

Conacher Consulting Pty Ltd

Environmental and Land Management Consultants

PO Box 4082, East Gosford NSW
Phone: 02 4324 7888
conacherconsulting@gmail.com

PREFACE

Conacher Consulting has been engaged to prepare a Biodiversity Assessment Report for the proposed Martins Creek Quarry Extension Project as part of the Environmental Impact Statement (EIS) documentation for the Project.

The proposed development is State Significant Development under the *Environmental Planning and Assessment Act* (1979) (Application Number SSD 6612) and this Biodiversity Assessment Report has been prepared by *Conacher Consulting* to address the Secretary's Environmental Assessment Requirements in relation to Biodiversity for the Martins Creek Quarry Expansion Project.

PROJECT TEAM

Report prepared by:

JACOB MANNERS B.Sc. (Senior Ecologist / Project Manager)
BioBanking Assessor Accreditation Number: 0132

Document review completed by:

PHILLIP ANTHONY CONACHER B.Sc.(Hons), Dip.Urb Reg Planning, M.Nat.Res.
Project Director

Field surveys completed by:

JACOB MANNERS B.sc (Senior Ecologist / Project Manager)

BRYAN FURCHERT B.BioCons (Sub-consultant Botanist)

DEAN CONACHER (GIS and field survey technician)

NPWS Scientific Licence Number: SL100361

Map production completed by:

ASHLEY MULLAHEY B.EnvScMgt in progress (GIS Technician)

DEAN CONACHER (GIS and field survey technician)

DOCUMENT DETAILS	
Project Name	Martins Creek Quarry Extension Project (SSD 6612)
Our Reference No.	6016
Status	Final Report
Version Number / Date	FV4 / 19 August 2016
Previous Versions	FV3 / 10 June 2016 (5008)
Revision Details	Revised to address EPBC Act Bilateral Assessment Requirements / Minor text and content edits

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

Definitions of Key Abbreviations and Terms Utilised	
SSD	State Significant Development
SEARS	Secretary's Environmental Assessment Requirements
EIS	Environmental Impact Statement
FBA	Framework for Biodiversity Assessment (OEH 2014)
DoEE	Australian Government Department of the Environment and Energy
OEH	Office of Environment and Heritage
TSC Act	Threatened Species Conservation Act (1995)
EP&A Act	Environmental Planning and Assessment Act (1979)
EPBC Act	Environment Protection and Biodiversity Conservation Act (1999)
EEC	Endangered ecological listed within the TSC Act or the EPBC Act
CEEC	Critically endangered ecological community listed within the TSC Act or the EPBC Act
VEC	Vulnerable ecological community listed within the TSC Act or the EPBC Act
Species Credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Species Profile Database.
Ecosystem Credit	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at an offset site

Note: For additional definitions in relation to key assessment terms used please refer to the published FBA documentation (OEH 2014a).

SECTION 1

INTRODUCTION AND BACKGROUND

1.1 BACKGROUND AND STUDY AIMS

Conacher Consulting has been engaged to prepare a Biodiversity Assessment Report for the proposed Martins Creek Quarry Extension Project as part of the Environmental Impact Statement (EIS) documentation for the Project, to address the Secretary's Environmental Assessment Requirements (SEARS) in relation to Biodiversity for the Martins Creek Quarry Expansion Project. The proposed development is State Significant Development (SSD) under the *Environmental Planning and Assessment Act* (1979) (Application Number SSD 6612).

The biodiversity assessment requirements for the proposal are set out in the revised Secretary's Environmental Assessment Requirements dated 22 May 2015. This report has been prepared to:

1. Identify the flora and fauna characteristics of the site; and
2. Provide biodiversity impact and offset assessments in accordance with the NSW Framework for Biodiversity Assessment and the NSW Biodiversity Offsets Policy for Major Projects as required by the Secretary's Environmental Assessment Requirements.

The proponents Biodiversity Offset Strategy is provided as separate documentation to this report.

The NSW Framework for Biodiversity Assessment is an accredited assessment process under the *Environment Protection & Biodiversity Conservation Act* 1999 (EPBC Act) NSW Assessment Bilateral Agreement. This report also provides the information identified in the Guidelines for preparing Assessment Documentation relevant to the *EPBC Act*, provided as part of the SEARS.

1.2 PROPOSED DEVELOPMENT DESCRIPTION

The development assessed in this report is the proposed Martins Creek Quarry Expansion Project.

The proposal seeks approval for:

- Extracting up to 1.5 million tonnes of hard rock material per annum;
- Expanding into new extraction areas and clearing approx. 36.8ha existing vegetation;
- Increasing the hours of operation for:-
- quarrying from 6am-6pm (Monday to Saturday),
- processing from 6am-10pm (Monday to Saturday),
- mixing and binding from 4:30am-10pm (Monday to Friday) and 4:30am-6pm (Saturdays),
- stockpiling, loading and dispatch of road transport to 5:30am-7pm (Monday to Saturday), and
- train loading 24 hours per day, 7 days per week;
- Consolidating existing operations and approvals;
- Construction of a new access driveway and bridge; and
- Rehabilitating the site.

The subject site location in the context of the locality is shown in Figure 1.1. The study area and development footprint location are shown in Figure 1.2.

1.3 STUDY AREA DETAILS

The planning and cadastral details of the study area are provided in Table 1.1.

TABLE 1.1 SITE DETAILS	
Subject Site	Lots 2, 5 & 6 DP 242210 Lot 42 DP 815628 Lot 21 DP 773220 Lot 1 DP 1006375 Lot 1 DP 204377
Subject Site Size	125.5 ha approx.
Study Area (Proposed Impact / Development Area Footprint)	82.8 ha
State	New South Wales
Local Government Area	Dungog
Major Catchment Area	Hunter – Central Rivers
Existing Land Use	Extractive industries

1.4 LEGISLATIVE CONTEXT

1.4.1 Commonwealth Biodiversity Legislation

***Environmental Protection and Biodiversity Conservation Act* 1999**

A referral has been submitted in accordance with the *EPBC Act* (1999) to the Australian Government Department of the Environment and Energy (DOEE). The DOEE have determined that the proposed development is a controlled action and will require assessment and approval under the *EPBC Act* (1999).

For SSD, the Commonwealth approval process is integrated with the NSW approval process in accordance with the Assessment Bilateral Agreement between the Commonwealth of Australia and the State of New South Wales made under Section 45 of the *EPBC Act* (1999).

The Framework for Biodiversity Assessment (NSW OEH 2014a) and NSW Biodiversity Offsets Policy for Major Projects (NSW OEH 2014b) are to be utilised for the assessment of the proposal in accordance with the Assessment Bilateral Agreement. The supplementary assessment requirements provided by the DOEE in the SEARS are also addressed within this report.

1.4.2 New South Wales Biodiversity Legislation

***Environmental Planning and Assessment Act* 1979**
The proposed development requires approval under Part 4 of the *Environmental Planning and Assessment Act* (1979) (EP&A Act) and has been declared State Significant Development under the Act.

The likely impacts of the proposed development on biodiversity are required to be addressed in accordance with the SEARS, as required under Section 78A(8A) of the *EP&A Act* (1979).

The SEARS have identified that the EIS must address the following specific matters in relation to Biodiversity:

- An assessment of the likely biodiversity impacts of the project, having regard to OEH's and the Commonwealth Department of the Environment's (DoE) requirements (as per Attachment 2 of the revised SEARS dated 4 August 2016);
- An offset strategy prepared in accordance with OEH and DoE requirements;

This report provides biodiversity impact and offset assessments in accordance with the NSW Framework for Biodiversity Assessment (NSW OEH 2014a) and the NSW Biodiversity Offsets Policy for Major Projects (NSW OEH 2014b) as required by the SEARS. A Biodiversity Offset Strategy for

the proposal has been provided as separate documentation to this report (Conacher Consulting 2016a).

***Threatened Species Conservation Act* 1995**

The *Threatened Species Conservation Act* (1995) (TSC Act) lists threatened species, populations and ecological communities, declared critical habitat, key threatening processes and allows for the preparation of Recovery Plans and Threat Abatement Plans (excluding fish and marine vegetation). The *TSC Act* also makes provision for assessor accreditation and the Biobanking offsets scheme.

***Fisheries Management Act* (1994)**

The *Fisheries Management Act* (1994) (FM Act) lists threatened fish and marine vegetation, populations and ecological communities and their habitats within NSW. The Act also lists declared critical habitat, key threatening processes and allows for the preparation of Recovery Plans and Threat Abatement Plans for fish and marine vegetation.

State Environmental Planning Policies

The General Requirements and Attachment 1 of the SEARS have identified that State Environmental Planning Policy 44 Koala Habitat Protection (SEPP 44) may be relevant to the proposal. Part 2 of SEPP 44 has been addressed within this report.

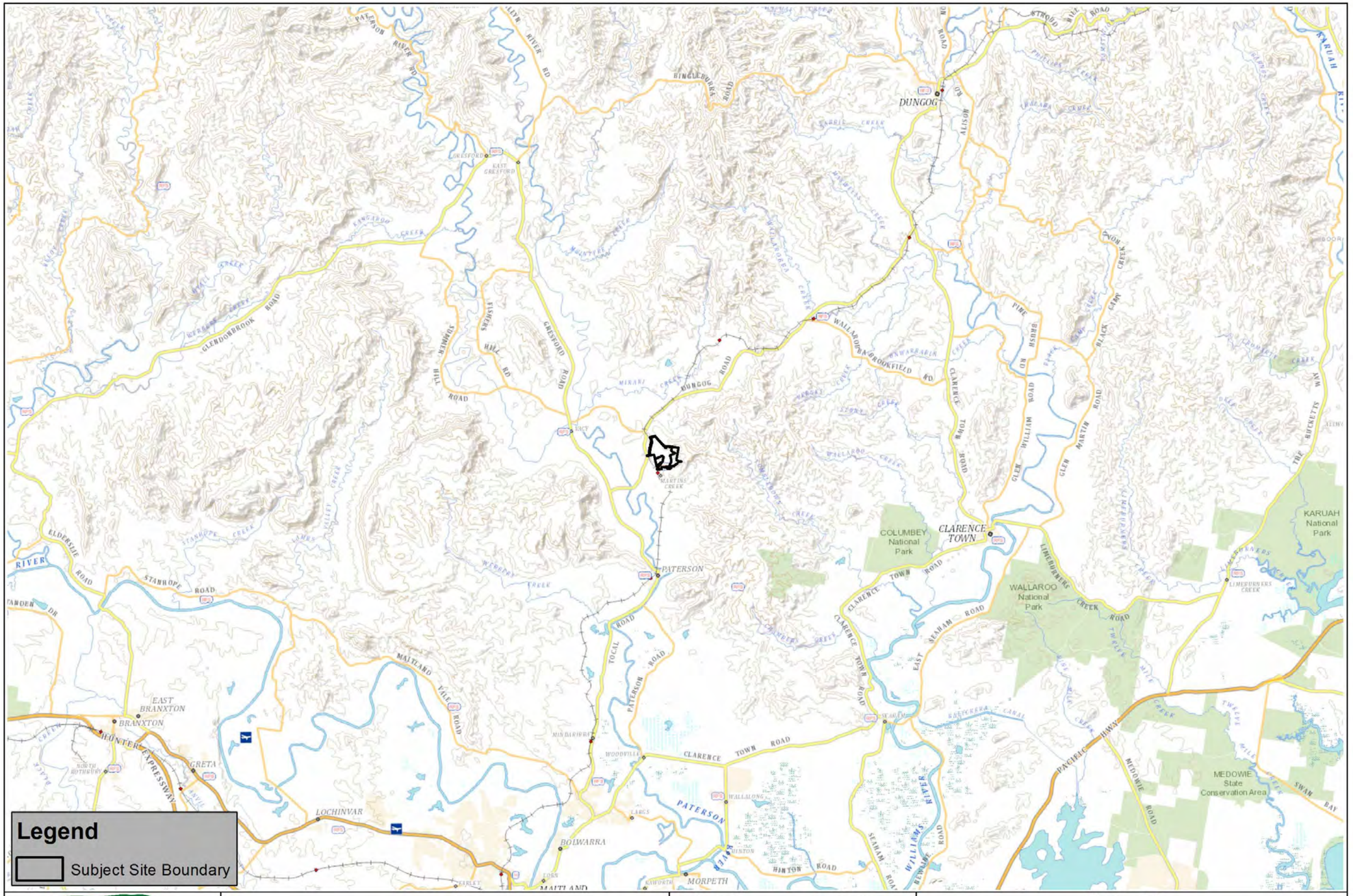

Figure 1.1
Subject SIte Location in Context of Locality
Martins Creek Quarry

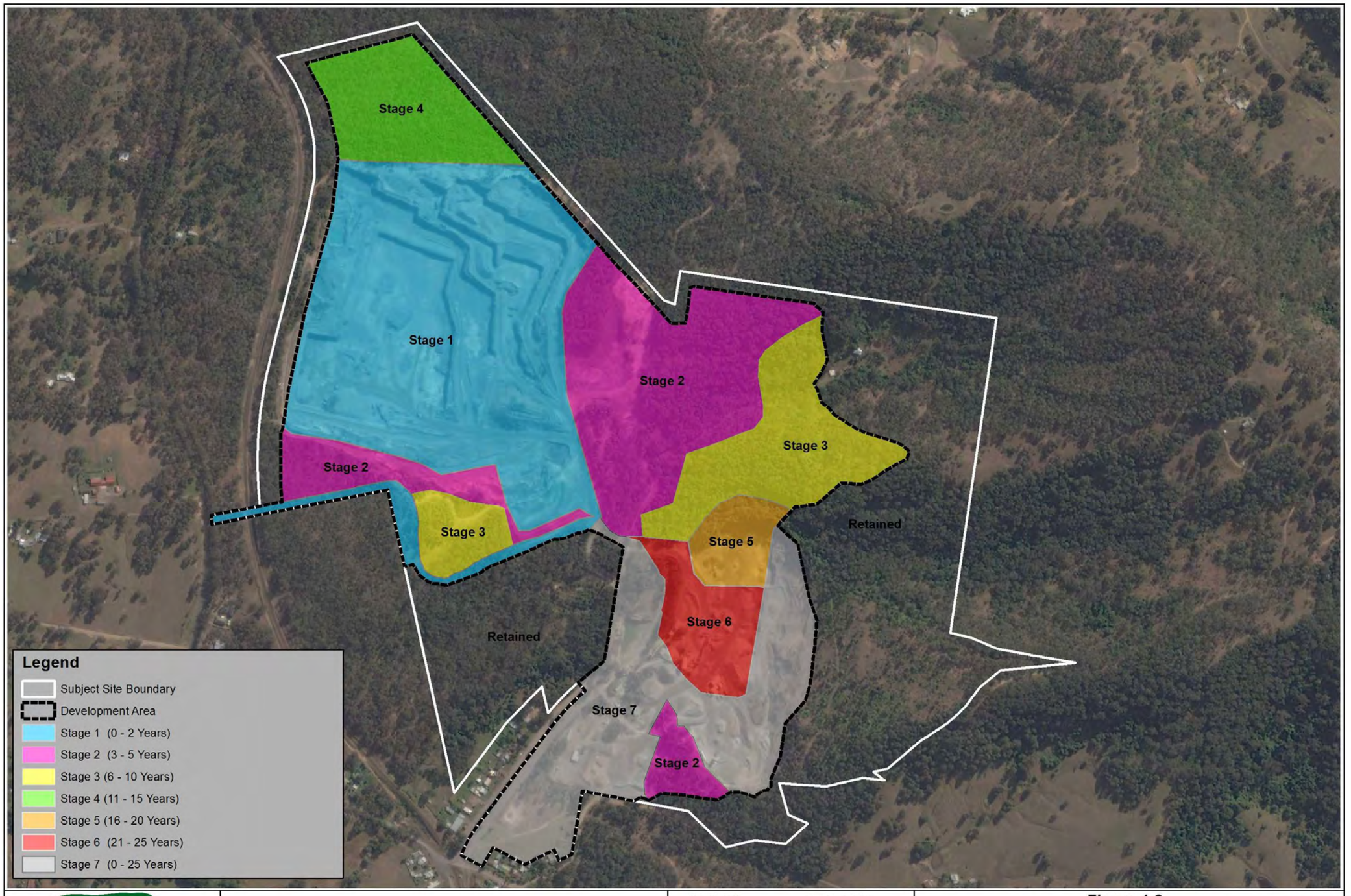

Figure 1.2
Subject Site Location & Development Stage Areas
Martins Creek Quarry

SECTION 2

LANDSCAPE FEATURES

2.1 Methodology for Identification of Landscape Features

The Landscape Features for the project site were identified by assessment of the standard datasets obtained from the OEH Data Portal website (NSW OEH 2016a) and aerial photograph interpretation.

2.2 Description of Landscape Features

The landscape features identified are documented in Table 2.1 and are shown in the corresponding Figures 2.1 to 2.4.

TABLE 2.1
LANDSCAPE VALUE DETAILS

Landscape Feature	Description	Figure Reference
IBRA Region (Version 4.1)	New South Wales North Coast	Figure 2.1
IBRA Sub-Region	Upper Hunter	Figure 2.1
Mitchell Landscape (Version 3)	Scone – Gloucester Foothills	Figure 2.1
Rivers	None	Figure 2.2
Streams	1st, 2nd and 3rd order streams present	Figure 2.2
Estuaries	None	Figure 2.2
Wetlands	None	Figure 2.2
Native Vegetation Extent (outer assessment circle)	Before development: 36-40% (1114 ha) After development: 36-40% (1081.7 ha)	Figure 2.3
Native Vegetation Extent (inner assessment circle)	Before development: 56-60% (181 ha) After development: 46-50% (148.6)	Figure 2.3
% Native Vegetation Score	0.80	NA
Assessment Circle Score	24.8	NA
Patch Size	>1000ha (approx. 7900 ha)	Figure 2.3
Patch Size Score	12	NA
Connectivity Value	**Width** Before Development: >100m – 500m After Development: >0m – 5m **Woody Vegetation** **Over storey condition** Before Development: PFC at BM After Development: No cover **Woody Vegetation** **Mid storey / ground cover condition** Before Development: PFC at BM After Development: No cover	Figure 2.4
State Significant Biodiversity Linkages	None identified	NA
Regionally Significant Biodiversity Linkages	None identified	NA
Other Landscape Features	None identified	NA

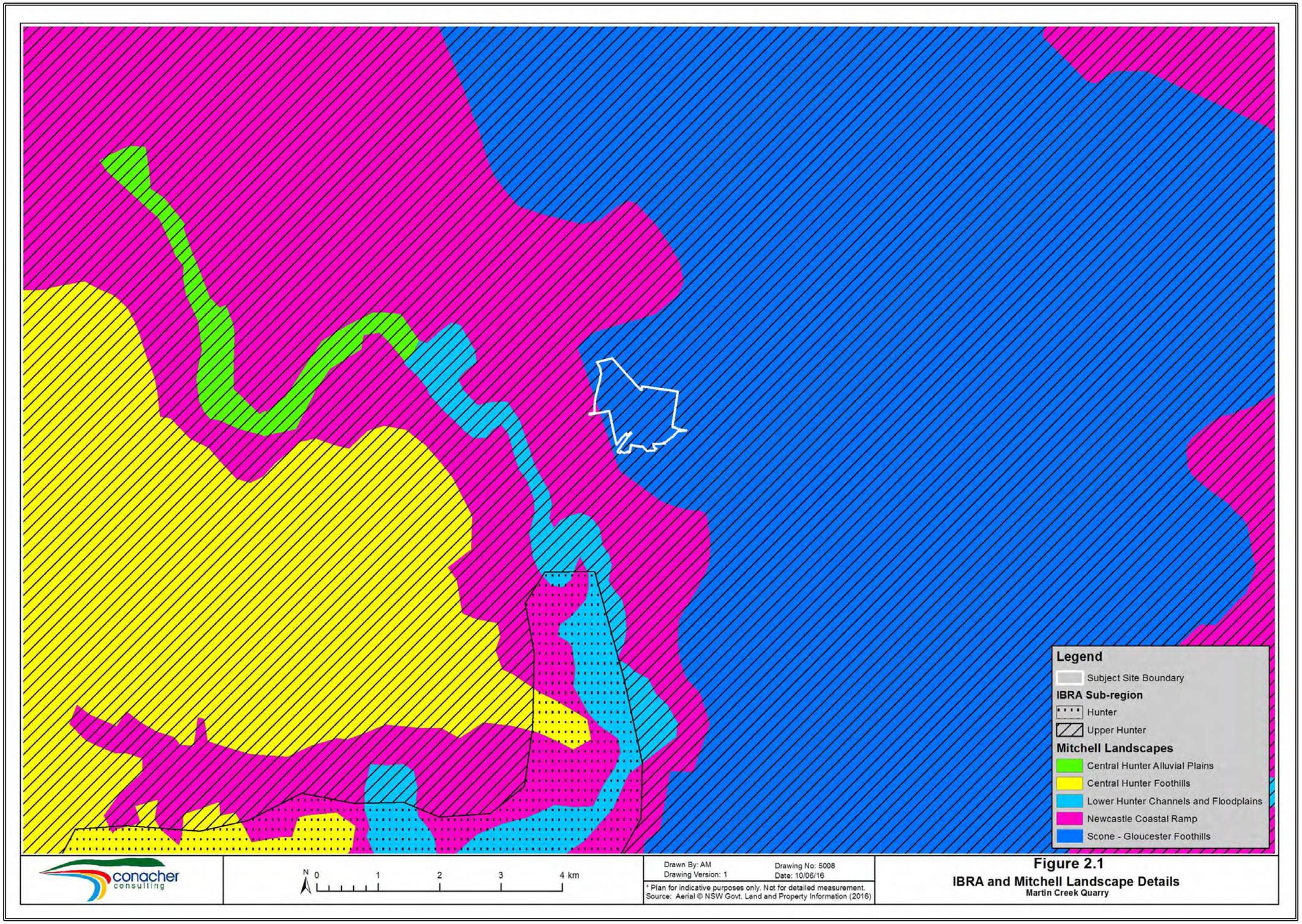

Figure 2.1
IBRA and Mitchell Landscape Details
Martin Creek Quarry

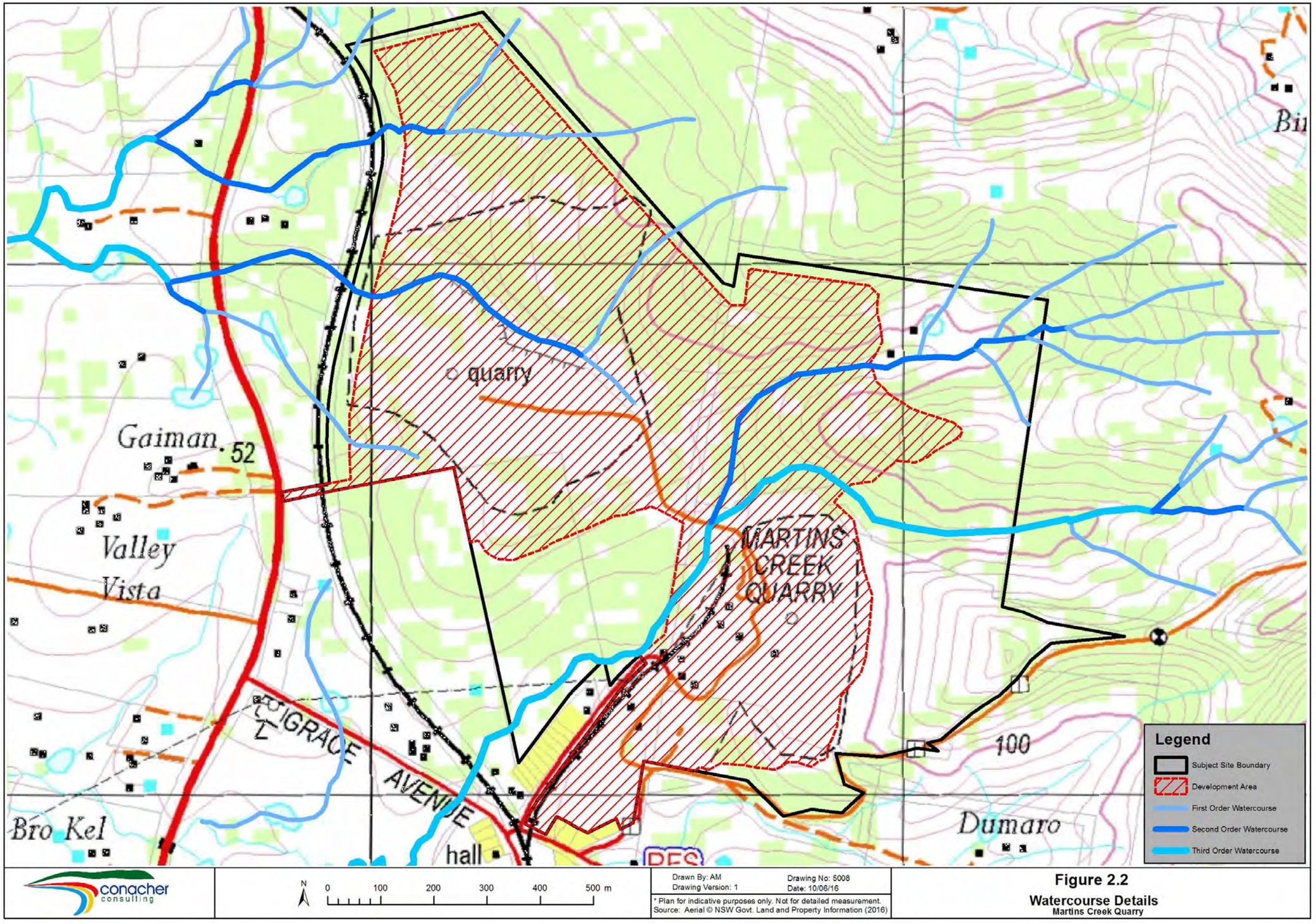

Figure 2.2
Watercourse Details
Martins Creek Quarry

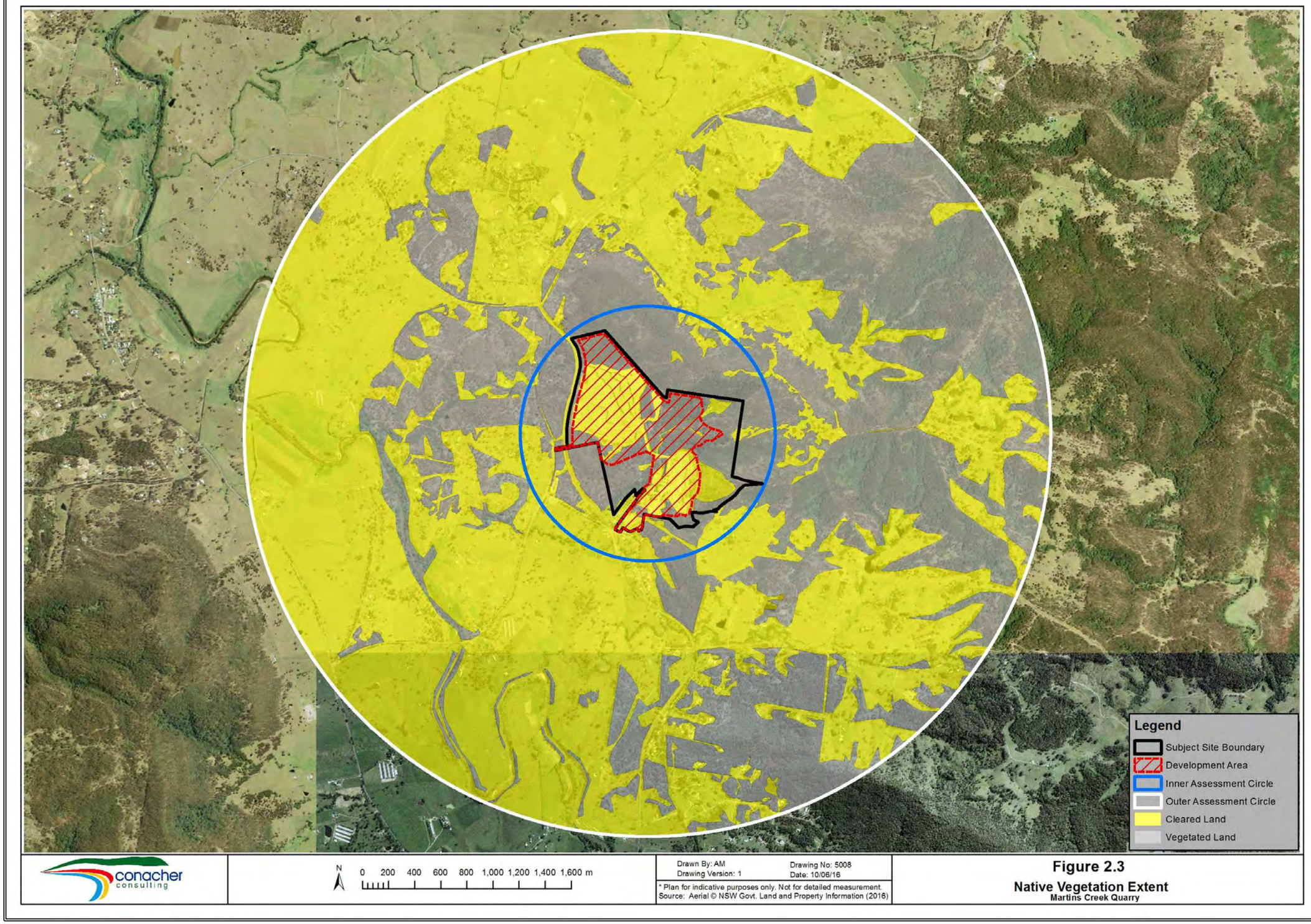

Figure 2.3

Native Vegetation Extent

Martins Creek Quarry

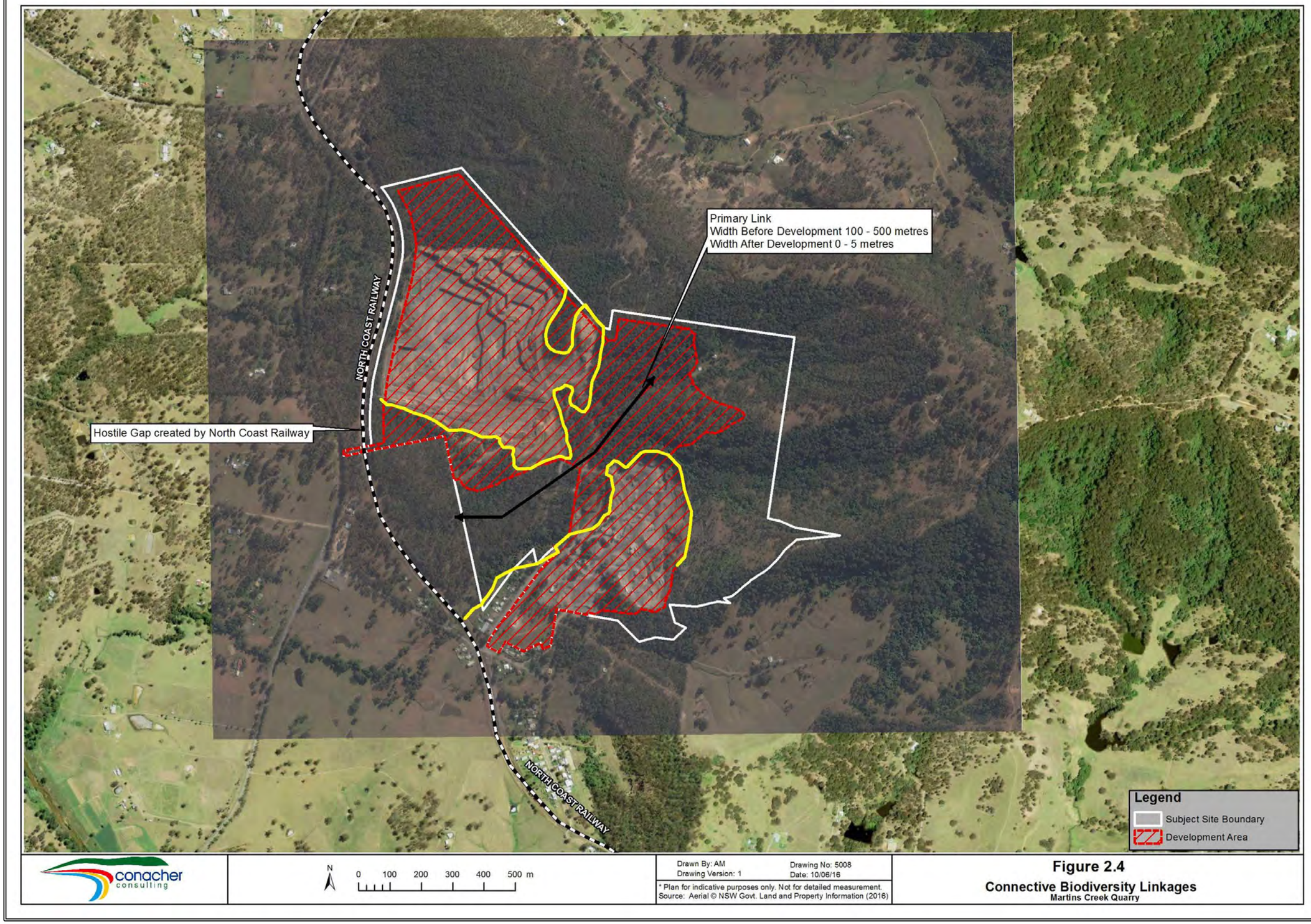

Figure 2.4
Connective Biodiversity Linkages
Martins Creek Quarry

SECTION 3

FIELD SURVEY & ASSESSMENT METHODS

3.1 Flora Survey and Assessment Methods

3.1.1 Database Searches and Literature Review

Review of the Bionet Atlas of NSW Wildlife (NSW OEH 2016b) and assessment with the FBA Calculator was undertaken to determine the threatened flora species and populations which required surveys and assessment.

The profiles of the threatened flora species on the NSW Threatened Species Profile Database (NSW OEH 2016c) were utilised to determine the following:

- Threatened flora species within the IBRA subregion;
- General information and requirements on habitat, ecology and threats;
- Credit classification (ecosystem or species type);
- The plant community type habitat associations;
- Associated percent native vegetation cover class (outer assessment circle);
- Minimum patch size associations;
- Ability to occupy low condition vegetation;
- Specific habitat features associated with occurrence;
- Geographic features associated with occurrence;
- Ability to withstand further loss; and
- Time of year identifiable through survey.

Literature Review
A review of available literature for the area was undertaken to obtain reference material and background information for this study. The following sources were reviewed as part of the flora assessment undertaken:

- Vegetation Information System (NSW OEH 2016d)
- The Vegetation of Tocal (Brouwer and Gillespie 2007)
- The Vegetation and Floristics of Columbey National Park, lower Hunter Valley, New South Wales (Bell 2009)
- Greater Hunter Vegetation Mapping V4 (Roff *et al*., 2012)
- Assessment of the Greater Hunter Mapping within the Upper Hunter (Hunter 2015)
- Flora and Fauna Impact Assessment for Proposed New Sedimentation Structures at Martins Creek Quarry, Dungog LGA (Ecotone Ecological Consultants 2010).

Current aerial photographs available from (Nearmap 2016) were also reviewed to identify the extent of vegetation and habitat information with respect to the site and surrounding areas.

3.1.2 Flora Survey Details

Plot and Transect Surveys
Plot and transect based flora surveys were undertaken within vegetated areas of the subject site in accordance with the stratification and methodology requirements of NSW OEH (2014a) and NSW DEC (2004).

Flora species observed were identified using the keys and nomenclature of Plantnet New South Wales Flora Online (Royal Botanic Gardens and Domain Trust 2016). Additional resources were also utilised where available and are listed in the references section of this report.

Specimens of plants not readily identified in the field were collected and/or photographed for identification. Specimens of plants tentatively identified as threatened species were sent to the Sydney Royal Botanic Gardens for confirmation of the identification.

Plot and transect surveys were undertaken on 18, 19 and 20 August 2015. A total of 15 plots and transects were sampled throughout the site with recording of all flora species observed. Relative abundance and an estimate of the percentage cover of each species observed within plots were recorded.

The vegetation community types and zones observed and corresponding site survey stratification details are listed in Table 3.1. Plot and transect surveys locations are shown in Figure 3.1.

TABLE 3.1
VEGETATION ZONE SURVEY STRATIFICATION

Vegetation Community / Zone	Condition	TSC Act Listing Status	Extent	Plot / Transect Stratification
HU 798 White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley	Good	Not listed	Subject site = 16.05 Development Site = 9.8	Required: 3 Sampled: 5 Requirement exceeded
HU 816 Spotted Gum – Narrow-leaved Ironbark shrub-grass open forest of the Central and Lower Hunter	Good	Does not correspond to Lower Hunter Spotted Gum - Ironbark Forest for the Sydney Basin Bioregion EEC Does correspond to preliminary determination for Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions	Subject site = 10.5 Development Site = 3.19	Required: 2 Sampled: 2 Requirement achieved
HU 619 Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast	Good	Not listed	Subject site = 22.09 Development Site = 9.4 ha	Required: 3 + 1 Sampled: 4 + 1 Requirement exceeded
HU 755 Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River	Good	Listed as Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions EEC	Subject site = 8.44 Development Site = 5	Required: 3 Sampled: 3 Requirement achieved
Cleared Land and Landscape Rehabilitation Areas.	Cleared Land	Not listed	Subject site = 68.4 Development Site = 55.4	None required

Targeted Searches for Threatened Flora Species
In addition to quadrat surveys, searches for threatened flora species were undertaken on the following dates:

- 20 August 2014 (1hr)
- 21 August 2014 (7hrs)
- 5 September 2014 (3hrs)
- 30 September 2014 (2hrs)
- 18 February 2015 (10hrs)
- 19 February 2015 (12hrs)
- 20 February 2015 (2hrs)
- 10 June 2015 (5hrs)
- 11 June 2015 (5hrs)
- 17 August 2015 (6hrs)
- 18 August 2015 (8hrs)
- 19 August 2015 (8hrs)
- 20 August 2015 (8hrs)
- 21 August 2015 (2hrs)
- 15 September 2015 (5hrs)
- 16 September 2015 (8hrs)
- 17 September 2015 (9hrs)
- 18 September 2015 (2hrs)
- 14 October 2015 (4.5hrs)

Surveys for species credit type threatened flora species were undertaken in accordance with the following methods:

Cynanchum elegans
This species was targeted during all flora searches through all plant community types. Searches were conducted while undertaking vegetation mapping and while searching for seasonal flowering threatened flora species.

Eucalyptus glaucina
Field traverses were undertaken across the vegetated areas of the subject site to determine the distribution of this species as part of vegetation mapping surveys. The *E. glaucina* specimens observed were mapped within the Slaty Red Gum Grassy Woodland on Hinterland Foothills of the Southern North Coast plant community type.

A total of thirteen (13) quadrats of 20x50m (1000m^2) size were surveyed within the identified distribution of this species within the subject site. The quadrat surveys for *E. glaucina* were undertaken on the 16th and 17th of September 2015.

Each quadrat was set out with a compass and marked in the field with flagging tape during the survey. GPS coordinates were recorded for each quadrat to enable mapping of survey quadrat locations on a plan of the site. The total number of all *E. glaucina* trees and saplings present within the quadrats were counted. Each *E. glaucina* individual within the quadrats was marked within spray paint to ensure none were missed or double counted.

The density of *E. glaucina* individuals present was determined for each quadrat which enabled the average density of the combined quadrats to be calculated and determination of the average density of *E. glaucina* per square metre of habitat.

The total number of *E. glaucina* individuals present across the site and within both areas to be retained and areas to be removed was estimated based on extrapolation of the survey results.

Some potential hybridisation between *Eucalyptus glaucina* and *Eucalyptus tereticornis* was observed, however these potential hybrid trees were assumed to be *Eucalyptus glaucina* as a precautionary measure.

Pterostylis chaetophora
This species was targeted during traverses across the site through all vegetation types, undertaken during the flowering season identified by the OEH on the following dates:

- 5 September 2014 (3hrs)
- 30 September 2014 (2hrs)
- 15 September 2015 (5hrs)
- 16 September 2015 (8hrs)
- 17 September 2015 (9hrs)
- 18 September 2015 (2hrs)
- 14 October 2015 (4.5hrs)

Senna acclinis
This species was targeted during all flora searches, particularly through the rainforest vegetation present and adjoining areas. Searches were conducted while undertaking vegetation mapping and while searching for seasonal flowering threatened flora species.

Vegetation Community Identification
Following a review of available vegetation mapping for the area and assessment of aerial photographs, a field survey which consisted foot traverses within vegetated areas was conducted to identify the occurrence of plant community types present across the subject site.

Plant community types present within the site were mapped and classified based on analysis of dominant and characteristic plant species, aerial photographs, field surveys and existing available vegetation mapping. This assisted with identification of any corresponding endangered ecological communities listed on either the *TSC Act* (1995) and/or *EP&BC Act* (1999).

Native vegetation communities were classified and described according to corresponding plant community types identified in the NSW Vegetation Information System (NSW VIS) (NSW OEH 2016d).

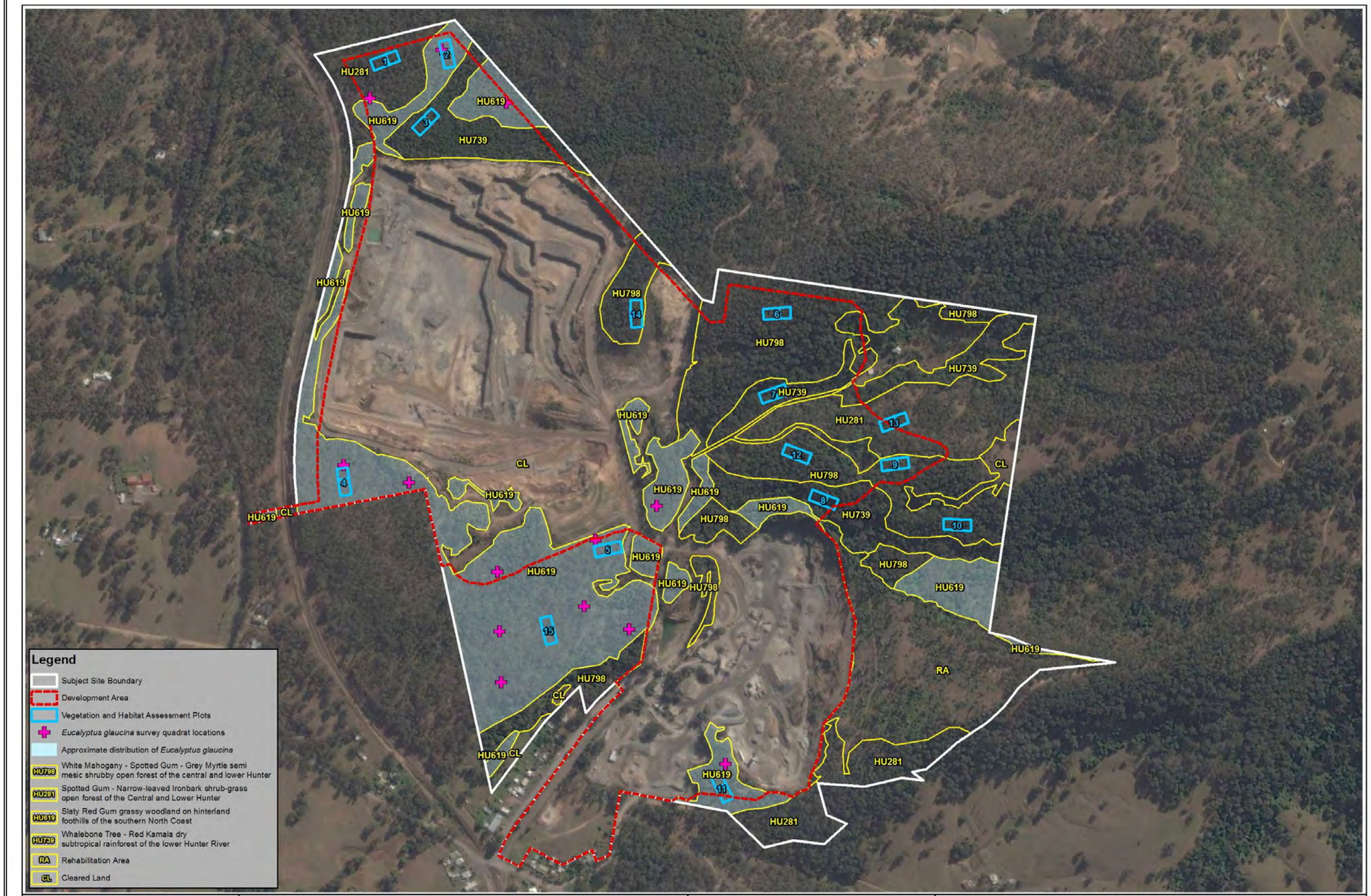

Figure 3.1
Flora Characteristics
Martins Creek

3.2 Fauna Survey and Assessment Methods

3.2.1 Database Searches and Literature Review

Review of the Bionet Atlas of NSW Wildlife (NSW OEH 2016b) and assessment with the FBA Calculator was undertaken to determine the threatened fauna species and populations which required surveys and assessment.

The profiles of the threatened fauna species on the NSW Threatened Species Profile Database (NSW OEH 2016c) were utilised to determine the following for threatened fauna species:

- Threatened fauna species within the IBRA subregion;
- Information and requirements on habitat, ecology and threats for threatened fauna species;
- Credit classification (ecosystem or species type);
- The plant community type habitat associations;
- Associated percent native vegetation cover class (outer assessment circle);
- Minimum patch size associations;
- Ability to occupy low condition vegetation;
- Specific habitat features associated with occurrence;
- Geographic features associated with occurrence;
- Ability to withstand further loss; and
- Time of year identifiable through survey.

Literature Review

A review of available literature for the area was undertaken to obtain reference material and background information for this study. These documents are listed in the References section of this Report.

Aerial photographs were also reviewed to identify the extent of fauna habitats with respect to the site and surrounding areas.

3.2.2 Fauna Survey Details

A detailed fauna survey was undertaken targeting the subject 'species credit' type species with potential to occur on the site incorporating the methodologies outlined in NSW DEC (2004). All fauna species encountered during surveys were recorded.

Stratification Units

Fauna surveys were stratified across the following three habitat types:

- Dry Sclerophyll Forest (HU 619 & HU 816) – 32.59 ha
- Wet Sclerophyll Forest (HU 798) – 16.05 ha
- Dry Rainforest (HU 755) – 8.44 ha

Specific OEH Requirements

The OEH were contacted to seek approval for use of modern survey methods employing nest boxes to survey for the Eastern Pygmy Possum and infra-red (IR) cameras to survey for the Brush-tailed Phascogale. The following details are provided:

Eastern Pygmy-possum

OEH Comments

I have no obvious reason why the survey time matrix does not list any suitable months for completing surveys for the Eastern Pygmy Possum, apart from the fact there might be a glitch in the credit tool. I will discuss with John Briggs to see if there is a data gap or an error occurring. I agree it should have stated preferred times.

On the OEH threatened species database, it states that the preferred time of surveying for Eastern Pygmy-possum is mid-spring to mid-autumn (and I have confirmed this with our specialist); as this is when the species is not in torpor and when its preferred food resources are available. Surveying

should not occur in winter months (late autumn to early spring) as the species is in torpor and not active.

Although nest boxes (e.g. 10 nest boxes per 25 ha stratification unit) is a good a technique for detecting the species, it needs to be for a much longer period; preferably a minimum of 1 year. The proposed nest boxes to be installed for one month then checked twice over a two week interval is therefore considered an inadequate timeframe to detect the species. OEH recognises that 1 year may be outside the scope of the current project parameters and recommends that you could either use (i) an expert report (which would likely end up in the assumption the species is likely present – given its broad habitat requirements), or (ii) traditional detection methods / techniques, such as arboreal Elliott traps and/or hair sampling tubes, in accordance with the recommended effort outlined in DEC 2004 (OEH's survey guidelines).

Conacher Consulting Comments
The traditional detection methods of Elliot trapping and spotlighting were utilised. The photos obtained during the IR camera surveys undertaken were also checked for records of the Eastern Pygmy Possum.

Trapping surveys for the Eastern Pygmy Possum were completed during spring in September 2015 throughout all vegetation types present. Tree mounted A Type Elliot traps baited with a mixture of honey, peanut butter and rolled oats were utilised with an attractant of honey and water sprayed on the tree the trap was mounted on.

Hair samples surveys were not undertaken for the Eastern Pygmy Possum as hair samples from this species can be confused with the Feathertail Glider (*Acrobates pygmaeus*) (Barbara Triggs pers. comm.; Georgeana Storey pers. comm.), a common species which may occur within the subject site.

Brush-tailed Phascogale

OEH Comments

- In discussions with the OEH specialist on this species, despite the survey time matrix indicating that this species can be surveyed all year, it is preferable that targeted surveys are undertaken between February and June when population numbers are higher and/or animals are moving more widely (i.e. more active). Winter to early Summer is not considered a preferable time due to lower numbers / smaller populations and/or animals are not dispersing.

- OEH considers Arboreal Remote IR cameras are the preferred sampling technique for this species, but the effort of 2 arboreal cameras per 25 ha stratification unit activated for one month each is not adequate. OEH recommends the effort should be 4 arboreal cameras per 25 ha stratification unit activated for one month each. This is due to the home ranges of females could be as small as 8 ha. OEH also recommends the use of an attractant, namely a honey / water mix sprayed on the tree in front of the camera.

Conacher Consulting Comments
The Threatened Species Database Profile (NSW OEH 2016C) for this species identifies that females have exclusive territories of approximately 20 - 40 ha, while males have overlapping territories often greater than 100 ha. Mating occurs in May to July and males dying soon after the mating season whereas females can live for up to three years but generally only produce one litter.

Studies in Victoria by Soderquist (1995) have identified that average home ranges are 41 hectares for males and 106 hectares for males. Soderquist (1995) also identified that home ranges of males overlap with those of females and other males and expand during the breeding season, to an average length of 2.7 km. Soderquist (1995) also identified that the individuals studied revisited nearly all portions of a home range during a two week period.

It is noted that the OEH recommend that surveys be undertaken over a period of one month between February and June.

The time when this species is likely to be most active is from mid-summer when juveniles disperse, until the end of the breeding season (early July).

The surveys undertaken by Conacher Consulting included a four week survey period between 11 June and 9 July during the breeding season, when male home ranges are likely to have been largest, with the highest probability of intersecting the site.

The surveys also included a six week survey period between 10 July and 21 August, which would have coincided with the end of the breeding season. This survey period had potential to detect any males in the area prior to the post-breeding season die off and any resident female phascogales.

The extended survey period of ten weeks is also likely to have provided more opportunity to detect the species, given that they take up to two weeks to revisit all areas within a home range.

The stratification units for the surveys were all approximately divisible by 8 hectares for every habitat type (the home range size for female phascogales identified by the OEH), and subsequently this was utilised as the minimum stratification area for IR Cameras.

An attractant of honey and water was sprayed on the tree in front of the camera, along with the placement of a sealed PVC bait tube with wire mesh opening containing a standard aromatic bait mix.

Survey Methods Employed
The survey methods that were utilised for each target fauna taxa are presented in Table 2.2. The locations of fauna field surveys are shown in Figure 3.2.

TABLE 3.2
FAUNA SURVEY TECHNIQUES UTILISED

Survey Techniques Utilised	Amphibians	Reptiles	Diurnal Birds	Nocturnal Birds	Arboreal Mammals	Medium Terrestrial Mammals	Small Terrestrial Mammals	Megachiropteran Bats	Microchiropteran Bats
Diurnal Habitat Search / Area Search	x	x	x	x	x	x	-	x	x
Night Habitat Search / Spotlighting	x	x	-	x	x	x	x	x	x
Nocturnal Call Playback	x	-	-	x	x	-	-	-	-
Night Watercourse Search	x	-	-	-	-	-	-	-	-
Stag watching	-	-	-	x	x		-	-	-
Arboreal Elliot Trapping	-	-	-	-	x	-	-	-	-
Terrestrial Elliot Trapping	-	-	-	-	-	x	x	-	-
IR Camera Survey	-	-	-	-	x	x	x	-	-
Searches for Scats and Signs	-	-	-	x	x	x	x	x	-
Ultrasonic Call Recording	-	-	-	-	-	-	-	-	x
Opportunistic Observation and/or Call Recognition	x	x	x	x	x	x	x	x	x

Amphibians
Amphibian surveys were targeted to the watercourses and dams present and included surveys during summer after periods of rain. The watercourses present within the subject site were found to be generally dry with only very minor water puddle areas following rain events. Amphibian surveys involved day habitat searches for frogs and tadpoles, night spotlight searches around dams and along watercourses and call playback surveys for target threatened species. Targeted call playback surveys were completed for the Green and Golden Bell Frog at all water source locations (dams and ponded water in drainage lines) during February 2015 (2 nights) and September 2015 (1 night).

Reptiles
Reptiles were targeted during diurnal and nocturnal habitat search surveys of the site during the warmer periods of the year throughout spring and summer. Reptiles were surveyed over all fauna survey stratification units. Targeted diurnal searches for the Pale-headed Snake were undertaken during February 2015 (3 days) and October 2015 (1 day). Targeted nocturnal searches were undertaken during February 2015 (2 nights).

Birds
Surveys for diurnal birds were undertaken during both the cooler months during late autumn, winter and early spring targeting winter migrants and winter breeding nocturnal birds and during the warmer months of late spring and summer. Diurnal census plots were conducted for diurnal birds at the same locations as flora plots. A total of 15 plots were sampled for diurnal bird species. Areas searches were also completed for diurnal bird species across all stratification units. Searches for the Regent Honeyeater were undertaken throughout the year, including during August 2014 and August – September 2015 when the *Corymbia maculata*, *Eucalyptus tereticornis* and *Eucalyptus glaucina* were flowering. Sporadic flowering of ironbark species was also observed throughout the survey period.

Nocturnal bird surveys involved quiet listening at dusk followed by call-playback surveys and spotlight searches. Day time searches for roost and nest hollow locations were also undertaken on foot for threatened nocturnal bird species.

Arboreal Mammals
Preliminary initial surveys for arboreal mammals involved the deployment of hair tubes and nest boxes within the site. These surveys were preliminary in nature only and not intended to meet the stratification and effort requirements of NSW DECC (2004).

Diurnal habitat searches and nocturnal spotlight searches were undertaken for arboreal mammals. Where target threatened species were observed during searches, the locations and number of individuals observed was recorded. Scat searches and trapping were also undertaken as described below.

The Spot Assessment Technique (SAT) (Phillips and Callaghan 2011) was utilised for Koala surveys. A scale grid of 150m spacing was placed over an aerial photograph of the site. At each grid intersect point (or the nearest suitable location), a scat search utilising the SAT Technique and a diurnal search of trees was conducted for Koalas. All scats collected were formally identified by Scats About P/L, a specialised hair and scat identification business.

Detailed targeted Elliot trapping (Type A size traps) and IR camera surveys were undertaken for the Brush-tailed Phascogale and other arboreal mammals, as agreed with the OEH. All fauna stratification units were surveyed. The lure for IR camera surveys consisted of bait holder constructed with a small length of PVC tube with a stainless steel screen fitting on one end and a screw cap to the other. Lures were baited with a mixture of rolled oats, honey, peanut butter and Wambaroo insectivore mix. Lures were affixed to tree trunks at a height of approximately 2 metres with the stainless steel screen facing downward to prevent water ingress. A mixture of honey and water was sprayed on each tree trunk above and below the lure locations. The Brush-tailed Phascogale was also targeted during spotlight surveys.

Arboreal Elliot trapping (type A size traps) was undertaken for the Eastern Pygmy Possum as agreed with the OEH. Traps were mounted on a wooden platform which was affixed to tree trunks. The bait mixture utilised for arboreal Elliot traps was a mixture of rolled oats, honey and peanut butter. A mixture of honey and water was also sprayed on each tree trunk above and below trap mount locations. The Eastern Pygmy Possum was also targeted during IR Camera surveys and spotlighting habitat searches.

Terrestrial Mammals
Searches were undertaken for the Parma Wallaby. This species targeted during all daytime mammal searches undertaken, including dusk searches. This species was also targeted during nocturnal surveys, particularly in the grassed area in the north-east of the subject site.

Targeted Elliot trapping (type B size traps) was undertaken for terrestrial and scansorial mammals, such as the Brush-tailed Phascogale. Traps were baited with the standard mixture of rolled oats, honey and peanut butter. Trap surveys were also supplemented with diurnal habitat searches, nocturnal spotlight searches and a preliminary terrestrial hair tube survey. The hair tube survey undertaken was not intended to meet the full stratification and effort requirements of DECC (2004) as it did not cover the full extent of the stratification units present.

Bats

Diurnal habitat searches and nocturnal spotlight searches were undertaken for mega-chiropteran bat species across all fauna survey stratification units. Harp trapping of drainage line / rainforest areas was undertaken for the Golden-tipped Bat during February 2015. Ultrasonic call recording surveys were undertaken for other 'ecosystem type' species across all fauna survey stratification units.

Fauna Field Survey Effort

The dates and times of fauna surveys undertaken are shown in Table 3.3. Weather conditions during the survey periods are provided in Appendix 1.

TABLE 3.3
FAUNA SURVEY DATES AND TIMES

Survey Type	Date	Time
Diurnal Surveys	20 August 2014	1hr 1145-1245 (2 persons)
	21 August 2014	7hrs 0900-1400 / 1530-1730 (2 persons)
	5 September 2014	3hrs 20 min / 0930-1250 (2 persons)
	30 September 2014	2hrs 30 min 0940-1210 (2 persons)
	18 February 2015	8hrs 1100-1930 (2 persons)
	19 February 2015	12hrs 0830-1330 / 1430-1930 (2 persons)
	20 February 2015	2hrs 0740-0940 2 persons)
	10 June 2015	5hrs 15min 1130-1645 (2 persons)
	11 June 2015	5hrs 0730-1230 (2 persons)
	17 August 2015	6hrs 30min 1000-1800 (2 persons)
	18 August 2015	8hrs 15min 0815-1630 (2 persons)
	19 August 2015	8hrs 30min 0800-1830 (2 persons)
	20 August 2015	8hrs 45min 0815-1700 (2 persons)
	21 August 2015	2hrs 45min 0815-1100 (2 persons)
	15 September 2015	7hrs 1100-1600 (2 persons)
	16 September 2015	9hrs 0730-1630 (2 persons)
	17 September 2015	8hrs 0745-1145 / 1400-1800 (2 persons)
	18 September 2015	2 hrs 30min 0740-1010 (2 persons)
	14 October 2015	4hrs 30min 1000-1200 / 1300-1530
Nocturnal Surveys	20 August 2014	2hrs1730-1930 (2 persons)
	21 August 2014	2hrs 1730-1930 (2 persons)
	18 February 2015	2hrs 1930-2130 (2 persons)
	19 February 2015	2hrs 1930-2130 (2 persons)
	17 August 2015	1hr 1830-1930 (2 persons)
	19 August 2015	1hr 1830-1930 (2 persons)
	17 September 2015	1hr 1800-1900 (2 persons)
Trapping / Remote Detection Surveys	21 August – 4 September 2014	14 nights camera of surveys and hair tube surveys
	21 August – 4 September 2014	Hair tube survey (14 nights) (preliminary / supplementary survey only)
	21 August – 30 September 2014	25 nights of nest box surveys (preliminary / supplementary survey only)
	5 September – 30	25 nights of songmeter recording

TABLE 3.3 FAUNA SURVEY DATES AND TIMES		
Survey Type	**Date**	**Time**
	September	
	18 &19 February 2015	2 nights harp trapping
	11 June 2015 -21 August 2015	71 nights of Arboreal camera survey
	17 August – 21 August 2015	4 nights of terrestrial Elliot trapping
	15 September – 17 September 2015	3 nights of arboreal Elliot trapping
	20 & 21 August 2014 (2 nights x 2 devices) 18-19 February 2015 (2 nights x 2 devices) 17-20 August 2015 (2 devices x 4 nights) 15-17/September 2015 (3 nights x 2 devices)	22 Anabat nights

The effort expended during the undertaking of each fauna survey technique and a comparison of the level of effort recommended within the DEC (2004) survey guidelines is provided in Table 3.4.

TABLE 3.4 FAUNA SURVEY EFFORT DETAILS				
Fauna Group	**Survey Methodology**	**Suggested Minimum Survey Guideline (DECC 2004)**	**Survey Undertaken**	**Comments**
AMPHIBIANS	**Diurnal Habitat Search (warm season)**	2 hrs (1hr per stratification unit x 2 stratification units dams and rainforest watercourse pools) (Note: Seasonal peak activity period = November to May).	58.5 hrs targeted and opportunistic observation over 10 days 5 Sept. 14 30 Sept. 14 18-20 Feb. 15 15-18 Sept. 15 14 Oct. 15	Surveys undertaken exceed effort requirements
	Night Habitat Search	30min x 2 nights / stratification unit.	5hrs over 3 nights x 2 persons 18 February 2015 19 February 2015 17 September 2015	Surveys undertaken exceed requirements. Surveys undertaken during periods of wet / warm weather.
	Nocturnal Call Playback	2 nights	3 nights per point 18 February 2015 19 February 2015 17 September 2015	Surveys undertaken exceed requirements
	Night watercourse Search	2hrs per 200m of water body edge.	5hrs over 3 nights x 2 persons 18 February 2015 19 February 2015 17 September 2015	Surveys undertaken exceed requirements

TABLE 3.4 FAUNA SURVEY EFFORT DETAILS				
Fauna Group	**Survey Methodology**	**Suggested Minimum Survey Guideline (DECC 2004)**	**Survey Undertaken**	**Comments**
REPTILES	**Diurnal Habitat Search (warm season)**	30min search x 2 days for each stratification unit (per 100ha stratification unit).	15 plot based searches 58.5 hrs targeted and opportunistic observation over 10 days 5 Sept. 14 30 Sept. 14 18-20 Feb. 15 15-18 Sept. 15 14 Oct. 15	Surveys undertaken exceed effort requirements
	Spotlighting	30min x 2 nights / per 100ha stratification unit.	11 hrs over 7 nights 20-21 Aug. 14 18-19 Feb. 15 17 Aug. 15 19 Aug. 15 17 Sept. 15	Surveys undertaken exceed requirements
DIURNAL BIRDS	**Area Search**	Methodology not resolved – (search utilising species time curve may be used). Undertake seasonal searches.	15 plot based searches Warm season searches 58.5 hrs targeted and opportunistic observation over 10 days 5 Sept. 14 30 Sept. 14 18-20 Feb. 15 15-18 Sept. 15 14 Oct. 15 Cool season searches 53 hrs targeted and opportunistic observation over 9 days 20-21 Aug. 14 10-11 Jun. 15 17-21 Aug. 15	Surveys undertaken exceed requirements
NOCTURNAL BIRDS	**Call playback**	Sites separated by 800m to 1km. -5 visits for Powerful Owl, Barking Owl and Grass Owl -6 visits for Sooty Owl -8 visits for Masked Owl	7 nights 20-21 Aug. 14 18-19 Feb. 15 17 Aug. 15 19 Aug. 15 17 Sept. 15	> 8 nights undertaken in conjunction with previous surveys.

TABLE 3.4 FAUNA SURVEY EFFORT DETAILS				
Fauna Group	**Survey Methodology**	**Suggested Minimum Survey Guideline (DECC 2004)**	**Survey Undertaken**	**Comments**
	Day habitat search	Search for pellets and likely hollows.	111.8 hrs over 19 days 20-21 Aug. 14 5 Sept. 14 30 Sept. 14 18-20 Feb. 15 10-11 Jun. 15 17-21 Aug. 15 15-18 Sept. 15 14 Oct. 15	Surveys undertaken exceed requirements
	Stag watching	Observing potential roost hollows for 30mins prior to sunset and 60mins following sunset.	Undertaken during spotlighting surveys	Surveys undertaken exceed requirements
	Spotlighting	By foot or from vehicle.	11 hrs over 7 nights 20-21 Aug. 14 18-19 Feb. 15 17 Aug. 15 19 Aug. 15 17 Sept. 15	Surveys undertaken exceed requirements
	Call recording	No requirement	25 nights of song meter recordings 5 September – 30 September	No direct survey requirement
ARBOREAL AND TERRESTRIAL MAMMALS	**Day habitat search**	- 30 minutes searching each relevant habitat, including trees for scratch marks / per 50ha stratification unit, plus additional effort required for every additional 100ha.	22 Spot Assessment Technique plots at 150m spacing across the site. Non-plot based searches conducted in conjunction with diurnal census surveys over 111.8 hrs over 19 days 20-21 Aug. 14 5 Sept. 14 30 Sept. 14 18-20 Feb. 15 10-11 Jun. 15 17-21 Aug. 15 15-18 Sept. 15 14 Oct. 15	Surveys undertaken exceed requirements

TABLE 3.4 FAUNA SURVEY EFFORT DETAILS				
Fauna Group	**Survey Methodology**	**Suggested Minimum Survey Guideline (DECC 2004)**	**Survey Undertaken**	**Comments**
	Small terrestrial mammal Elliot trapping	100 trap nights over 3-4 consecutive nights x 3 stratification units	Terrestrial mammal A type Elliot trapping Total = 360TN (120TN per. stratification unit) (9 transects of 10 traps x 4 nights) 17 August – 20 August 2015	Surveys undertaken exceed requirements
	Terrestrial Mammal IR Camera Survey	NA	Terrestrial remote camera survey 28 Camera nights (2 cameras x 14 nights) 21 August – 4 September 2014	Surveys supplementary only and not undertaken to meet requirements
	Terrestrial Mammal Hair Tube Survey	NA	140 hair tube nights (10 hair tubes x 14 nights)	Surveys supplementary only and not undertaken to meet requirements
	Arboreal Mammal Elliot Trapping	24 trap nights over 3-4 consecutive nights.	Arboreal mammal A type Elliot trapping Total = 162 TN Per Strat. Unit = 54 TN (9 transects of 6 traps x 3 nights) 15 Sept. -17 Sept. 15	Surveys undertaken exceed requirements
	Arboreal Mammal IR Camera Survey	1 camera per 8ha x 1 month	28 baited camera nights (2 cameras x 14n) 21 August – 4 September 2014	Preliminary survey only
		1 camera per 8ha x 1 month	568 baited camera nights (8 cameras x 71n) 11 June 2015 -21 August 2015	Surveys undertaken exceed requirements
	Spotlighting	(on foot or from vehicle) -2 x 1hr and 1km up to 200 hectares of stratification unit, walking at approx. 1km per hour on 2 separate nights.	11 hrs over 7 nights 20 & 21 Aug. 14 18 & 19 Feb. 15 17 Aug. 15 19 Aug. 15 17 Sept. 15	Surveys undertaken exceed requirements

TABLE 3.4 FAUNA SURVEY EFFORT DETAILS				
Fauna Group	**Survey Methodology**	**Suggested Minimum Survey Guideline (DECC 2004)**	**Survey Undertaken**	**Comments**
	Search for scats and signs	- 30 minutes searching each relevant habitat, including trees for scratch marks / per 50ha stratification unit, plus additional effort required for every additional 100ha.	22 Spot Assessment Technique plots at 150m spacing across the site. Non-plot based searches conducted in conjunction with diurnal census surveys	Surveys undertaken exceed requirements
	Collection of predator scats	Opportunistic.	Opportunistic	Surveys undertaken meet requirements
	Call Playback	2 sites per stratification unit (up to 200ha).	7 nights 20 & 21 Aug. 14 18 & 19 Feb. 15 17 Aug. 15 19 Aug. 15 17 Sept. 15	Surveys undertaken exceed requirements
	Stag-watching	Observing potential roost hollows for 30mins prior to sunset and 60mins following sunset.	Undertaken during spotlighting surveys	Surveys undertaken exceed requirements
	Call recording	No requirement	25 nights of song meter recordings 5 September – 30 September	No direct survey requirement
MEGA BATS	**Spotlighting**	1hr x 2 nights / per 100ha stratification unit.	11 hrs over 7 nights 20-21 Aug. 14 18-19 Feb. 15 17 Aug. 15 19 Aug. 15 17 Sept. 15	Surveys undertaken exceed requirements
	Diurnal Habitat Search	Search for bat excreta at or near potential habitats.	111.8 hrs over 19 days 20-21 Aug. 14 5 Sept. 14 30 Sept. 14 18-20 Feb. 15 10-11 Jun. 15 17-21 Aug. 15 15-18 Sept. 15 14 Oct. 15	Surveys undertaken exceed requirements

TABLE 3.4 FAUNA SURVEY EFFORT DETAILS				
Fauna Group	**Survey Methodology**	**Suggested Minimum Survey Guideline (DECC 2004)**	**Survey Undertaken**	**Comments**
MICRO BATS	**Ultrasonic Call Recording**	4 overnight recordings / per 100ha stratification unit (October to March).	22 Ultrasonic call recording nights Rainforest Overnight x 2 nights (August 2014) Overnight x 4 nights (February 2015) Overnight x 2 nights (September 2015) Dry Sclerophyll Forest Overnight x 2 nights (August 2014) Overnight x 4 nights (August 2015) Wet Sclerophyll Forest Overnight x 4 nights (August 2015) Overnight x 4 nights (September 2015)	Utilised as supplementary survey method only (method not suitable for target species)
	Spotlighting Roost Searches	1hr x 2 nights / per 100ha stratification unit.	11 hrs over 7 nights 20 & 21 Aug. 14 18-19 Feb. 15 17 Aug. 15 19 Aug. 15 17 Sept. 15	Surveys undertaken exceed requirements
	Diurnal Roost Searches	Search for bat excreta at or near potential habitats.	111.8 hrs over 19 days 20-21 Aug. 14 5 Sept. 14 30 Sept. 14 18-20 Feb. 15 10-11 Jun. 15 17-21 Aug. 15 15-18 Sept. 15 14 Oct. 15	Surveys undertaken exceed requirements
	Harp Trap Survey	Four trap nights over two consecutive nights with one trap placed outside the flyways for one night (October to March)	Four trap nights over two consecutive nights (2 traps x 2 nights) in rainforest habitat targeting Golden-tipped bat with one trap placed outside flyway for one night 18 &19 February 2015	Surveys undertaken meet requirements

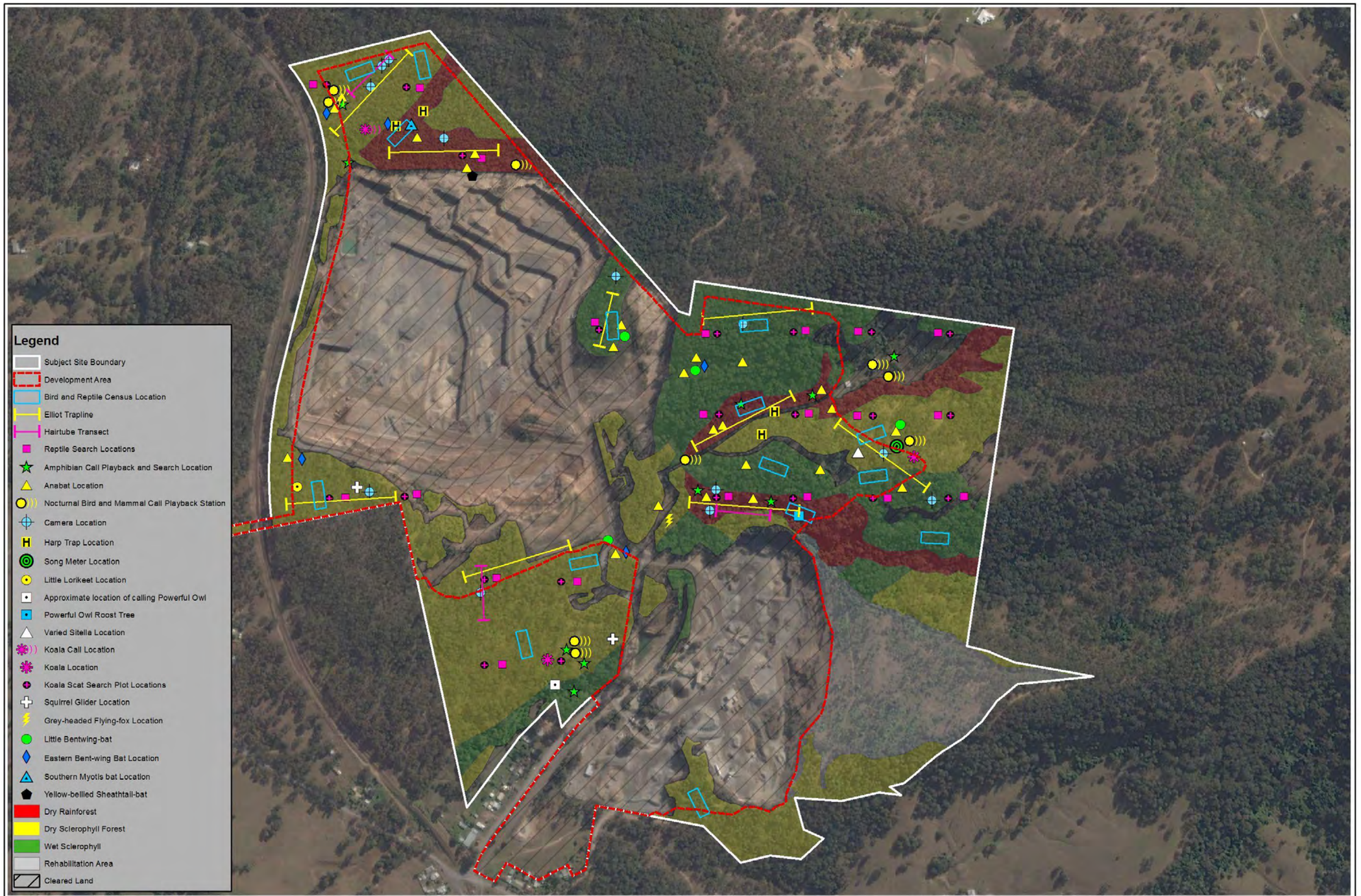

Figure 3.2
Fauna Characteristics
Martins Creek

SECTION 4

FLORA AND FAUNA SURVEY RESULTS

4.1 FLORA CHARACTERISTICS

4.1.1 Plant Community Types Observed

The following plant community types were observed during surveys:

i. HU798 White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley
ii. HU816 Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter
iii. HU619 Whalebone Tree – Red Kamala dry subtropical rainforest of the lower Hunter River
iv. HU755 Slaty Red Gum grassy woodland on the hinterland of the southern North Coast
v. Cleared Land & Landscape Rehabilitation Areas

Descriptions of the plant community types observed are provided below. The locations of vegetation communities are shown in Figure 3.1. A list of flora species observed during surveys is provided in Appendix 2.

i. HU 798 WHITE MAHOGANY – SPOTTED GUM – GREY MYRTLE SEMI MESIC SHRUBBY OPEN FOREST OF THE CENTRAL AND LOWER HUNTER VALLEY

Structure:

Upper Stratum:	To 40 metres high, with 40% Projected Foliage Cover (PFC).
Mid Stratum (upper layer):	To 20 metres high, with 15% PFC
Mid Stratum (lower layer):	To 5 metres high, with 40% PFC.
Lower Stratum:	To 0.4 metres high, with 70% PFC.

Floristics:
(Characteristic Species)

Upper Stratum:	*Eucalyptus acmenoides, Corymbia maculata, Eucalyptus canaliculata*, and *Eucalyptus paniculata.*
Mid Stratum (upper layer):	*Allocasuarina torulosa*, *Eucalyptus paniculata, Backhousia myrtifolia* and *Alphitonia excelsa*.
Mid Stratum (lower layer):	*Denhamia silvestris, Acacia implexa, Backhousia myrtifolia, Jasminum volubile, Notelaea longifolia, Pittosporum multiflorum, Pittosporum revolutum* and *Lantana camara.*
Lower Stratum:	*Doodia aspera, Adiantum aethiopicum, Brunoniella australis, Dichondra repens, Pratia purpurascens, Imperata cylindrica, Microlaena stipoides, Oplismenus aemulus, Lepidosperma laterale, Lomandra confertifolia*
Exotics:	*Lantana camara.*

Variation / Zones:
The canopy species composition is variable throughout this community. It is considered that one zone of this vegetation type is present within the site.

Disturbance:
Disturbances include weed invasion and historical clearing.

Weed Invasion:
Weed invasion is present in the mid stratum and consists predominantly of *Lantana camara* which occurs in varying density throughout this community. Highest densities of weed invasion are on lower south facing slopes.

Location and Distribution:
This community predominantly occurs in the eastern sections of the site as shown in Figure 3.1. This community occupies approximately 16.05 hectares of the subject site, including approximately 9.8 hectares within the development area (study area).

Classification:
This vegetation community corresponds to Plant Community Type 1584 White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley.

The vegetation present does not correspond to any threatened ecological communities listed under the *TSC Act* (1995) or the *EPBC Act* (1999).

Survey Plot Details
Survey plots 6, 9, 10, 12 and 14 were completed within this vegetation type. Photographs 1 to 5 were taken in the survey plots respectively.

Photograph 1 - Plot 6

Photograph 2 - Plot 9

Photograph 3 - Plot 10

Photograph 4 - Plot 12

Photograph 5 - Plot 14

ii. HU816 SPOTTED GUM – NARROW-LEAVED IRONBARK SHRUB-GRASS OPEN FOREST OF THE CENTRAL AND LOWER HUNTER

Structure:

Upper Stratum:	To 25 metres high, with 40% Projected Foliage Cover (PFC).
Mid Stratum:	To 4 metres high, with 50% PFC.
Lower Stratum:	To 1 metre high, with 75% PFC.

Floristics:
(Characteristic Species)

Upper Stratum:	*Corymbia maculata, Eucalyptus crebra* and *Eucalyptus globoidea* and *Eucalyptus acmenoides*.
Mid Stratum:	*Denhamia silvestris, Hibbertia diffusa, Acacia implexa, Acacia ulicifolia, Notelaea longifolia, Breynia oblongifolia, Bursaria spinosa, Pittosporum revolutum , Pittosporum undulatum, Persoonia linearis.*
Lower Stratum:	*Brunoniella australis, Dichondra repens, Pratia purpurascens, Cymbopogon refractus, Entolasia stricta, Imperata cylindrica, Microlaena stipoides, Oplismenus aemulus, Panicum effusum, Themeda triandra, Lomandra confertifolia, Lomandra multiflora*.
Exotics:	*Lantana camara, Bidens pilosa* and *Olea europaea.*

Variation:
The patch of this community in the eastern section of the site has a high level of weeds in the understorey.

Disturbance:
Disturbances include weed invasion and historical clearing.

Weed Invasion:
Weeds were mostly observed in the mid stratum with low to moderate levels of occurrence.

Location and Distribution:
This community occupies approximately 10.5 hectares of the subject site, including approximately 3.19 hectares within the development area (study area) as shown in Figure 3.1.

Classification:
This vegetation community corresponds to Plant Community Type ID 1602 Spotted Gum – Narrow-leaved Ironbark shrub-grass open forest of the Central and Lower Hunter as described in the NSW VIS (NSW OEH 2016d).

The NSW VIS (NSW OEH 2016d) identifies that this vegetation type corresponds to the endangered ecological community Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion as listed under the *TSC Act* (1995). The subject site is located within the Dungog LGA, which is not within the Sydney Basin Bioregion and is therefore not within the particular area where this community is recognised as an endangered ecological community under the *TSC Act* (1995).

This vegetation type does correspond to the preliminary determination for the Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions EEC under the *TSC Act* (1995).

The vegetation present does not correspond to a threatened ecological communities listed under the *EPBC Act* (1999).

Survey Plot Details
Survey plots 1 and 13 were completed within this vegetation type. Photographs 6 and 7 were taken in the survey plots respectively.

Photograph 6 - Plot 1

Photograph 7 - Plot 13

iii. HU 755 WHALEBONE TREE - RED KAMALA DRY SUBTROPICAL RAINFOREST OF THE LOWER HUNTER RIVER

Structure:

Upper Stratum (upper layer):	To 25 metres high, with 5% PFC.
Upper Stratum (lower layer):	To 15 metres high, with 80% PFC
Mid Stratum:	To 3 metres high, with 30% PFC.
Lower Stratum:	To 0.2 metre high, with 30% PFC.

Floristics:
(Characteristic Species)

Emergent Trees:	*Corymbia maculata, Eucalyptus acmenoides* and *Eucalyptus paniculata.*
Upper Stratum:	*Ficus rubiginosa, Backhousia myrtifolia* and *Streblus brunonianus*.
Mid Stratum:	*Alchornea ilicifolia, Claoxylon australe, Croton verreauxii, Streblus brunonianus, Backhousia myrtifolia, Jasminum volubile, Notelaea longifolia, Breynia oblongifolia, Pittosporum undulatum.*
Lower Stratum:	*Doodia caudata, Adiantum aethiopicum, Adiantum hispidulum, Pellaea paradoxa, Pseuderanthemum variabile* and *Oplismenus imbecillis.*
Exotics:	*Lantana camara*.

Variation:
B. myrtifolia is the dominant upper stratum species, however occurs in lower densities in the deeper gully area in the eastern section of the site.

Disturbance:
Weed invasion of the mid stratum.

Weed Invasion:
Low and present in the mid stratum.

Location and Distribution:
This community occupies in fractured rock lined drainage line areas which are predominantly dry other than times during and immediately following heavy rainfall. This community occupies approximately 8.44 hectares of the subject site, including approximately 5 hectares within the development area (study area).

Classification:
Although a poor floristic match, it is considered that this vegetation community is most similar to Plant Community Type 1541 Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River. The VIS lists this community as corresponding to the Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions, vulnerable ecological community, as listed under the *TSC Act* (1995).

Survey Plot Details
Survey plots 3, 7 and 8 were completed within this vegetation type. Photographs 8 to 10 were taken in the survey plots respectively.

Photograph 8 - Plot 3

Photograph 9 - Plot 7

Photograph 10 - Plot 8

iv. HU 619 SLATY RED GUM GRASSY WOODLAND ON HINTERLAND FOOTHILLS OF THE SOUTHERN NORTH COAST

Structure:

Upper Stratum:	To 30 metres high, with 30% PFC.
Mid Stratum (upper layer):	To 15 metres high, with 20% PFC
Mid Stratum (lower layer):	To 5 metres high, with 45% PFC.
Lower Stratum:	To 1 metre high, with 95% PFC.

Floristics:
(Characteristic Species)

Upper Stratum:	*Eucalyptus glaucina, Eucalyptus crebra, Corymbia maculata, Eucalyptus globoidea* and *Eucalyptus moluccana*.
Mid Stratum (upper layer):	*Acacia binervata, Eucalyptus crebra,* and *Eucalyptus glaucina*.
Mid Stratum (lower layer):	*Denhamia silvestris, Leucopogon juniperinus, Acacia falcata, Acacia implexa, Sannantha crassa, Jasminum volubile, Notelaea longifolia, Breynia oblongifolia, Pittosporum revolutum,* and *Pittosporum undulatum.*
Lower Layer:	*Aristida vagans, Cymbopogon refractus, Microlaena stipoides, Panicum effusum* and *Themeda triandra.*
Exotics:	*Lantana camara, Olea europaea subsp. cuspidata* and *Bidens pilosa*.

Variation:
The distributions of the sub-dominant canopy species, *Eucalyptus crebra*, *Corymbia maculata, Eucalyptus globoidea* and *Eucalyptus moluccana* was variable throughout this community. Two vegetation zones were mapped for this vegetation type. The majority of this vegetation type was observed to be regenerating following historical clearing and in moderate to good condition. These areas are identified as HU619A in Figure 3.1.

An area of approximately 0.778 hectares of this vegetation type within the southern section of the site was observed to be in poor condition due to dense growth of lantana. This area was mapped as a separate vegetation zone, identified as HU619B in Figure 3.1.

Disturbance:
Historical clearing and weed invasion, particularly in the shrub layer.

Weed Invasion:
Weeds were mostly observed in the mid stratum with low to moderate levels of occurrence.

Location and Distribution:
This community occupies mid to lower slopes, particularly within the western section of the site. This community occupies approximately 22.09 hectares of the subject site, including approximately 9.4 hectares within the development area (study area).

Classification:
This vegetation community corresponds to Plant Community Type 1178 Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast

The vegetation present does not correspond to any threatened ecological communities listed under the *TSC Act* (1995) or the *EPBC Act* (1999).

Survey Plot Details
Survey plots 2, 4, 5 and 15 were completed within this vegetation type. Photographs 11 to 14 were taken in the survey plots respectively.

Photograph 11 - Plot 2

Photograph 12 - Plot 4

Photograph 13 - Plot 5

Photograph 14 - Plot 15

V. CLEARED LAND & LANDSCAPE REHABILITATION AREAS

Cleared Land & Landscape Rehabilitation Areas are present within the footprint of the existing quarry development or consist of areas which are undergoing rehabilitation from historical quarrying activities. These areas are not required to be subject to detailed surveys. Cleared Land occupies approximately 60.19 hectares of the subject site including approximately 55.3 hectares of the development area (study area). Rehabilitation Areas are not located within the development footprint and cover approximately 8.24 hectares of the subject site.

4.1.2 Flora Species Observed

The flora species observed within the subject site are listed in Appendix 2.

Species Credit Threatened Flora

Eucalyptus glaucina was observed within the subject site during surveys. The *E. glaucina* specimens observed were located within the Slaty Red Gum Grassy Woodland on Hinterland Foothills of the Southern North Coast plant community type. A total of thirteen (13) 20x50m quadrats were sampled to determine the average density of this species across this community. The results of the quadrat counts are provided in Table 4.1.

The surveys undertaken determined that the average density of *E. glaucina* was 12.8 specimens per 1000m^2 quadrat. It is estimated that 2827 *E. glaucina* individuals are present within the subject site over approximately 22.09 ha, including an estimated 1203 *E. glaucina* individuals within the proposed development footprint over an area of 9.4 ha.

TABLE 4.1 EUCALYPTUS GLAUCINA QUADRAT COUNT DATA	
Quadrat Number	**Tree Count**
1	5
2	2
3	3
4	1
5	10
6	50
7	20
8	1
9	7
10	2
11	60
12	1
13	5
Average	12.8

Ecosystem Credit Threatened Flora
No ecosystem credit type threatened flora was observed within the subject site during surveys.

4.2 FAUNA CHARACTERISTICS

4.2.1 Specific Geographic Habitat Features

The specific geographic / habitat features identified by the FBA calculator are present on the site. These are:

- Land within 100m of emergent aquatic or riparian vegetation (potential Green and Golden Bell Frog habitat)
- Land within 40m of watercourses, containing hollow-bearing trees, loose bark and/or fallen timber (potential Pale-headed Snake habitat).

4.2.2 Fauna Species Observed

The fauna species observed during current and previous fauna surveys of the site are listed in Table 4.2.

Species Credit Threatened Fauna
The Koala was observed within the subject site during surveys, the following observation details are provided:

One Koala was observed during the spotlighting survey undertaken on 20 August 2014 at the top of the hill in the eastern portion of the subject site. A male Koala was recorded calling on a songmeter device during call recording surveys on the 6th, 7th, 9th and 10th September within the vicinity of the initial spotlighting observation location.

A Koala was observed during the spotlighting surveys undertaken on 18 and 19 February 2015 to the west of the detention basin and the western alternate access road.

A Koala was heard calling from the forested area within the northern section of the site during a spotlighting survey undertaken on 19 February 2015.

The Koala was observed in all habitat areas with the exception of the rainforest habitats and the portion of the Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast vegetation community which was in moderate to good/low condition. It is considered that this species is not likely to utlise the rainforest habitats due to the lack of preferred feed trees. It is also considered that Koalas are not likely to inhabit the small patch of Slaty Red Gum grassy woodland on hinterland

foothills of the southern North Coast vegetation community in poor condition and identified as HU619B in Figure 3.1, due to the presence of dense lantana growth.

No Koala scats were observed during the koala spot assessment surveys and the activity levels of Koalas on the site are therefore low.

Ecosystem Credit Threatened Fauna
The following "ecosystem credit" type threatened fauna were observed within the subject site during surveys:

- Little Lorikeet;
- Speckled Warbler (previous surveys only);
- Varied Sittella;
- Powerful Owl;
- Squirrel Glider;
- Grey-headed Flying-fox;
- Yellow-bellied Sheathtail-bat;
- Eastern Freetail-bat (previous surveys only);
- Little Bentwing-bat;
- Eastern Bentwing-bat;
- Southern Myotis; and
- Greater Broad-nosed Bat (previous surveys only).

The following observation details are provided in relation to the above species:

Little Lorikeet
Two Little Lorikeets (*Glossopsitta pusilla*) were observed flying over the subject site during diurnal fauna surveys undertaken on 20 August 2014.

Speckled Warbler
This species was recorded in 2007 just outside of the quarry lands (Ecotone Ecological Consultants 2011). This species was not observed during current surveys undertaken by Conacher Consulting.

Varied Sittella
Three Varied Sittellas were observed foraging within the subject site during diurnal fauna surveys undertaken on 17 September 2015.

Powerful Owl
A likely roost site of the Powerful Owl was observed during diurnal surveys on 20 August 2015. The likely roost site was identified by the presence of a dead Brush Turkey with a small amount of owl whitewash in a drainage line gully under the canopy of a large rainforest tree. It is considered that the likely roost site is only occasionally used, as this species was not observed at this location during any site visits.

The Powerful Owl was also heard calling during nocturnal surveys on 17 September 2015, to the south-west of the development area (study area).

Squirrel Glider
A Squirrel Glider was observed by spotlight leaving a tree hollow during surveys undertaken on 19 February 2015 in the southern section of the site. The Squirrel Glider was also detected by a photos captured during infrared baited camera surveys in the western section of the site.

Grey-headed Flying-fox
Two Grey-headed Flying-foxes were observed within the central area of the site during nocturnal surveys on 17 September 2015.

Yellow-bellied Sheathtail-bat
This species was recorded within the subject site during an ultrasonic call recording survey undertaken in 2007 (Ecotone Ecological Consultants 2011). This species was also recorded during current surveys on 18 February 2015.

Eastern Freetail-bat
This species was recorded within the subject site during an ultrasonic call recording survey undertaken in 2007 (Ecotone Ecological Consultants 2011). This species was not observed during current surveys undertaken by Conacher Consulting.

Little Bentwing-bat
This species was recorded within the subject site during overnight ultrasonic call recording surveys on the following dates:

- 20 August 2014
- 20 February 2015
- 20-21 August 2015
- 15-17 September 2015

No potential maternity cave roost sites for this species were located during site habitat searches.

Eastern Bentwing-bat
One male and one female Eastern Bentwing-bat were captured in a harp trap on 18 February 2015 within the creek line west of the access road through the central section of the subject site. This species was also recorded within the subject site during overnight ultrasonic call recording surveys on the following dates:

- 17, 19 & 20 August 2015
- 15 September 2015

No potential maternity cave roost sites for this species were located during site habitat searches.

Southern Myotis
Three female Southern Myotis bats were captured in a harp trap on 18 February 2015 within the creek line north of the quarry pit.

Greater Broad-nosed Bat
This species was identified as a possible record from an ultrasonic call recording survey undertaken in 2007 (Ecotone Ecological Consultants 2011). This species was not observed during current surveys undertaken by Conacher Consulting.

Threatened fauna species locations for current surveys are shown in Figure 3.1. Locations of threatened fauna species recorded during previous surveys reported by Ecotone Ecological Consultants (2011) are not mapped and were not available in the documentation obtained.

EPBC Act Listed Migratory Fauna Species
The following migratory species listed under the EPBC Act (1999) were observed within the subject site during surveys:

- Rufous Fantail
- Black-faced Monarch

These species were observed during summer surveys within the drainage line which runs through the central parts of the proposed development area (study area).

TABLE 4.2
FAUNA OBSERVED WITHIN THE SUBJECT SITE

Common Name	Scientific Name	Observation Type
Amphibians		
Dusky Toadlet	*Uperoleia fusca*	X
Brown-striped Frog	*Limnodynastes peronii*	W
Bibron's Toadlet	*Pseudophryne bibronii*	X
Red-backed Toadlet	*Pseudophryne coriacea*	OW
Common Eastern Froglet	*Crinia signifera*	OW
Eastern Dwarf Tree Frog	*Litoria fallax*	W

TABLE 4.2 FAUNA OBSERVED WITHIN THE SUBJECT SITE		
Common Name	**Scientific Name**	**Observation Type**
Broad-palmed Frog	*Litoria latopalmata*	O
Peron's Tree Frog	*Litoria peronii*	X
Leaf-green Tree Frog	*Litoria phyllochroa*	OW
Lesueur's Tree Frog	*Litoria wilcoxii*	X
Reptiles		
Burton's Snake-lizard	*Lialis burtonis*	X
Southern Rainbow-skink	*Carlia tetradactyla*	X
Eastern Water Dragon	*Physignathus lesueurii*	O
Lace Monitor	*Varanus varius*	O
Dark-flecked Garden Sunskink	*Lampropholis delicata*	O
Eastern Water-skink	*Eulamprus quoyii*	O
Common Tree Snake	*Dendrelaphis punctulatus*	O
Eastern Water Dragon	*Physignathus lesueurii lesueurii*	O
Diamond Python	*Morelia spilota spilota*	X
Birds		
Australian Brush-turkey	*Alectura lathami*	O K
Brown Cuckoo-Dove	*Macropygia amboinensis*	OW
Common Bronzewing	*Phaps chalcoptera*	X
Bar-shouldered Dove	*Geopelia humeralis*	O
Wonga Pigeon	*Leucosarcia melanoleuca*	OW Q
Topknot Pigeon	*Lopholaimus antarcticus*	OW
Tawny Frogmouth	*Podargus strigoides*	X
White-throated Nightjar	*Eurostopodus mystacalis*	W
Australian Owlet-nightjar	*Aegotheles cristatus*	W
Black Kite	*Milvus migrans*	O
Wedge-tailed Eagle	*Aquila audax*	O E
Masked Lapwing	Vanellus miles	OW
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	OW
Rainbow Lorikeet	Trichoglossus haematodus	OW
Little Lorikeet[TS1]	***Glossopsitta pusilla***	OW
Australian King-Parrot	*Alisterus scapularis*	OW
Crimson Rosella	*Platycercus elegans*	OW
Eastern Rosella	*Platycercus eximius*	X
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	OW Q
Brush Cuckoo	*Cacomantis variolosus*	X
Powerful Owl[TS1]	***Ninox strenua***	W E
Southern Boobook	*Ninox novaeseelandiae*	OW
Laughing Kookaburra	*Dacelo novaeguineae*	OW
Sacred Kingfisher	*Todiramphus sanctus*	X
Dollarbird	*Eurystomus orientalis*	X
White-throated Treecreeper	*Cormobates leucophaea*	OW
Satin Bowerbird	*Ptilonorhynchus violaceus*	OW
Superb Fairy-wren	*Malurus cyaneus*	O Q
Variegated Fairy-wren	*Malurus lamberti*	X
Pilotbird	*Pycnoptilus floccosus*	X

TABLE 4.2 FAUNA OBSERVED WITHIN THE SUBJECT SITE		
Common Name	**Scientific Name**	**Observation Type**
White-browed Scrubwren	*Sericornis frontalis*	OW Q
Large-billed Scrubwren	*Sericornis magnirostris*	OW
Speckled Warbler[TS1]	***Chthonicola sagittata***	X
Brown Gerygone	*Gerygone mouki*	OW
Striated Thornbill	*Acanthiza lineata*	OW
Yellow Thornbill	*Acanthiza nana*	OW
Brown Thornbill	*Acanthiza pusilla*	OW
Buff-rumped Thornbill	*Acanthiza reguloides*	OW
Spotted Pardalote	*Pardalotus punctatus*	OW
Striated Pardalote	*Pardalotus striatus*	X
Eastern Spinebill	*Acanthorhynchus tenuirostris*	OW
Lewin's Honeyeater	*Meliphaga lewinii*	OW Q
Yellow-faced Honeyeater	*Lichenostomus chrysops*	OW
Yellow-tufted Honeyeater	*Lichenostomus melanops*	OW
Bell Miner	*Manorina melanophrys*	X
Noisy Miner	*Manorina melanocephala*	X
Red Wattlebird	*Anthochaera carunculata*	OW
Scarlet Honeyeater	*Myzomela sanguinolenta*	OW
Brown-headed Honeyeater	*Melithreptus brevirostris*	X
White-naped Honeyeater	*Melithreptus lunatus*	OW
Noisy Friarbird	*Philemon corniculatus*	OW
Eastern Whipbird	*Psophodes olivaceus*	W
Varied Sittella [TS1]	***Daphoenositta chrysoptera***	OW
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	OW
Cicadabird	*Coracina tenuirostris*	X
Golden Whistler	*Pachycephala pectoralis*	OW
Rufous Whistler	*Pachycephala rufiventris*	OW
Grey Shrike-thrush	*Colluricincla harmonica*	OW Q
Australasian Figbird	*Sphecotheres vieilloti*	OW
Olive-backed Oriole	*Oriolus sagittatus*	OW
Pied Butcherbird	*Cracticus nigrogularis*	OW
Australian Magpie	*Cracticus tibicen*	OW
Pied Currawong	*Strepera graculina*	OW
Rufous Fantail[M]	***Rhipidura rufifrons***	OW
Grey Fantail	*Rhipidura fuliginosa*	OW Q
Australian Raven	*Corvus coronoides*	OW
Leaden Flycatcher	*Myiagra rubecula*	X
Black-faced Monarch[M]	***Monarcha melanopsis***	OW
Magpie-lark	*Grallina cyanoleuca*	X
White-winged Chough	*Corcorax melanorhamphos*	X
Eastern Yellow Robin	*Eopsaltria australis*	OW
Silvereye	*Zosterops lateralis*	OW
Common Myna	*Sturnus tristis*	X
Mistletoebird	*Dicaeum hirundinaceum*	OW
Double-barred Finch	*Taeniopygia bichenovii*	OW

TABLE 4.2 FAUNA OBSERVED WITHIN THE SUBJECT SITE		
Common Name	**Scientific Name**	**Observation Type**
Red-browed Finch	*Neochmia temporalis*	OW
Mammals		
Short-beaked Echidna	*Tachyglossus aculeatus*	O
Brown Antechinus	*Antechinus stuartii*	T Q
Northern Brown Bandicoot	*Isoodon macrourus*	H
Long-nosed Bandicoot	*Perameles nasuta*	X
Common Brushtail Possum	*Trichosurus vulpecula*	O H Q
Common Ringtail Possum	*Pseudocheirus peregrinus*	O Q
Squirrel Glider [TS1]	***Petaurus norfolcensis***	O Q
Sugar Glider	*Petaurus breviceps*	Q
Koala [TS1 / TS2]	***Phascolarctos cinereus***	OW
Swamp Wallaby	*Wallabia bicolor*	Q
Red-necked Wallaby	*Macropus rufogriseus*	O
Eastern Grey Kangaroo	*Macropus giganteus*	O
Common Wallaroo	*Macropus robustus*	X
Bush Rat	*Rattus fuscipies*	T
Black Rat *	*Rattus rattus*	Q
Brown Rat *	*Rattus norvegicus*	X
Rabbit *	*Oryctolagus cuniculus*	H
Brown Hare *	*Lepus capensis*	X
European cattle *	*Bos taurus*	P
Fox *	*Vulpes vulpes*	O Q
Cat *	*Felis catus*	O
Dog *	*Canis lupus familiaris*	F
Large Forest Bat	*Vespadelus darlingtoni*	X
Grey-headed Flying-fox [TS1 / TS2]	***Pteropus poliocephalus***	OW
Eastern Horseshoe-bat	*Rhinolophus megaphyllus*	U
Yellow-bellied Sheathtail-bat [TS1]	***Saccolaimus flaviventris***	U
White-striped Freetail-bat	*Tadarida australis*	U
Eastern Freetail-bat [TS1]	***Mormopterus norfolkensis***	X
Undescribed Freetail Bat	*Mormopterus "Species 2"*	X
Undescribed Freetail Bat	*Mormopterus "Species 4"*	X
Gould's Long-eared Bat	*Nyctophilus gouldi*	X
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	X
Long-eared Bat	*Nyctophilus sp. (gouldi or geoffroyi)*	U
Little Bentwing-bat [TS1]	***Miniopterus australis***	U
Eastern Bentwing-bat [TS1]	***Miniopterus schreibersii oceanensis***	T U
Gould's Wattled Bat	*Chalinolobus gouldii*	U
Chocolate Wattled Bat	*Chalinolobus morio*	U
Large-footed Myotis [TS1]	***Myotis adversus***	T
Greater Broad-nosed Bat [TS1]	***Scoteanax rueppellii***	X
Eastern Broad-nosed Bat	*Scotorepens orion*	U
Central Eastern Broad-nosed Bat	*Scotorepens sp.*	X

TABLE 4.2 FAUNA OBSERVED WITHIN THE SUBJECT SITE		
Common Name	**Scientific Name**	**Observation Type**
Eastern Forest Bat	*Vespadelus pumilus*	U
Little Forest Bat	*Vespadelus vulturnus*	T

Key to Observation Type

E - Nest / Roost	O - Observed
F - Tracks / Scratchings / Chew Marks	OW - Observed and Heard Call
FB - Burrow	P - Scat
G - Crushed Cones	Q - Camera
H - Hair / Feathers / Skin	T - Trapped
K - Dead	U - Ultrasonic Recording
M - Miscellaneous Record	W - Heard

X – Previous site survey record (Ecotone 2010)

Note: * indicates introduced species. [TS1] indicates threatened species TSC Act (1995) [TS2] indicates threatened species EPBC Act (1999)

4.3 AQUATIC & RIPARIAN CHARACTERISTICS

4.3.1 *Aquatic Habitat Characteristics*

There are three watercourse branches mapped as intersecting the site on the 1:25,000 topographic map. All watercourses present are tributaries of the Paterson River and the stream order characteristics for the site are mapped within Figure 2.2. The following descriptions are provided for each watercourse present.

The northern most watercourse consisted of a second order watercourse with two first order tributaries. This watercourse was dry during all site inspections, possibly due to the fractured rock beds lining the watercourses.

The central watercourse mapped has been removed within the site boundaries by the existing quarry operations within the site.

The southernmost watercourse mapped consists of a third order tributary, a second order tributary and four first order tributaries within the site. Runoff from this watercourse is diverted to a detention basin prior to discharge from the site. The natural areas of this watercourse above the detention basin were also mostly dry during all site inspections, possibly due to the fractured rock beds lining the watercourse.

The section of the southern watercourse below the site detention basin contained freshwater habitat with in-stream gravel beds and is therefore classified as TYPE 2 – Moderately sensitive key fish habitat as some freshwater habitats were present (other than those specified for TYPE 1 habitats). It is considered that this area contains CLASS 3 Minimal key fish habitat as it is an unnamed waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies).

The remainder of the site did not contain substantial areas of standing freshwater habitats. It is therefore considered that the remainder of the habitats present consist of TYPE 3 – Minimally sensitive key fish habitat. These streams contain areas of CLASS 3 Minimal key fish habitat and CLASS 4 Unlikely key fish habitat as they are located mostly in dry gullies are unnamed and have only intermittent flows following rain events with little or no flow or free standing pools post rain events.

The dams present within the subject site do not meet the criteria for classification as key fish habitat.

4.3.2 *Riparian and Aquatic Vegetation Characteristics*

The watercourses present within the subject site were found to be generally dry, possibly due to the fractured rock beds lining the watercourses, with only very minor areas of ponded water following heavy rain events. No aquatic vegetation was observed within the watercourses in the proposed development area (study area).

4.3.3 *Description of Aquatic Fauna Characteristics*

The freshwater fish species recorded on the Bionet Atlas of NSW Wildlife (OEH 2016) within the Upper Hunter / Central Rivers CMA are listed in Table 4.3. The Longfin Eel has potential to occur within the dams and detention basins within the site. The Mosquito Fish was observed within the dams during aquatic fauna surveys. It is considered that there are likely to be other species of fish present within the area not recorded on the Bionet Atlas of NSW Wildlife, however no threatened aquatic species are likely to occur.

TABLE 4.3
FRESHWATER FISH SPECIES RECORDED IN THE CMA

Common Name	**Scientific Name**
Harrisson's Dogfish	*Centrophorus harrissoni*
Southern Dogfish	*Centrophorus zeehaani*
longfin eel	*Anguilla reinhardtii*
Shortfin Eel	*Anguilla sp.*
Common Jollytail	*Galaxias maculatus*
Mountain Galaxias	*Galaxias olidus*
Striped Gudgeon	*Gobiomorphus australis*
Cox's gudgeon	*Gobiomorphus coxii*
	Cherax cuspidatus
	Euastacus sp.
Mosquito Fish*	*Gambusia holbrooki*
Pinkeye Mullet, Fresh Water Mullet	*Trachystoma petardi*
Australian Smelt	*Retropinna semoni*

*= Introduced Species

SECTION 5

MITIGATION MEASURES & IMPACT ASSESSMENTS

5.1 DESCRIPTION OF AVOIDANCE AND MITIGATION MEASURES

The proposed development footprint has been selected and refined to target the resource rich areas of the site for extraction. The proposal includes the expansion of an existing extractive operation with established infrastructure and is therefore suitably located to minimise impacts. The type of development proposed is highly dependent on the locations of the geological resources present and further reduction or relocation of the proposed footprint to avoid impacts is considered not practical or feasible. The final proposed development area (study area) have also been determined through assessment of constraints associated with noise impacts and buffer requirements, particularly at the northern extents of the site which adjoin vegetated lands.

The following measures are to be implemented to minimise impacts to biodiversity:

- Pre-clearing & relocation surveys for fauna species during construction / site clearing
- Ecological supervision of clearing during construction / site clearing to minimise harm to fauna species
- Implementation of suitable erosion and sediment controls during construction and operation
- Implementation of suitable nutrient management controls during construction and operation
- Implementation of protection zones for adjoining vegetation to be retained during construction and operation
- Weed management of cleared edges and quarry pit during construction and operation
- Implement environmental safeguards required under EPA licensing requirements and EIS recommendations.

Flora and fauna management measures during the pre-clearing and clearing stages of the proposal are provided in the Flora and Fauna Management Plan prepared for the proposal by Conacher Consulting (2016b), provided in Appendix 5.

5.2 SUMMARY OF PROPOSED IMPACTS

5.2.1 Identification of Impacts which Require further Consideration

i. Impacts to 4th order or greater rivers and streams

No fourth order streams are likely to be impacted by the proposal.

ii. Impacts to state significant biodiversity links

No state significant biodiversity links have been identified as likely to be impacted by the proposal.

iii. Impacts to important wetlands and their buffers

No important wetlands or their buffers are likely to be impacted by the proposal.

iv. Impacts in the buffer zone along estuaries

No estuary buffer zones are likely to be impacted by the proposal.

v. Impacts to critically endangered ecological communities which exceed the impact threshold

No critically endangered ecological communities were observed within the subject site during surveys.

vi. Impacts to endangered ecological communities which exceed the impact threshold

No endangered ecological communities listed within the *TSC Act* (1995) or the EPBC Act (1999), were observed within the subject site during surveys.

There is a preliminary determination to list Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions as an endangered ecological community within the TSC Act (1995). This ecological community corresponds to the Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower hunter plant community type observed within the subject site.

The proposal is not likely to result in impacts endangered ecological communities which exceed the impact threshold.

vii. Impacts to critical habitat

No critical habitats are located in or near to the site and no critical habitats are likely to be impacted by the proposal.

viii. Impacts on critically endangered threatened species

No critically endangered species were observed within the subject site during surveys.

ix. Impacts on threatened species or populations nominated in the SEARS because it is likely to cause the extinction of a species or population from an IBRA subregion, or significantly reduce the viability of a species or population.

Pterostylis chaetophora (a terrestrial orchid) was the only threatened species nominated within the SEARS for further consideration under Section 9.2 of the Framework for Biodiversity Assessment (OEH 2014). This species was not observed during targeted surveys, and therefore further consideration is not required.

x. Impacts on threatened species or populations *not previously recorded on the Atlas in the IBRA subregion*

No threatened species or populations not previously recorded on the Atlas in the IBRA subregion were observed within the site. The list of threatened species and populations recorded on the Bionet Atlas of NSW Wildlife (NSW OEH 2016) is provided in Table 5.1.

TABLE 5.1
THREATENED SPECIES & POPULATIONS RECORDED
WITHIN THE IBRA SUBREGION ON THE BIONET ATLAS

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Number of Records
Cynanchum elegans	White-flowered Wax Plant	E1,P	E	1
Rutidosis heterogama	Heath Wrinklewort	V,P	V	P
Tetratheca juncea	Black-eyed Susan	V,P	V	K
Senna acclinis	Rainforest Cassia	E1,P		P
Acacia pendula	Acacia pendula population in the Hunter catchment	E2		2
Angophora inopina	Charmhaven Apple	V,P	V	1
Callistemon linearifolius	Netted Bottle Brush	V,P,3		P
Eucalyptus camaldulensis	Eucalyptus camaldulensis population in the Hunter catchment	E2		P
Eucalyptus glaucina	Slaty Red Gum	V,P	V	109
Eucalyptus largeana	Craven Grey Box	E1,P		5
Syzygium paniculatum	Magenta Lilly Pilly	E1,P	V	2
Corybas dowlingii	Red Helmet Orchid	E1,P,2		P
Cymbidium canaliculatum	Cymbidium canaliculatum population in the Hunter	E2,P,2		P

TABLE 5.1
THREATENED SPECIES & POPULATIONS RECORDED
WITHIN THE IBRA SUBREGION ON THE BIONET ATLAS

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Number of Records
	Catchment			
Pterostylis chaetophora		V,P,2		2
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V,P	V	1
Pseudophryne australis	Red-crowned Toadlet	V,P		P
Litoria aurea	Green and Golden Bell Frog	E1,P	V	2
Aprasia parapulchella	Pink-tailed Legless Lizard	V,P	V	P
Hoplocephalus bitorquatus	Pale-headed Snake	V,P		1
Anseranas semipalmata	Magpie Goose	V,P		13
Ptilinopus magnificus	Wompoo Fruit-Dove	V,P		2
Ephippiorhynchus asiaticus	Black-necked Stork	E1,P		18
Botaurus poiciloptilus	Australasian Bittern	E1,P	E	1
Ixobrychus flavicollis	Black Bittern	V,P		5
Circus assimilis	Spotted Harrier	V,P		4
Erythrotriorchis radiatus	Red Goshawk	E4A,P,2	V	P
Hieraaetus morphnoides	Little Eagle	V,P		4
Falco hypoleucos	Grey Falcon	E1,P,2		1
Falco subniger	Black Falcon	V,P		1
Burhinus grallarius	Bush Stone-curlew	E1,P		1
Irediparra gallinacea	Comb-crested Jacana	V,P		2
Numenius madagascariensis	Eastern Curlew	P	CE,C,J,K	1
Turnix maculosus	Red-backed Button-quail	V,P		1
Callocephalon fimbriatum	Gang-gang Cockatoo	V,P,3		1
Calyptorhynchus lathami	Glossy Black-Cockatoo	V,P,2		21
Glossopsitta pusilla	Little Lorikeet	V,P		28
Lathamus discolor	Swift Parrot	E1,P,3	E	6
Neophema pulchella	Turquoise Parrot	V,P,3		5
Ninox connivens	Barking Owl	V,P,3		5
Ninox strenua	Powerful Owl	V,P,3		25
Tyto novaehollandiae	Masked Owl	V,P,3		8
Tyto tenebricosa	Sooty Owl	V,P,3		3
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V,P		17
Chthonicola sagittata	Speckled Warbler	V,P		18
Anthochaera phrygia	Regent Honeyeater	E4A,P	CE	3
Epthianura albifrons	White-fronted Chat	V,P		1
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V,P		1
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V,P		101
Daphoenositta chrysoptera	Varied Sittella	V,P		13
Pachycephala olivacea	Olive Whistler	V,P		1
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V,P		5
Petroica boodang	Scarlet Robin	V,P		8
Petroica phoenicea	Flame Robin	V,P		1
Stagonopleura guttata	Diamond Firetail	V,P		7
Dasyurus maculatus	Spotted-tailed Quoll	V,P	E	150
Phascogale tapoatafa	Brush-tailed Phascogale	V,P		33
Phascolarctos cinereus	Koala	V,P	V	296
Cercartetus nanus	Eastern Pygmy-possum	V,P		P
Petaurus australis	Yellow-bellied Glider	V,P		1

TABLE 5.1 THREATENED SPECIES & POPULATIONS RECORDED WITHIN THE IBRA SUBREGION ON THE BIONET ATLAS				
Scientific Name	**Common Name**	**TSC Act Status**	**EPBC Act Status**	**Number of Records**
Petaurus norfolcensis	Squirrel Glider	V,P		22
Potorous tridactylus	Long-nosed Potoroo	V,P	V	1
Macropus parma	Parma Wallaby	V,P		K
Pteropus poliocephalus	Grey-headed Flying-fox	V,P	V	37
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V,P		2
Mormopterus norfolkensis	Eastern Freetail-bat	V,P		73
Chalinolobus dwyeri	Large-eared Pied Bat	V,P	V	3
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V,P		2
Kerivoula papuensis	Golden-tipped Bat	V,P		1
Miniopterus australis	Little Bentwing-bat	V,P		64
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V,P		30
Myotis macropus	Southern Myotis	V,P		13
Scoteanax rueppellii	Greater Broad-nosed Bat	V,P		10
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	V,P		K
Pseudomys novaehollandiae	New Holland Mouse	P	V	18

5.2.2 Identification of Impacts which Require Offsets

i. Plant community types

The impact polygon areas and ecosystem credit requirements for the plant community types to be impacted are detailed in Table 5.2. The Biodiversity Credit Report for the proposal is provided in Appendix 3.

TABLE 5.2 IMPACT AREAS AND OFFSET REQUIREMENTS FOR PLANT COMMUNITY TYPES			
Plant Community Type	**TSC Act Status**	**Impact Polygon Area**	**Ecosystem Credits Required**
HU 798 White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley	Not listed	9.8 ha	738
HU 816 Spotted Gum – Narrow-leaved Ironbark shrub-grass open forest of the Central and Lower Hunter	Preliminary listing as Endangered Ecological Community	3.19 ha	252
HU 619 Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast	Not listed	9.4 ha	579
HU 755 Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River	Vulnerable Ecological Community	5 ha	384
Total		27.39 ha	1,953

ii. Threatened Species

The extent of impacts to 'species credit type' threatened flora and fauna and the species credit requirements for the proposal are identified in Table 5.3. The Biodiversity Credit Report for the proposal is provided in Appendix 3.

TABLE 5.3
IMPACT AREAS AND OFFSET REQUIREMENTS
FOR SPECIES CREDIT TYPE THREATENED SPECIES

Species Name	Extent of Proposed Impact	Number of species credits required
Eucalyptus glaucina (Slaty Red Gum)	1203 individuals	16,842
Koala (*Phascolarctos cinereus*)	21.61 ha	562

5.2.3 Identification of Impacts which Do Not Require Determination of Offsets by the Assessor

i. PCTs with a site value score of <17 and which are not EEC or CEECs

No plant communities identified have site value scores of < 17.

ii. PCTs not associated with a threatened species habitat and which are not EEC or CEECs

No plant communities have been identified which are not associated with a threatened species habitat or EEC.

iii. Impacts on threatened species habitat associated with a PCT zone with a value score of <17

No impacts on threatened species habitat associated with a PCT zone with a value score of <17 have been identified.

5.2.4 Impacts which Do Not Require Further Assessment by the Assessor

i. Areas of land without native vegetation

The development footprint contains approximately 55.3 hectares of cleared land which does not require further assessment.

5.3 BIODIVERSITY CREDIT REPORT

The Biodiversity Credit Report for the site is provided as Appendix 3.

5.4 BIODIVERSITY OFFSET STRATEGY DETAILS

The proponents Biodiversity Offset Strategy is provided as separate documentation to this report and outlines the staged delivery of biodiversity offsets for the proposed development.

5.5 ASSESSMENT OF EPBC ACT LISTED BIODIVERSITY

The *Environment Protection and Biodiversity Conservation Act*, (1999) requires that Commonwealth approval be obtained for certain actions. The Act provides an assessment and approvals systems for actions that have a significant impact on matters of National Environment Significance (NES). These may include:-

- Wetlands protected by international treaty (the Ramsar Convention);
- Nationally listed threatened species and ecological communities;
- Nationally listed migratory species.

Actions are projects, developments, undertakings, activities, series of activities or alteration of any of these. An action that needs Commonwealth approval is known as a controlled action. A controlled action needs approval where the Commonwealth decides the action would have a significant effect on a NES matter.

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, the matter needs to be referred to the Australian Government Department of the Environment and Energy (DoEE).

The proposed development was referred to the DoEE (Referral Reference No. 2016/7725), and has been determined to be a controlled action under the EPBC Act. The proposal is to be assessed in accordance with the Bilateral Agreement made between the state of New South Wales and the Commonwealth under section 45 of the *EPBC Act* in relation to environmental assessment.

The Department of the Environment and Energy's Environment Reporting Tool (ERT) identified that 26 threatened species and communities may occur within 5 km of the proposed action. Based on the information in the referral documentation, the location of the action, species records and likely habitat present in the area, the DoEE have determined that there are likely to be significant impacts to:

- Slaty Red Gum (Eucalyptus glaucina) – Vulnerable;
- Koala (Phascolarctos cinereus) combined populations of Qld, NSW and the ACT – Vulnerable;
- Regent Honeyeater (Anthochaera phrygia) – Critically Endangered;
- Swift Parrot (Lathamus discolour) – Critically Endangered; and
- Spot-tailed Quoll (Dasyurus maculatus maculatus) SE mainland population – Endangered.

The key issues identified by the DoEE in relation to biodiversity, as outlined in the revised SEARS, are addressed in Appendix 4 of this Report.

5.6 STATE ENVIRONMENTAL PLANNING POLICY NO. 44 KOALA HABITAT PROTECTION

State Environmental Planning Policy 44 (SEPP 44) is identified in Attachment 1 of the SEARS, and is addressed below.

The subject site was assessed for activity by Koalas using the following methods:

i. A search of the BioNet Atlas of NSW Wildlife (NSW OEH 2016b) was undertaken to identify records of Koalas in the area;

ii. The site was surveyed on foot with any species of Koala food trees being inspected for signs of Koala usage. Trees were inspected and identified for presence of Koalas, scratch and claw marks on the trunk and scats around the base of each tree. The proportion of any trees showing signs of Koala use was calculated for the whole of the site. Additionally the location and density of droppings if found were documented;

iii. Identification and assessment of the density of tree species listed as Koala food trees in State Environmental Planning Policy No. 44 - Koala Habitat Protection was undertaken across the site as outlined in Table 5.4.

TABLE 5.4
SEPP-44 KOALA FEED TREE SPECIES
(From SEPP-44 Schedule 2)

Scientific Name	Common Name	Observed On Site	Percentage within survey plots
Eucalyptus tereticornis	Forest Red Gum	Yes	<15%
Eucalyptus microcorys	Tallowwood	No	0%
Eucalyptus punctata	Grey Gum	No	0%
Eucalyptus viminalis	Ribbon or Manna Gum	No	0%
Eucalyptus camaldulensis	River Red Gum	No	0%

TABLE 5.4 SEPP-44 KOALA FEED TREE SPECIES (From SEPP-44 Schedule 2)			
Scientific Name	**Common Name**	**Observed On Site**	**Percentage within survey plots**
Eucalyptus haemastoma	Broad-leaved Scribbly Gum	No	0%
Eucalyptus signata	Scribbly Gum	No	0%
Eucalyptus albens	White Box	No	0%
Eucalyptus populnea	Bimble Box or Poplar Box	No	0%
Eucalyptus robusta	Swamp Mahogany	No	0%

The Koala food tree species, *Eucalyptus tereticornis*, as listed on Schedule 2 of State Environmental Planning Policy No. 44 - Koala Habitat Protection (SEPP 44) was observed within the subject site.

The site does not contain vegetation where the listed trees constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. Therefore the site is considered to not contain potential Koala habitat as defined by SEPP 44 and a consideration as to whether the site contains core koala habitat as defined by SEPP 44 is not required.

SECTION 6

CONCLUSIONS & RECOMMENDATIONS

6.1 CONCLUSIONS

Based on the field survey undertaken and the assessment information included within this report it is concluded that:

i. The following threatened species were observed during surveys:
   - *Eucalyptus glaucina* (Slaty Red Gum) (species credit species)
   - Little Lorikeet (ecosystem credit species);
   - Speckled Warbler (previous surveys only / ecosystem credit species);
   - Varied Sittella (ecosystem credit species);
   - Powerful Owl (ecosystem credit species);
   - Squirrel Glider (ecosystem credit species);
   - Koala (species credit species)
   - Grey-headed Flying-fox (ecosystem credit species);
   - Yellow-bellied Sheathtail-bat (ecosystem credit species);
   - Eastern Freetail-bat (previous surveys only / ecosystem credit species);
   - Little Bentwing-bat (ecosystem credit species);
   - Eastern Bentwing-bat (ecosystem credit species);
   - Southern Myotis (ecosystem credit species); and
   - Greater Broad-nosed Bat (previous surveys only / ecosystem credit species);

ii. The vulnerable ecological community listed within the *TSC Act* (1995), Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions, was observed during surveys.

iii. The subject site contains vegetation which corresponds to the preliminary determination for the Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions EEC, under the *TSC Act* (1995).

iv. No threatened ecological communities listed within the *EPBC Act* (1999) were observed during surveys.

v. No threatened populations listed within the *TSC Act* (1999) were observed during surveys.

vi. The subject site does not contain a critical habitat listed within the *EPBC Act* (1999) or the *TSC Act* (1995).

vii. The following migratory species listed within the *EPBC Act* (1999) were observed during surveys:
   - Rufous Fantail; and
   - Black-faced Monarch.

viii. A total of 1,953 ecosystem credits are required for offsetting.

ix. A total of 16,842 *Eucalyptus glaucina* species credits are required for offsetting.

x. A total of 562 Koala species credits are required for offsetting.

6.2 RECOMMENDATIONS

i. The mitigation measures recommended in Section 5.1 of this report should be implemented for the proposal

REFERENCES

Antsis. M,. (2002). *Tadpoles of South-eastern Australia a Guide with Keys*. Reed New Holland.

Australian Government Department of Sustainability, Environment, Water, Populations and Communities (2011) *Survey guidelines for Australia's threatened mammals.* Produced by Australian Government Department of Sustainability, Environment, Water, Commonwealth of Australia.

Australian Government Department of Sustainability, Environment, Water, Populations and Communities (2016) *Protected Matters Search Tool.* [Online]. Available from: http://www.environment.gov.au/epbc/pmst/index.html

Bell (2009) The Vegetation and Floristics of Columbey National Park, lower Hunter Valley, New South Wales, Cunninghamia (2009) 11(2): 241–275.

Bishop A. (2000) *Field guide to Orchids of New South Wales and Victoria*. 2nd Edition. University of New South Wales Press.

Brouwer and Gillespie (2007), The Vegetation of Tocal, NSW Department of Primary Industries.

Churchill, S (2008*), "Australian Bats"* (Second edition), Allen and Unwin, Crows Nest, NSW.

Cogger, H.G., (2000) *Reptiles and Amphibians of Australia*. (6th Edition) Reed New Holland, Frenchs Forest NSW.

Conacher Consulting (2016a) *Preliminary Biodiversity Offset Strategy prepared for Martins Creek Quarry Expansion Project (SSD 14-6612) Station Street Martins Creek.*

Conacher Consulting (2016b) *Flora and Fauna Management Plan prepared for Martins Creek Quarry. Station Street, Martins Creek.*

Conacher Consulting (2016c) *Referral of Proposed Action Proposed Martins Creek Quarry Expansion Project Station Street Martins Creek.*

Courtney J, Debus SJS (2006) *Breeding habits and conservation status of the Musk Lorikeet Glossopsitta concinna and Little Lorikeet G. pusilla in Northern New South Wales*. Australian Field Ornithology 23, 109-124.

Cropper, S.C. (1993). *Management of Endangered Plants*. CSIRO Publications, East Melbourne.

Australian Government Department of the Environment (2008) *Approved Conservation Advice for Eucalyptus glaucina.* Australian Government Department of the Environment. [Online] Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/5670-conservation-advice.pdf

Department of the Environment, 2014. *EPBC Act referral guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory).* Commonwealth of Australia.

Department of the Environment, 2016. *National Recovery Plan for the Regent Honeyeater (Anthochera Phrygia)*. Commonwealth of Australia.

Department of Environment and Climate Change 2007, *Threatened Species Assessment Guidelines, The assessment of significance*, Department of Environment and Climate Change, Sydney South.

Department of Environment and Conservation NSW 2005, *NSW Draft Recovery Plan for the Green*

and Golden Bell Frog Litoria aurea (Lesson 1829). DEC, Sydney.

Department of Environment and Conservation NSW 2006, *NSW Recovery Plan for the Large Forest Owls: Powerful Owl (Ninox strenua), Sooty Owl (Tyto tenebricosa) and Masked Owl (Tyto novaehollandiae)*. DEC, Sydney.

Department of the Environment and Energy, 2016a *Species Profile and Threats Database. Eucalyptus glaucina – Slaty Red Gum*. [Online] Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=5670

Department of the Environment and Energy, 2016b *Species Profile and Threats Database Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) – Koala (combined populations of Queensland New South Wales and the Australian Capital Territory)*. [Online] Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=85104

Department of the Environment and Energy, 2016c *Species Profile and Threats Database. Lathamus discolour – Swift Parrot*. [Online] Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=744

Department of the Environment and Heritage, 2004. *Nationally threatened species and ecological communities. Administrative guidelines on significance – Supplement for the Tiger Quoll (southeastern mainland population) and the use of 1080.* Commonwealth of Australia

Department of the Environment and Resource Management, 2011 National Recovery Plan for the Large-eared Pied Bat Chalinolobus dwyeri. Prepared by Department of the Environment and Resource Management, City East, Qld.

Department of Environment, Climate Change and Water NSW 2009, *Draft National Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus.* Prepared by Dr Peggy Eby, Department of Environment, Climate Change and Water NSW, Sydney.

Department of the Environment, Water, Heritage and the Arts (2010) *Survey guidelines for Australia's threatened bird,* Commonwealth of Australia.

Department of the Environment, Water, Heritage and the Arts (2013) *EP&BC Act Policy Statement 1.1 Significant Impact Guidelines, Matters of National Environmental Significance*, Commonwealth of Australia.

Ecotone Ecological Consultants 2010 Flora and Fauna Impact Assessment for Proposed New Sedimentation Structures at Martins Creek Quarry, Dungog LGA. Unpublished report prepared for Rail Corp NSW.

Edgar, R. (1988) *Tiger Quoll (Dasyurus maculatus),* In The Australian Museum Complete Book of Australian Mammals. R. Strahan (Ed.). Angus and Robertson, Sydney.

Environment Protection and Biodiversity Conservation Act (1999). Commonwealth Government.

Environmental Planning and Assessment Act (1979). New South Wales Government.

Fairley, A & Moore, P 1995, *Native Plants of the Sydney District*, Kangaroo Press.

Fox, B. J. (1988). *Eastern Chestnut Mouse (Pseudomys gracilicaudatus). In The Australian Museum Complete Book of Australian Mammals*. R. Strahan (Ed.). Angus and Robertson Publishers, Sydney.

Harden, G.J. (1994) *Flora of New South Wales Vols 1-4, and supplements*. Royal Botanic Gardens. New South Wales University Press, Kensington NSW.

Higgins, P.J. (Ed. (1999) *Handbook of Australian, New Zealand and Antarctic Birds*. *Volume 4:*

Parrots to Dollarbird. Oxford University Press, Melbourne.

Higgins, P.J., & J.M.Peter. (Eds) 2002. *Handbook of Australian New Zealand and Antartic Birds. Volume 6: Pardalotes to shrike-thrushes*. Oxford University Press, Melbourne.

Higgins, P.J., & S.J.J.F. Davies. (Eds) 1996. *Handbook of Australian New Zealand & Antartic Birds. Volume 3: Snipe to Pigeons*. Oxford University Press, Melbourne.

Higgins, P.J., J.M. Peter & S.J. Cowling. (Eds) 2006. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 7: Boatbill to Starlings*. Oxford University Press, Melbourne.

Higgins, P.J., J.M. Peter & W.K. Steel. (Eds) 2001. *Handbook of Australian New Zealand and Antartic Birds. Volume 5: Tyrant-flycatchers to Chats.* Oxford University Press, Melbourne.

Hunter, J.T. (2015) Assessment of the Upper Hunter Mapping Unpublished report to the Environmental Division, Hunter Councils.

Keith, D. (2004) *Ocean Shores to Desert Dunes: The Native Vegetation of New South Wales and the ACT*. Department of Environment and Conservation, Hurstville.

Kingsford, R. (1991) *Australian Waterbirds: A field guide*, Kangaroo Press.

Law B. S., and Chidel M. (2004) *Roosting and foraging ecology of the golden-tipped bat (Kerivoula papuensis) on the south coast of New South Wales*. Wildlife Research, 31, 73-82.

Marchant, S., & P.J. Higgins (Eds) (1990). *Handbook of Australian, New Zealand and Antartic Birds. Volume 1 Ratite's to Ducks Part A Ratite's to Petrels*, Oxford University Press, Melbourne.

Marchant, S., & P.J. Higgins (Eds) (1993). Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings. Oxford University Press, Melbourne.

Marchant, S., & P.J. Higgins (Eds) (1998). *Handbook of Australian, New Zealand and Antartic Birds. Volume 1 Ratite's to Ducks Part A Ratite's to Petrels*, Oxford University Press, Melbourne.

McLean C.M., Varhammar A., and Mikac K.M. *Use of motion activated remote cameras to detect the endangered spotted-tail quoll (Dasyurus maculatus): results from a pilot study.* Australian Mammalogy 37(2) 264 – 264.

Matthei, L.E. Ed. (1995) *Soil Landscapes of the Newcastle 1:100,000 sheet*, Soil Conservation Service of NSW.

Menkhorst P., Schedvin N., and Geering D. 1999, *Regent Honeyeater Recovery Plan 1999-2003,* National Heritage Trust, Melbourne.

Nearmap, 2016. *Martins Creek Quarry and Locality 32°32'58.05"S, 151°37'09.04" elevation 90m.* Aerial Photographs. http://www.nearmap.com.au/ [Viewed 10 June 2016]

NSW Department of Environment and Climate Change 2008, *Approved Recovery Plan for the Koala (Phascolarctos cinereus),* Department of Environment and Climate Change NSW, Sydney.

NSW Department of Environment and Conservation 2004, *Threatened Biodiversity and Assessment: Guidelines for Developments and Activities (working draft)*, New South Wales Department of Environment and Conservation, Hurstville, NSW.

NSW Department of Primary Industries (2013) Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update). Available online: http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/468927/Policy-and-guidelines-for-fish-habitat.pdf

NSW National Parks and Wildlife Service (1999) *Green and Golden Bell Frog (Litoria aurea) Threatened Species Information*. NPWS Hurstville NSW.

NSW National Parks And Wildlife Service (1999) *Spotted-tailed Quoll (Dasyurus maculatus) Threatened Species Information*. NPWS Hurstville NSW.

NSW National Parks and Wildlife Service 2002, *Grevillea parviflora subsp. parviflora Threatened Species Information,* NPWS Hurstville NSW.

NSW National Parks and Wildlife Service 2003, *Draft Recovery Plan for the Barking Owl.* New South Wales National Parks and Wildlife Service, Hurstville, NSW

NSW Office of Environment and Heritage 2012. *National Recovery Plan Magenta Lilly Pilly Syzygium paniculatum*. Hurstville: NSW Available from: http://www.environment.gov.au/biodiversity/threatened/publications/recovery/syzygium-paniculatum.html.

NSW Office of Environment and Heritage 2016a, *OEH Data Portal* [Online] Available from: http://data.environment.nsw.gov.au/

NSW Office of Environment and Heritage 2016b, *BioNet Atlas of NSW Wildlife*, [Online] Available from: http://www.bionet.nsw.gov.au/

NSW Office of Environment and Heritage 2016c, *Profiles for NSW Threatened Species*. [Online]. Available from: http://www.environment.nsw.gov.au/threatenedspecies/

NSW Office of Environment and Heritage 2016d, *Vegetation Information System*. [Online]. Available from: http://www.environment.nsw.gov.au/research/Vegetationinformationsystem.htm

NSW Office of Environment and Heritage 2016e. *Saving Our Species. Slaty Red Gum (Eucalyptus glaucina).* [Online]. Available from: http://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10295

NSW Office of Environment and Heritage (2014a) Framework for Biodiversity Assessment. Available online: http://www.environment.nsw.gov.au/resources/biodiversity/140675fba.pdf

NSW Office of Environment and Heritage (2014b) NSW Biodiversity Offsets Policy for Major Projects. available online: http://www.environment.nsw.gov.au/resources/biodiversity/140672biopolicy.pdf

National Herbarium of NSW Royal Botanic Garden 2015, NSW Flora Online, http://plantnet.rbgsyd.nsw.gov.au/floraonline.htm

Reed, P.C., Lunney, D. and Walker, P. (1991) *A 1986-1987 survey of the Koala Phascolarctos cinereus (Goldfuss) in New South Wales and an ecological interpretation of its distribution. In: Biology of the Koala*. A. K. Lee, K. A. Handasyde and G. D. Sanson, (Eds). Surrey Beatty and Sons, Chipping Norton, Sydney. Pp. 55-73.

Roff, A., Sivertsen, D., Somerville, M. and Denholm, B. 2011. Hunter Native Vegetation Mapping. Geodatabase source book, Office of Environment and Heritage, Department of Premier and Cabinet, Sydney, Australia.

Royal Botanic Gardens and Domain Trust 2016, NSW Flora Online [Online]. Available from:http://plantnet.rbgsyd.nsw.gov.au

Saunders, D.L. and Tzaros, C.L. 2011, *National Recovery Plan for the Swift Parrot Lathamus discolor*, Birds Australia, Melbourne.

Schulz, M. (1998). Bats and other fauna in disused Fairy Martin Hirundo arial nests. Emu. 98:184-191.

Soderquist, T.R. (1995) *Spatial organisation of the arboreal carnivorous marsupial Phascogal tapoatafa.* Journal of Zoology, London, 237, 385-398

Specht, R.L., Specht, A., Whelan, M.B., and Hegarty, E.E. (1995) *Conservation Atlas of Plant Communities in Australia*. Southern Cross University Press, Lismore.

Suckling, G.C. (1995) *Squirrel Glider (Petaurus norfolcensis)*. In The Mammals of Australia. R. Strahan (Ed.). Reed Books, Chatswood.

Threatened Species Conservation Act (1995). New South Wales Government.

Tidemann, C. (1995). "*The Mammals of Australia"*. (R. Strahan (Ed)). New Holland Publishers Pty. Ltd. Melbourne.

Turner, V & S.J. Ward (1995) in *The Mammals of Australia*, The Australian Museum, Sydney.

VGT Pty Ltd 2014. *Martins Creek Andesite Quarry Geology and Blast Vibration Assessment August 2014.* Unpublished report prepared for Daracon Group Pty Limited.

Walker, J. and Hopkins, M.S. (1990) V*egetation. In Australian soil and land survey field handbook*, second edition McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J. and Hopkins, M.S. Inkata Press, Melbourne.

Wilson B.A. and Laidlaw W.S. (2003) Habitat Characteristics for New Holland Mouse Pseudomys novaehollandiae in Victoria, Australian Mammalogy 25: 1-11.

APPENDIX 1
WEATHER CONDITIONS DURING THE SURVEY PERIOD

Paterson, New South Wales
August 2014 Daily Weather Observations

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Fr	6.1	20.5	0	6.0		NW	59	13:48	19.3	20	0	NW	26		17.6	35		W	31	
2	Sa	7.1	15.9	0	4.6		WNW	41	00:05	10.7	43	0	W	13		14.9	40		SSE	9	
3	Su	3.2	16.4	0.2	1.8					8.5	79	7	NE	9		15.0	60		ESE	11	
4	Mo	2.4	20.1	0	3.2		SSE	20	15:20	7.6	93	6	ENE	7		18.3	49		S	9	
5	Tu	4.7	21.1	0	1.6		W	26	12:47	11.9	81	1	ENE	4		20.0	36		WNW	11	
6	We	2.6	20.5	0	2.6					9.2	87	0	ENE	7		19.6	33		WNW	13	
7	Th	8.1	18.5	0	1.8		W	26	03:20	13.0	54	1	WNW	13		17.4	47		SE	7	
8	Fr	3.0	20.1	0	1.8		SSE	24	15:03	9.5	88	7	NNE	4		19.0	52		S	13	
9	Sa	3.7	21.9	0.2	3.6		NW	30	14:25			7	ENE	6		20.8	27		WNW	17	
10	Su	4.7	21.4	0	2.8					14.9	43	6	WNW	17		19.2	26		WNW	15	
11	Mo	4.9	16.4	0	7.6		SE	31	13:41	11.4	50	1	ESE	6		14.1	50		SSE	17	
12	Tu	3.2	16.5	0	0.7		SE	28	12:13	11.5	63	3	WNW	9		14.9	59		SE	13	
13	We	5.3	15.9	0	1.1		SSE	26	14:46	10.0	90	6	NE	7		15.4	52		S	9	
14	Th	1.2	19.1	0	0.9					7.7	87	0	ENE	9		18.9	40		S	11	
15	Fr	5.3	19.7	0	1.0		SE	28	13:34	11.1	80	0	NE	9		17.8	57		ESE	15	
16	Sa	5.0	18.1	0	1.0		ESE	22	12:26	8.2	99	8		Calm		16.5	78		SE	7	
17	Su	8.2	19.9	14.4	1.0					13.6	97	8	N	2		19.1	34		WNW	24	
18	Mo	9.8	17.1	0	4.0		W	52	21:21	13.0	70	8	NW	20		13.4	96		W	15	
19	Tu	11.7	17.1	15.6	2.5		SW	48	14:49	13.2	94	8	WSW	13		15.6	67		SSW	26	
20	We	11.0	17.9	2.0			SSE	30	14:43	13.4	62		WSW	11		14.9	66		S	15	
21	Th	6.5	15.9	0.2	3.8					11.2	97	8		2		14.0	92		NE	7	
22	Fr	11.2	19.9	4.2	1.0		SE	28	15:22	13.7	94	5	SE	2		17.3	65		ESE	13	
23	Sa	7.3	17.4	0	4.0		SE	26	11:48	12.9	96	4	NE	4		15.4	93		E	7	
24	Su	8.9	19.4	2.6	0.6					13.8	94	5	N	7		17.1	80		ESE	7	
25	Mo	7.4	20.5	0.8			SSE	24	15:09				NNE	7		20.3	54		SSE	9	
26	Tu	8.3	17.7	0.2	2.8		SE	20	11:21	13.4	96	8		Calm		16.1	82		S	9	
27	We	12.4	19.4	25.4	0.6					17.6	64	2	SE	17		14.1	93		S	9	
28	Th	11.5	18.6	14.8	1.4		SSE	43	13:20	14.3	89	4	SW	9		17.4	57		SSE	13	
29	Fr	8.9	17.9	4.2	1.0		SSW	41	14:33	13.2	73	4	W	15		15.7	71		SW	13	
30	Sa	12.3	17.6	0.4	1.3		SW	31	14:35	14.0	71	8	WSW	13		16.9	70		SW	15	
31	Su	13.2	22.4	0	2.2					16.7	68	4	W	11		21.2	49		W	11	
Statistics for August 2014																					
Mean		7.1	18.7		2.4					12.4	76	4		9		17.0	58			12	
Lowest		1.2	15.9		0.6					7.6	20	0		Calm		13.4	26		#	7	
Highest		13.2	22.4	25.4	7.6		NW	59		19.3	99	8	NW	26		21.2	96		W	31	
Total				85.2	68.3																

Observations were drawn from Paterson (Tocal AWS) (station 061250)

IDCJDW2108.201408 Prepared at 13:01 UTC on 11 Jul 2015

Paterson, New South Wales
September 2014 Daily Weather Observations

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Mo	6.8	23.8	0	1.8		NW	39	12:35	13.6	84	0	ENE	9		23.6	33		NW	19	
2	Tu	10.8	18.9	0			SW	50	23:06	15.8	58	7	NW	4		16.4	63		WNW	13	
3	We	9.1	17.6	3.8	1.0		SW	54	13:05	13.4	46	7	WSW	28		17.3	34		SW	26	
4	Th	9.8	17.8	0	4.0		SSW	41	15:09	13.9	47	1	WSW	20		16.6	41		SSW	19	
5	Fr	10.1	18.6	0.4	1.6		S	48	14:49	13.1	69	8	W	11		13.8	74		SSW	17	
6	Sa	9.3	19.0	3.6			SE	30	12:12	13.1	86	8	WSW	9		18.4	54		SE	15	
7	Su	8.9	18.8	1.6	2.9					13.9	88	7	NNE	7		17.6	65		SE	15	
8	Mo	5.3	20.8	0	1.6		ESE	35	14:31	14.8	83	1		Calm		19.6	54		ENE	19	
9	Tu	7.8	24.7	0	2.0		NNE	17	00:23	15.9	73	0	ENE	7		24.1	45		SE	7	
10	We	12.8	24.2	3.8	2.8					14.6	86	5	N	13		22.9	33		WNW	26	
11	Th	11.0	24.2	0.2	4.0		NW	31	15:26	17.7	46	0	WNW	15		23.9	31		NW	17	
12	Fr	9.3	19.1	0			ESE	30	14:16	16.5	73	7	SW	11		17.5	64		ESE	15	
13	Sa	11.1	21.8	0	1.2		S	28	15:58	17.8	72	4	SE	11		20.7	62		SSE	15	
14	Su	9.1	26.0	0	1.0					13.8	100	8	NE	9		25.6	30		WNW	15	
15	Mo	12.0	23.4	0			S	28	14:55	17.7	73	5	SW	11		22.2	47		S	19	
16	Tu	11.7	26.1	0	3.4		W	48	15:34	17.4	76	3	NNW	7		25.9	29		NW	19	
17	We	13.5	23.3	0	6.4		NNW	43	14:46	17.6	40	2	W	17		22.8	24		NW	20	
18	Th	9.0	22.1	0	8.0					16.3	34	0	WNW	22		18.7	37		SE	20	
19	Fr	4.6	19.4	0	4.0		NW	20	09:16	14.1	56	6	NE	6		19.0	32		NNW	9	
20	Sa	3.3	20.9	0	5.8		SSE	43	13:00	13.6	64	1	E	7		19.5	47		SE	19	
21	Su	7.2	20.4	0.2	1.2					15.7	78	2	NE	7		19.4	52		ESE	15	
22	Mo	6.7	21.9	0.2	2.4		S	28	12:57	14.8	78	5	NE	7		20.4	44		SE	17	
23	Tu	4.8	23.6	0	2.6		SE	30	14:49	14.5	70	0	ESE	6		22.0	52		SSE	17	
24	We	6.9	26.5	0	2.6		SE	22	13:35	16.9	72	0	NE	9		26.0	36		SE	9	
25	Th	12.4	24.6	0.2	4.2					18.4	73	8	ESE	2		19.9	72		N	13	
26	Fr	13.9	21.9	9.4	4.0		W	26	08:40	16.9	70	8	W	15		20.6	56		SSE	13	
27	Sa	12.1	20.8	0	1.5		SE	31	12:34	16.2	78	7	ENE	4		19.6	53		SE	13	
28	Su	7.2	25.1	0	1.4					16.2	75	0	NNE	7		23.9	32		NNW	9	
29	Mo	8.1	30.6	0	5.6		NNW	41	13:08	21.5	49	0	ENE	7		29.9	21		NW	19	
30	Tu	12.0	32.9	0	6.4		NW	41	13:21	22.5	52	4	NE	9		30.5	21		NNW	28	
Statistics for September 2014																					
Mean		9.2	22.6		3.2					15.9	68	3		9		21.3	44			16	
Lowest		3.3	17.6		1.0					13.1	34	0		Calm		13.8	21		SE	7	
Highest		13.9	32.9	9.4	8.0		SW	54		22.5	100	8	WSW	28		30.5	74		NNW	28	
Total				23.4	83.4																

Observations were drawn from Paterson (Tocal AWS) (station 061250)

IDCJDW2108.201409 Prepared at 13:01 UTC on 10 Jul 2015

Paterson, New South Wales
February 2015 Daily Weather Observations

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Su	16.1	27.4	0	4.4					19.9	89	8	NE	7		26.3	59		SE	19	
2	Mo	17.8	25.9	0	7.2		SE	39	13:52	20.8	82	4	SW	2		24.8	61		SE	24	
3	Tu	15.5	25.7	5.4	8.0		ESE	31	12:04	17.9	89	6	SW	9		23.5	54		SSE	17	
4	We	13.3	25.6	0.2	4.0					19.4	80	1	NE	7		24.6	55		S	13	
5	Th	15.7	24.3	1.2	1.6		SE	35	12:45	19.1	94	8	SE	2		24.1	56		SE	13	
6	Fr	13.8	25.6	1.4	1.6		ESE	31	16:13	19.0	83	2	ENE	6		24.7	47		SE	17	
7	Sa	16.3	28.4	0	6.4					20.4	77	7	SE	11		27.5	52		SSE	13	
8	Su	15.3	34.5	0	3.0		W	20	13:59	21.3	83	2	NE	11		33.7	28		WNW	11	
9	Mo	17.7	29.0	0	6.4		SE	35	13:42	25.8	79	4	SSE	13		27.5	62		SE	20	
10	Tu	18.9	29.5	0						24.3	84	1	S	7		29.0	54		E	20	
11	We	16.7	30.1	0	1.8		SE	30	16:09	23.4	80	1		Calm		29.1	52		ESE	13	
12	Th	16.4	31.6	0	7.4					22.5	78	0	N	7		30.9	49		S	17	
13	Fr	19.3	28.6	0	4.0					22.8	82	6		Calm		27.2	56		SE	19	
14	Sa	15.9	30.3	0	3.4					22.2	76	0		Calm		28.6	41		NE	15	
15	Su	16.9	32.7	0	4.6					22.3	73	3		Calm		31.3	40		SSE	11	
16	Mo	16.2	32.2	0.4	8.8		ESE	33	16:56	21.7	81	0	E	2		30.7	39		SSW	7	
17	Tu	18.2	31.4	0.2	7.2		E	39	16:48	24.0	65	1	ENE	15		30.8	37		NE	20	
18	We	17.9	29.5	0	10.1		NE	39	12:15	24.5	61	1	ENE	11		28.3	47		ENE	20	
19	Th	16.2	27.9	0	4.0		NE	35	11:10	21.6	81	7	W	2		24.9	63		ENE	17	
20	Fr	17.2	26.4	0	2.2					21.3	89	8		Calm		24.9	77		SSE	9	
21	Sa	20.0	25.7	12.4	4.8		NE	30	23:27	21.3	86	7	NE	7		24.0	79		ENE	13	
22	Su	19.8	27.4	2.0	3.4		ESE	31	15:33	22.1	93	7	S	6		26.2	68		SE	19	
23	Mo	20.4	28.8	1.4	1.4					22.4	91	7	SSE	6		27.3	66		SE	17	
24	Tu	19.3	29.2	0.2	4.2		S	37	14:20	21.1	95	7		Calm		26.4	68		SSE	19	
25	We	20.0	28.2	2.0	3.8		SSW	33	15:14	21.3	89	8	SSW	7		26.8	59		SSE	13	
26	Th	19.9	28.5	4.0						21.9	87	8	SSW	4		27.6	57		ENE	9	
27	Fr	19.0	28.9	2.4			SE	28	15:26	22.1	89	6	SSW	6		28.1	57		S	15	
28	Sa	16.5	30.8	0			SE	24	17:13	19.3	97	0	NNW	6		29.1	54		NNW	7	
Statistics for February 2015																					
	Mean	17.4	28.7		4.7					21.6	83	4		5		27.4	54			15	
	Lowest	13.3	24.3		1.4					17.9	61	0		Calm		23.5	28		#	7	
	Highest	20.4	34.5	12.4	10.1		#	39		25.8	97	8	ENE	15		33.7	79		SE	24	
	Total			33.2	113.7																

Observations were drawn from Paterson (Tocal AWS) (station 061250)

Paterson, New South Wales
June 2015 Daily Weather Observations

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Mo	10.9	17.4	1.4	0.6		WSW	52	11:17	15.1	54	1	WNW	17		15.7	24		SW	22	
2	Tu	5.0	15.2	0	0.8		NW	24	12:14	10.5	50	0	NW	13		14.4	46		W	11	
3	We	2.9	16.5	0	1.0		WSW	19	11:05	8.8	78	0	NNE	9		15.3	53		WSW	7	
4	Th	1.2	16.8	0			W	24	14:14	7.3	91	0	NE	7		15.9	41		W	11	
5	Fr	4.1	14.4	0.6			NW	31	04:49	10.2	76	8	WNW	11		13.8	59		WNW	11	
6	Sa	6.3	19.4	0						10.8	78	1	NNE	6		18.2	58		WNW	7	
7	Su	4.4	21.4	0.2	1.4		NW	28	14:29	8.7	95	0	NE	7		20.8	49		NNW	15	
8	Mo	6.6	21.7	0	1.6		NW	41	12:18	9.8	95	7		Calm		21.0	40		NNW	24	
9	Tu	8.1	22.8	0			NNW	44	14:21	10.4	89		WSW	4		21.8	36		WNW	22	
10	We	9.3	16.7	0	7.2		S	24	13:28	12.2	75	7	NE	7		14.1	96		S	9	
11	Th	11.0	16.8	3.6	0.2		SSW	19	12:59	12.6	97	7	NNW	9		15.4	81		ENE	6	
12	Fr	11.2	18.4	0.2			SSE	13	07:34	13.1	97	8		Calm		16.9	68		SE	7	
13	Sa	11.7	20.1	0	0.2		N	19	12:22	13.3	88	6	NE	6		18.5	56		SSW	6	
14	Su	6.6	19.4	0	0.1		WSW	15	12:40	10.9	94	3	NNE	6		18.3	63		SE	7	
15	Mo	6.9	18.7	0.2	1.0					10.4	100	8		Calm		18.1	73		E	9	
16	Tu	10.3	18.0	0	1.0		NNE	37	08:57	17.1	76	6	NE	26		15.3	97			Calm	
17	We	13.3	17.4	14.4	0.6		NW	44	23:43	13.7	100	8		Calm		16.9	91			Calm	
18	Th	12.3	18.6	4.0	0.8					16.2	62	1	NW	9		16.9	60		WNW	13	
19	Fr	10.9	13.3	0	1.3		WSW	26	05:21	11.4	85	8	W	13		13.1	84		W	13	
20	Sa	7.8	14.3	5.4	0.8		W	19	12:15	10.8	78	8	WNW	6		13.6	61		NNW	11	
21	Su	4.3	16.5	0	1.1					8.2	87	6	ENE	7		15.4	61		SW	9	
22	Mo	2.7	17.3	0.2	2.4		ESE	15	12:29	6.5	95	0	NE	9		16.6	58		NE	7	
23	Tu	4.1	20.1	0	1.6		NE	17	14:12	9.3	86	0	NE	2		19.9	48		NNE	13	
24	We	7.3	15.3	0.2	4.6					10.9	85	4		Calm		14.8	76		NE	7	
25	Th	9.4	19.5	0.2	0.3		S	28	15:35	13.4	87	7	NE	11		18.7	57		SSW	9	
26	Fr	8.9	18.1	2.8	0.8		SSE	22	12:36	12.6	92	2	NE	2		17.2	52		S	9	
27	Sa	4.1	18.7	0.2	3.2		E	13	11:37	8.9	95	1	NE	9		17.8	58		NNE	7	
28	Su	2.5	18.1	0.2	2.2		SW	20	14:29	8.5	88	1	ENE	7		17.1	51		SW	9	
29	Mo	4.5	18.3	0	0.2		SE	17	13:45	8.4	92	2	NE	7		17.3	66		ESE	7	
30	Tu	5.6	15.3	0.2	0.2		NE	13	06:15	7.4	100	8	NE	9		15.2	80			Calm	
Statistics for June 2015																					
	Mean	7.1	17.8		1.4					10.9	85	4		7		16.8	61			9	
	Lowest	1.2	13.3		0.1					6.5	50	0		Calm		13.1	24			Calm	
	Highest	13.3	22.8	14.4	7.2		WSW	52		17.1	100	8	NE	26		21.8	97		NNW	24	
	Total			34.0	35.2																

Observations were drawn from Paterson (Tocal AWS) (station 061250)

Paterson, New South Wales
July 2015 Daily Weather Observations

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	We	7.4	17.3	1.2	0.4		WNW	19	23:41	13.1	93	7	ENE	6		16.7	71		NE	9	
2	Th	7.3	14.7	0.2	1.0		WNW	41	12:56	9.5	64	4	WNW	9		14.2	44		NW	15	
3	Fr	6.0	16.2	0	1.0		WSW	24	05:45	9.4	53	7	NW	11		14.6	54		WSW	9	
4	Sa	2.0	17.3	0	1.4		WNW	43	12:21	7.3	90	4	NE	7		16.4	40		WNW	17	
5	Su	1.7	18.8	0	1.2		W	31	12:48	7.7	76	2		Calm		17.7	42		WNW	13	
6	Mo	4.0	17.1	0	2.4					13.3	54	0	NW	20		16.2	33		WNW	19	
7	Tu	7.1	17.5	0	4.0		W	31	10:33	12.5	52	0	WNW	13		15.0	54		SSE	13	
8	We	5.4	16.9	0.2	1.2		SE	22	13:15	10.0	88	1	NE	6		14.6	68		SE	11	
9	Th	2.7	17.4	0.2	1.2		ESE	17	14:35	7.1	95	0	N	2		16.6	53		SE	6	
10	Fr	4.4	18.6	0	4.2		W	26	18:43	7.4	100		E	6		17.9	58		NNE	7	
11	Sa	3.7	18.7	0.4	2.2		N	48	20:49	9.3	95	0	NE	4		18.4	59		E	7	
12	Su	7.6	13.0	2.2	1.5					9.0	61	6	WNW	28		10.8	60		NW	30	
13	Mo	8.3	16.4	0	2.2		NW	61	07:11	11.4	66	8	NW	30		16.1	48		WNW	24	
14	Tu	8.9	16.9	0.8	4.2		WNW	54	13:44	12.8	59	1	WNW	22		15.0	38		NW	26	
15	We	3.4	16.1	0	4.3					8.5	75	1	NNW	4		15.2	45		SW	11	
16	Th	3.4	16.4	0			WNW	41	13:24	11.6	73	6	NE	7		13.3	51		WNW	15	
17	Fr	6.4	13.3	0			NW	46	04:29	7.8	69	8	WNW	26		12.5	59		W	17	
18	Sa	7.4	14.8	0.8						10.0	57	5	W	13		13.7	53		SSW	13	
19	Su	5.7	15.3	0.4	0.8		SW	22	14:53	10.2	84	8	NNW	6		13.9	75		SW	15	
20	Mo	6.1	17.8	0.2	1.8		SSE	22	14:16	9.7	99	1	NW	2		15.6	73		SE	11	
21	Tu	5.0	17.9	0.2	1.2		NE	24	16:18	6.5	100	8	E	4		16.5	69		SW	13	
22	We	4.8	14.9	0	1.4		ENE	11	06:10	7.3	99	8		Calm		14.6	74		ENE	2	
23	Th	7.3	17.0	2.0	0.8		NE	15	12:20	10.4	99	8	NE	9		16.2	74		NE	7	
24	Fr	8.6	18.7	0.2	0.4					11.4	100	8	NW	2		16.9	87		NE	9	
25	Sa	10.9	19.8	1.8	2.6		NW	54	12:15	15.7		1	NNW	19		19.0	33		NW	30	
26	Su	10.9	20.2	2.2	4.0		WNW	59	12:27	14.4	51	7	NW	19		19.1	36		NW	31	
27	Mo	7.8	15.5	0	2.2					10.9	47	0	WNW	17		14.7	34				
28	Tu	3.5	16.2	0	2.0		WSW	26	11:03	9.8	56	0	N	7		15.1	44		SSW	9	
29	We	3.9		0	2.4					9.1	74	3	NE	6		16.6	100		ENE	4	
Statistics for the first 29 days of July 2015																					
Mean		5.9	16.8		2.0					10.1	76	4		10		15.6	56			14	
Lowest		1.7	13.0		0.4					6.5	47	0		Calm		10.8	33		ENE	2	
Highest		10.9	20.2	2.2	4.3		NW	61		15.7	100	8	NW	30		19.1	100		NW	31	
Total				13.0	52.0																

Observations were drawn from Paterson (Tocal AWS) {station 061250}

Paterson, New South Wales
August 2015 Daily Weather Observations

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Sa	2.7	24.1	0			NW	37	13:21	9.3	78		ENE	4		22.9	29		WNW	17	
2	Su	6.1	27.9	0	2.0					13.2	66	1	E	9		26.5	20		NW	35	
3	Mo	11.4	19.0	0	8.0		WNW	48	12:30	13.6	75	0	WSW	15		17.6	31		NW	20	
4	Tu	4.0	15.4	0	8.0		WNW	28	20:22	10.5	58	7	WSW	6		13.7	44		W	19	
5	We	5.4	15.1	0	2.0					10.0	40	0	NW	22		14.5	34		WNW	30	
6	Th	8.0	16.7	0	3.0		WNW	39	09:30	11.2	57	0	WNW	20		15.7	31		SW	17	
7	Fr	2.7	17.2	0	2.2		W	30	11:51	10.0	66	0	ENE	7		16.2	39		W	13	
8	Sa	2.9	16.9	0	3.0					9.8	71	4	ENE	9		15.4	55		S	9	
9	Su	2.6	18.6	0	2.6		E	19	12:57	8.9	84	3	NE	7		17.7	53		ESE	13	
10	Mo	4.1	20.4	0	2.8		WNW	43	12:55	10.9	76	0	NE	9		19.7	31		WNW	17	
11	Tu	2.3	22.6	0	1.8		WNW	26	13:56	12.3	62	0	NE	7		20.1	31		W	13	
12	We	2.0	19.2	0	4.0		NW	56	20:23	8.9	72	3	NNE	4		16.5	42		WSW	15	
13	Th	8.8	18.7	0	3.8		NW	50	01:37	12.8	52	0	WNW	22		18.1	33		NW	20	
14	Fr	5.9	18.4	0	2.4					12.8	55	0	NNE	2		17.6	40		WNW	17	
15	Sa	2.4	18.3	0	1.6		SSE	22	15:15	9.1	81	1	NE	13		17.3	60		SSE	11	
16	Su	9.0	21.4	0.2	1.0		E	19	12:02	12.4	95	8	WSW	6		20.9	45		ESE	7	
17	Mo	5.6	19.9	0.2	4.0					14.6	54	0	WNW	15		18.9	33		NW	19	
18	Tu	6.4	18.4	0	4.0		W	31	09:37	13.6	55	0	WNW	15		17.4	33		W	9	
19	We	2.6	19.4	0	2.0		ESE	30	12:45	10.1	77	0	ENE	7		18.1	42		SSE	6	
20	Th	4.6	21.2	0	2.0					11.5	82	0	NNE	6		20.3	43		ESE	9	
21	Fr	5.4	23.6	0	2.4		NE	20	14:18	11.9	85	0	ENE	7		22.4	35		NE	11	
22	Sa	8.6	27.8	0	3.4		NW	33	13:55	17.5	57	3	NE	2		27.4	31		NW	13	
23	Su	11.3	16.7	8.8			NNE	28	12:39	14.0	97	8	NW	6		15.4	96		NNE	15	
24	Mo	13.8	18.1	30.2	4.0		NE	35	00:49	15.0	97	8	ENE	2		17.8	87		S	6	
25	Tu	13.8	20.7	2.8	1.0		NW	50	21:31	16.8	75	4	W	17		18.9	57		WNW	20	
26	We	13.3	19.8	0	2.2		NW	48	00:07	15.0	61	8	NW	24		18.7	55		WNW	17	
27	Th	11.2	18.5	0	4.0					16.1	66	7	WNW	13		17.1	54		NW	17	
28	Fr	10.6	19.6	0	1.8		W	46	10:45	14.4	53	0	WNW	22		19.1	37		WNW	22	
29	Sa	5.0	19.8	0	2.2					12.5	70	0	ENE	7		19.3	37		WNW	19	
30	Su	4.6	19.1	0	2.4					12.6	53	1	W	13		18.7	37		W	9	
31	Mo	6.8	19.8	0	7.0		W	26	10:13	14.3	66	2	NNE	7		18.8	41		W	13	
Statistics for August 2015																					
Mean		6.6	19.8		3.1					12.4	68	2		10		18.7	43			15	
Lowest		2.0	15.1		1.0					8.9	40	0	#	2		13.7	20		#	6	
Highest		13.8	27.9	30.2	8.0		NW	56		17.5	97	8	NW	24		27.4	96		NW	35	
Total				42.2	90.6																

Observations were drawn from Paterson (Tocal AWS) {station 061250}

Paterson, New South Wales
September 2015 Daily Weather Observations

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Tu	7.4	20.1	0	1.4					14.0	52	0	WNW	17		19.9	27		WNW	19	
2	We	3.8	20.4	0	4.0		NE	19	20:23	11.0	69	6	E	7		20.1	30		ENE	11	
3	Th	10.7	18.5	8.6	4.8		WSW	61	13:32	17.7	41	1	NW	22		14.4	70		NW	19	
4	Fr	11.4	15.6	2.4	2.8		W	33	00:38	13.7	85	8	WSW	7		14.7	93		E	6	
5	Sa	8.7	21.3	3.0	4.8		SSE	28	15:49	10.9	100	7	NE	9		20.8	41		WSW	11	
6	Su	10.9	18.9	7.2	1.2		SSE	24	12:15	14.1	94	6	NE	9		17.6	69		SE	13	
7	Mo	7.7	24.5	0.2	1.0		WNW	44	11:56	14.9	81	0	NE	9		23.6	31		NNW	20	
8	Tu	7.1	19.8	0	4.0		WNW	41	09:03	13.3	39	0	WNW	24		19.3	30		NW	17	
9	We	7.1	20.8	0	4.0		NW	31	00:40	15.9	51	0	W	17		20.4	35		W	13	
10	Th	9.2	18.7	0.4	4.6					13.3	88	3	NE	11		17.8	54		SE	15	
11	Fr	7.6	22.2	0	2.2		SE	22	16:36	14.0	74	1	ENE	6		21.8	38		WSW	6	
12	Sa	7.0	26.1	0	1.6		WSW	39	12:21	15.7	76	0	NE	6		25.4	32		NNW	9	
13	Su	8.0	25.4	0	1.2					17.3	71	0	NE	2		24.8	38		S	9	
14	Mo	8.3	25.8	0	8.0		ESE	24	17:17	17.1	72	0	NNE	6		25.6	34		ENE	9	
15	Tu	9.2	27.9	0	4.0		NNW	52	13:24	19.6	67	0	NE	7		27.4	31		NW	26	
16	We	9.1	23.2	0	6.0					17.6	45	0	SE	11		21.3	42		SSE	15	
17	Th	12.2	20.7	0	7.0		SW	35	15:39	18.2	69	6	N	7		18.2	58		S	19	
18	Fr	11.6	19.5	16.0	6.0		SSE	37	14:03	16.6	66	6	SSW	9		17.8	58		SE	17	
19	Sa	11.2	19.4	2.4	2.8					15.3	88	7	W	6		18.2	65		SE	19	
20	Su	13.0	20.5	3.0	3.0		SE	26	14:34	15.4	89	8	SSE	7		17.6	86		SE	13	
21	Mo	9.5	24.1	0	1.6					16.5	80	1	N	7		23.4	40		WSW	13	
22	Tu	11.3	21.9	0	2.2							7				17.3	56		SSE	17	
23	We	8.9	16.6	0.6	4.2		S	46	12:36	12.3	57	8	SW	11		15.1	48		SSW	15	
24	Th	8.8	17.3	0.2	4.0		SSW	44	14:30	12.6	52	5	WSW	17		15.5	46		SW	24	
25	Fr	9.7	15.7	8.0	2.0					12.4	88	8	W	7		14.9	76		SSW	17	
26	Sa	11.0	19.5	9.0			SSE	33	14:14	13.9	83	7	N	7		17.3	59		SSE	15	
27	Su	10.7	18.5	2.0	2.4		SSW	39	10:48	14.2	80	8	SW	20		17.7	59		SE	17	
28	Mo	6.6	21.9	0	4.0					16.3	62	0	W	11		20.8	48		SW	9	
29	Tu	6.4	25.8	0	4.0		N	30	14:44	15.7	72	0	NNE	7		25.5	21		WNW	9	
30	We	8.7	23.8	0	4.0		SE	31	14:20	18.8	52	1	N	4		21.2	63		SE	19	
Statistics for September 2015																					
Mean		9.1	21.1		3.5					15.1	70	3		10		19.8	49			14	
Lowest		3.8	15.6		1.0					10.9	39	0	NE	2		14.4	21		#	6	
Highest		13.0	27.9	16.0	8.0		WSW	61		19.6	100	8	WNW	24		27.4	93		NW	26	
Total				63.0	102.8																

Observations were drawn from Paterson (Tocal AWS) {station 061250}

Paterson, New South Wales
October 2015 Daily Weather Observations

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Th	11.9	27.3	0	3.6					17.0	90	0	NNE	7		26.9	40		ENE	11	
2	Fr	12.5	25.7	0	4.0		SE	31	12:32	19.0	75	5	NNE	7		22.5	55		SSE	15	
3	Sa	10.4	31.5	0	6.2		NNW	31	13:21	19.8	76	1	NNE	2		30.8	26		NW	15	
4	Su	12.5	34.3	0	2.0					20.2	59	3	E	7		33.7	16		NNW	22	
5	Mo	11.5	35.9	0	3.8		WNW	37	11:57	20.4	57	0	NNE	2		34.6	14		NNW	13	
6	Tu	12.6	35.5	0	10.2		ESE	22	16:36	20.0	55	0	NE	7		35.0	21		ENE	11	
7	We	13.3	22.2	0	8.0					21.5	73	0	S	19		19.1	73		SSE	15	
8	Th	13.0	20.4	0	2.6		E	33	12:23	16.0	88	8		Calm		19.2	70		E	13	
9	Fr	12.2	25.8	0	1.8		NNE	26	08:42	18.7	59	0	NE	15		25.5	44		SSW	9	
10	Sa	10.0	27.9	0.2	2.0					17.8	80	0	NE	15		27.3	39		SE	11	
11	Su	11.2	30.2	0	2.8		S	35	16:22	17.9	83	4	ENE	9		28.7	30		W	15	
12	Mo	13.3	33.0	1.0	9.0		NNW	39	14:49	19.7	79	0	NE	9		32.6	21		NW	17	
13	Tu	17.9	24.4	0	5.6					21.1	82	7	SSW	13		23.1	67		SE	19	
14	We	14.2	26.0	0	4.0		SE	31	15:48	20.5	75	4	N	2		25.3	53		E	17	
15	Th	12.2	28.4	0	4.0		NE	17	11:17	16.5	91	8	NE	6		27.5	38		ENE	11	
16	Fr	11.6	33.0	0	4.0					18.9	66	0	NE	7		32.2	19		NNW	13	
17	Sa	14.7	28.8	0	11.4		SE	30	13:13	22.2	62	1	SE	2		27.4	58		ESE	17	
18	Su	19.2	21.5	0	5.6		SE	30	10:53	20.2	92	8	SSE	9		20.0	81		SSE	11	
19	Mo	16.0	29.8	0	0.8					20.1	85	6	E	7		29.4	35		SE	7	
20	Tu	13.0	33.8	0	4.0		WSW	33	21:14	20.9	70	0	ENE	7		32.3	29		SE	11	
21	We	16.1	35.1	0	5.6					24.8	58	1	ESE	6		34.1	20		WNW	13	
22	Th	17.6	26.6	2.6	7.0					17.9	96	8	S	2		24.9	46		N	9	
23	Fr	14.1	22.0	5.2	5.0		SW	37	23:09	16.6	76	8	SW	13		19.9	50		SSE	13	
24	Sa	9.1	25.0	0	1.8		ENE	26	09:52	16.6	74	1	E	9		23.8	52		ESE	17	
25	Su	10.5	29.7	0	3.2		ESE	26	16:07	18.4	75	3	ENE	4		28.8	35		E	9	
26	Mo	13.6	33.8	1.0	8.0		W	76	14:26	21.4	73	0	NE	6		30.2	30		W	15	
27	Tu	16.3	18.2	1.8	6.8		SSW	41	03:55	16.8	86	8	SSW	15		17.5	59		S	15	
28	We	11.3	21.6	1.6	3.2					18.0	61	1	ESE	7		20.5	44				
29	Th	11.3	24.4	0.2	4.0		E	37	13:29	19.0	64	5	NE	4		22.8	48		E	19	
30	Fr	8.6	26.0	0	4.0		ESE	33	13:28	17.7	73	0	NE	6		24.8	43		SSE	17	
31	Sa	12.5	26.0	0	2.0					20.8	64	4	ESE	6		21.6	69		W	9	
Statistics for October 2015																					
Mean		13.0	27.9		4.7					19.2	74	3		7		26.5	42			13	
Lowest		8.6	18.2		0.8					16.0	55	0		Calm		17.5	14		SE	7	
Highest		19.2	35.9	5.2	11.4		W	76		24.8	96	8	S	19		35.0	81		NNW	22	
Total				13.6	146.0																

Observations were drawn from Paterson (Tocal AWS) {station 061250}

APPENDIX 2
VEGETATION SURVEY DATA

A2.1 FLORA SPECIES OBSERVED

The flora species observed during surveys are listed in Table A2.1. Cover and abundance ratings are provided in accordance with the requirements of NSW OEH (2014a).

TABLE A2.1
FLORA SPECIES OBSERVED DURING SURVEYS

Family	Scientific Name	Common Name	Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10		Q11		Q12		Q13		Q14		Q15	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Upper Stratum																																
Moraceae	*Ficus rubiginosa*	Rusty Fig													X	X	5	1														
Myrtaceae	*Backhousia myrtifolia*	Grey Myrtle					61	20							10	3	25	4														
	Corymbia maculata	Spotted Gum	10	4	5	1					2	1	4	1	10	2			10	4	5	2	10	13	11	6	17	16	15	4	X	X
	Eucalyptus acmenoides	White Mahogany					4	1							3	1			2	5	10	3			20	12			5	2		
	Eucalyptus canaliculata	Grey Gum											15	3							10	2										
	Eucalyptus carnea	Thick-leaved Mahogany									X	X																				
	Eucalyptus crebra	Narrow-leaved Ironbark	5	3	5	2			15	9	X	X	X	X					5	2			2	2			10	4	15	6		
	Eucalyptus fibrosa	Red Ironbark	5	2																												
	Eucalyptus glaucina [TS1/TS2]	Slaty Red Gum			10	5			5	2	15	4											2	1							10	3
	Eucalyptus globoidea	White Stringybark	15	5	10	6							X	X													3	1	10	5		
	Eucalyptus moluccana	Grey Box									2	1															X	X			25	8
	Eucalyptus paniculata	Grey Ironbark					10	2					15	8	10	2					15	4			4	1						
	Eucalyptus siderophloia	Grey Ironbark									10	4	5	5																		
	Eucalyptus tereticornis	Forest Red Gum									X	X																				
Mid Stratum (upper layer)																																
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak											X	X					X	X									2	2		
Fabaceae (Mimosoideae)	*Acacia binervata*	Two-veined Hickory							10	10																						
	Acacia implexa	Hickory Wattle																									4	6				
Malvaceae	*Hibiscus heterophyllus*	Native Rosella																	X	X												
Moraceae	*Ficus rubiginosa*	Rusty Fig																	X	X												
	Streblus brunonianus	Whalebone Tree													5	3	5	7														
Myrtaceae	*Backhousia myrtifolia*	Grey Myrtle					30	20							45	20	40	20							3	1			5	4		
	Corymbia maculata	Spotted Gum	10	8									1	1					5	3			10	12			10	5	2	4		
	Eucalyptus acmenoides	White Mahogany																	5	2	3	2			8	4	2	1				
	Eucalyptus canaliculata	Grey Gum																			5	2										
	Eucalyptus crebra	Narrow-leaved Ironbark	5	4	2	3			10	9									10	4			5	4			5	3	5	6		
	Eucalyptus fibrosa	Red Ironbark	1	1																												
	Eucalyptus glaucina [TS1/TS2]	Slaty Red Gum			5	10			5	6																					5	4
	Eucalyptus globoidea	White Stringybark	5	4	5	8																										
	Eucalyptus paniculata	Grey Ironbark											10	5							5	3										
	Eucalyptus siderophloia	Grey Ironbark									5	3	5	3																		
	Eucalyptus tereticornis	Forest Red Gum									5	2																				
	Melaleuca styphelioides	Prickly-leaved Tea Tree													X	X					3	1					2	1				
Oleaceae	*Olea europaea* subsp. *cuspidata**	African Olive							3	2																						
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree									1	1																				
Rhamnaceae	*Alphitonia excelsa*	Red Ash																											5	4		
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart																											2	1		

TABLE A2.1
FLORA SPECIES OBSERVED DURING SURVEYS

Family	Scientific Name	Common Name	Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10		Q11		Q12		Q13		Q14		Q15	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Mid Stratum (lower layer)																																
Apocynaceae	*Gomphocarpus fruticosus**	Narrow-leaved Cotton Bush																					<1	1								
Araliaceae	*Polyscias sambucifolia* subsp. *Long leaflets*																								<1	1						
Asteraceae	*Cassinia quinquefaria*								<1	1													X	X								
	Ozothamnus diosmifolius	Rice Flower																									<1	1				
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine					X	X																								
Capparaceae	*Capparis arborea*	Native Pomegranate															<1	1														
Celastraceae	*Denhamia silvestris*	Narrow-leaved Orangebark			<1	1					<1	1	4	20	X	X			<1	1	1	3			1	3	<1	2	<1	2		
	Elaeodendron australe var. *australe*	Red Olive Plum													1	3					1	1							1	1		
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower																	<1	5					1	5						
	Hibbertia diffusa	Wedge Guinea Flower	<1	1							<1	1							<1	10					1	10	<1	7	<1	5		
Ebenaceae	*Diospyros australis*	Black Plum															3	4	X	X	1	4										
Ericaceae (Styphelioideae)	*Leucopogon juniperinus*	Prickly Beard-heath	3	10	2	10	X	X	2	10	<1	3	<1	4													<1	3	1	3	5	20
Euphorbiaceae	*Alchornea ilicifolia*	Dovewood					3	5							1	4	1	3														
	Claoxylon australe	Brittlewood					X	X									<1	1														
	Croton verreauxii	Green Native Cascarilla					X	X							<1	1	2	3														
Fabaceae (Caesalpinioideae)	*Senna pendula**																														<1	1
Fabaceae (Faboideae)	*Bossiaea obcordata*	Spiny Bossiaea																											<1	2		
	Chorizema parviflorum	Eastern Flame Pea																											<1	1		
	Daviesia genistifolia	Broom Bitter Pea																									X	X				
	Indigofera australis	Australian Indigo											X	X																		
	Jacksonia scoparia	Winged Broom-pea	1	2																			1	1								
	Podolobium ilicifolium	Prickly Shaggy Pea																			X	X							2	4		
Fabaceae (Mimosoideae)	*Acacia binervata*	Two-veined Hickory							4	7																						
	Acacia falcata	Hickory Wattle	1	2	5	10					2	3											4	6					<1	1	<1	1
	Acacia implexa	Hickory Wattle							4	7	5	6	1	2					4	10	3	10	3	5	<1	2	5	110	<1	1	5	7
	Acacia irrorata																														X	X
	Acacia ulicifolia	Prickly Moses	<1	3	1	5			1	4									<1	1			<1	1			<1	2	1	2	<1	1
Flacourtiaceae	*Scolopia braunii*	Flintwood													1	2																
Lamiaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum					3	2											1	2					<1	2						
Lauraceae	*Neolitsea dealbata*	White Bolly Gum																			1	1										
Malvaceae	*Brachychiton populneus*	Kurrajong																											<1	1		
	Hibiscus heterophyllus	Native Rosella					X	X									1	3														
Monimiaceae	*Wilkiea huegeliana*	Veiny Wilkiea					X	X									1	3														
Moraceae	*Ficus coronata*	Sandpaper Fig															X	X														
	Ficus rubiginosa	Rusty Fig					X	X									<1	1														
	Maclura cochinchinensis	Cockspur Thorn																									<1	1				
	Streblus brunonianus	Whalebone Tree					X	X					<1	1	10	20			X	X	2	4										
Myrsinaceae	*Myrsine variabilis*												<1	2	<1	1			<1	1	<1	1										

TABLE A2.1
FLORA SPECIES OBSERVED DURING SURVEYS

Family	Scientific Name	Common Name	Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10		Q11		Q12		Q13		Q14		Q15	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Myrtaceae	*Backhousia myrtifolia*		3	2			20	20					3	3			5	10			1	3			<1	1			3	5		
	Corymbia maculata	Spotted Gum	<1	2																												
	Eucalyptus acmenoides	White Mahogany																	2	2												
	Eucalyptus crebra	Narrow-leaved Ironbark			2	4			1	4													5	10			3	3				
	Eucalyptus glaucina$^{TS1/TS2}$	Slaty Red Gum			3	5			1	3																					1	2
	Eucalyptus moluccana	Grey Box																													3	5
	Leptospermum polygalifolium	Tantoon					X	X																								
	Sannantha crassa		2	5	35	200			1	3	1	2	X	X																		
Ochnaceae	*Ochna serrulata**	Mickey Mouse Plant													<1	1															<1	1
Oleaceae	*Jasminum volubile*	Stiff Jasmine			<1	1	5	10			10	6	5	50	3	5	1	10	<1	2	2	10			2	10	<1	3	2	10	3	10
	Notelaea longifolia	Large Mock-olive	<1	2	2	5	2	3	1	3			6	20	<1	2	10	20	1	4	3	10			6	10			8	20	2	4
Oleaceae	*Olea europaea* subsp. *cuspidata**	African Olive					<1	2			3	3									1	1	2	2	<1	1					1	1
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush	<1	1	1	5	3	5	5	20	2	5	5	20	2	5	<1	3	1	5	5	20	1	3	1	3	5	10			7	10
	Glochidion ferdinandi	Cheese Tree									5	3									<1	1	1	1							X	X
	Phyllanthus gunnii	Scrubby Spurge											X	X					<1	1												
	Phyllanthus hirtellus	Thyme Spurge	1	20	<1	20																							1	50		
	Bursaria spinosa	Blackthorn	3	10	10	20																							1	3		
	Pittosporum multiflorum	Orange Thorn											2	20	<1	5					1	10										
	Pittosporum revolutum	Wild Yellow Jasmine					X	X	<1	1	5	20	1	5	<1	2			1	5	3	10			1	5	1	2	1	3	1	5
	Pittosporum undulatum	Native Daphne							1	1	10	5	2	5	2	5	2	5	3	5	2	4	2	1	10	5	10	8			3	3
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung	1	2					3	5											1	1			<1	1	1	1	1	2	1	1
Putranjivaceae	*Drypetes deplanchei*	Yellow Tulipwood															15	30														
Rhamnaceae	*Alphitonia excelsa*	Red Ash									1	1																	1	2		
Rutaceae	*Boronia polygalifolia*	Dwarf Boronia	<1	1																												
	Correa reflexa	Common Correa																							<1	1						
	Melicope micrococca	Hairy-leaved Doughwood																			<1	1										
	Zieria smithii	Sandfly Zieria											X	X															4	10		
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart	<1	1					1	1	2	2																				
Sapindaceae	*Alectryon subcinereus*	Native Quince																			1	2										
	Diploglottis australis	Native Tamarind											5	20																		
	Dodonaea triquetra	Large-leaf Hop-bush											X	X																		
	Dodonaea viscosa subsp. *angustifolia*	Sticky Hop-bush	<1	4																												
	Dodonaea viscosa subsp. *cuneata*	Wedge-leaf Hop-bush	<1	1																												
Ulmaceae	*Trema tomentosa*	Native Peach					X	X																								
Urticaceae	*Dendrocnide excelsa*	Giant Stinging Tree															1	1														
Verbenaceae	*Lantana camara**	Lantana	20	50	10	20	15	20	15	20			5	10	3	10	5	10	4	6	15	20	60	50	10	10	15	20	5	5	20	20
Ground Layer																																
Ferns and Allies																																
Aspleniaceae	*Asplenium australasicum*	Bird's Nest Fern													<1	2																
Blechnaceae	*Doodia aspera*	Prickly Rasp Fern											3	200	3	50	2				5	50										

TABLE A2.1
FLORA SPECIES OBSERVED DURING SURVEYS

Family	Scientific Name	Common Name	Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10		Q11		Q12		Q13		Q14		Q15	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
	Doodia caudata	Small Rasp Fern													5	100	5	100														
Dennstaedtiaceae	*Pteridium esculentum*	Bracken Fern																			X	X										
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern															<1	10														
Polypodiaceae	*Dictymia brownii*	Strap Fern													1	20																
Pteridaceae	*Adiantum aethiopicum*	Common Maidenhair					5	50					5	200	15	500	10	200	1	20	10	500							1	10		
	Adiantum hispidulum	Rough Maidenhair Fern					5	50					<1	1	5	100	5	100	<1	3	5	200			2	100						
	Cheilanthes distans	Bristly Cloak Fern																					<1	20			<1	5				
	Cheilanthes sieberi		2	50	1	50			2	50	1	50											2	50	1	50	1	50	1	100	<1	20
	Pellaea falcata	Sickle Fern																			<1	10										
	Pellaea paradoxa						5	100							5	200	3	50	<1	10	2	50			1	20						
Polypodiaceae	*Dictymia brownii*	Strap Fern													1	20																
Dicots (Herbs)																																
Acanthaceae	*Brunoniella australis*	Blue Trumpet	1	20					1	50	1	50	3	100	<1	2			<1	50	1	50			1	50			<1	20		
	Brunoniella pumilio	Dwarf Brunoniella																											<1	1		
	Pseuderanthemum variabile	Pastel Flower					2	20							1	20	1	20	X	X	<1	5							<1	5		
Apiaceae	*Centella asiatica*	Indian Pennywort									<1	20																			X	X
	*Cyclospermum leptophyllum**	Slender Celery									<1	20																				
	Daucus glochidiatus	Native Carrot																			X	X										
Asteraceae	*Bidens pilosa**	Cobblers Pegs			<1	3	<1	10	<1	20													2	20	<1	5	<1	10			X	X
	*Conyza sumatrensis**	Tall Fleabane																					<1	2								
	Euchiton sphaericus										X	X																				
	*Hypochaeris microcephala**	White Flatweed									<1	3																				
	*Hypochaeris radicata**	Flatweed							<1	1													<1	10							X	X
	Lagenophora stipitata	Blue Bottle-daisy	<1	7															<1	2	<1	10									<1	10
	*Senecio madagascariensis**	Fireweed									1	20											1	20								
	Solenogyne bellioides										<1	3																				
	*Sonchus oleraceus**	Common Sowthistle																									<1	1				
	Vernonia cinerea								<1	1															<1	5					<1	2
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell																			X	X	<1	3			<1	2			X	X
	*Cerastium glomeratum**	Mouse-ear Chickweed									<1	10																				
	Stellaria flaccida																				X	X										
	*Stellaria media**	Common Chickweed																					<1	1								
	Einadia hastata	Berry Saltbush																					<1	1								
Clusiaceae	*Hypericum gramineum*	Small St. John's Wort																									X	X				
	Hypericum japonicum										<1	10																				
Convolvulaceae	*Dichondra repens*	Kidney Weed							1	50			3	200					1	20	2	50	<1	50	1	20	1	100			1	20
Dilleniaceae	*Hibbertia diffusa*	Wedge Guinea Flower							<1	2																						
Droseraceae	*Drosera peltata*										X	X																				
Fabaceae (Faboideae)	*Swainsona galegifolia*	Smooth Darling-pea											<1	1					<1	1	<1	3										
Iridaceae	*Romulea rosea**	Onion Grass																			X	X										
Lamiaceae	*Plectranthus parviflorus*	Cockspur Flower			<1	2									<1	2	<1	5	X	X	<1	2					<1	1				

TABLE A2.1
FLORA SPECIES OBSERVED DURING SURVEYS

Family	Scientific Name	Common Name	Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10		Q11		Q12		Q13		Q14		Q15	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
	Scutellaria humilis	Dwarf Skullcap																			X	X					<1	4				
Lobeliaceae	*Pratia purpurascens*	Whiteroot	3	500	2	200			2	200	3	500	5	500					2	20 0	3	20 0	2	10 0	3	20 0	1	100	1	20 0	2	20 0
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne																					<1	2								
Myrsinaceae	*Anagallis arvensis**	Scarlet Pimpernel																					<1	6			<1	5				
Oxalidaceae	*Oxalis perennans*				2	100	X	X	<1	3	<1	10					<1	1	<1	4	X	X	<1	3	<1	1					<1	2
Peperomiaceae	*Peperomia blanda* var. *floribunda*																<1	20														
Phyllanthaceae	*Poranthera microphylla*				<1	1					<1	2																	<1	5	<1	1
Plantaginaceae	*Plantago debilis*																										X	X			X	X
	*Plantago lanceolata**	Lamb's Tongues									1	20															<1	3				
Polygonaceae	*Acetosa sagittata**	Rambling Dock																					2	50								
	Rumex brownii	Swamp Dock																					<1	10								
Rubiaceae	*Galium gaudichaudii*	Rough Bedstraw																							<1	2						
	Galium leiocarpum						<1	1													<1	1										
	Opercularia diphylla		<1	5	<1	10			<1	4	<1	10																			<1	2
	Pomax umbellata		<1	10	<1	1																							<1	10	<1	5
Solanaceae	*Solanum prinophyllum*	Forest Nightshade					X	X	<1	2							<1	1					<1	2					<1	1		
	Solanum stelligerum	Devil's Needles					X	X					1	10	<1	1			<1	5											<1	7
Stackhousiaceae	*Stackhousia viminea*	Slender Stackhousia																													<1	1
Verbenaceae	*Verbena rigida**	Veined Verbena																			<1	3	1	20			1	20				
Violaceae	*Viola hederacea*						X	X																								
Monocots (Grasses)																																
Poaceae	*Aristida ramosa*	Purple Wiregrass																	<1	5							5	50				
	Aristida vagans	Threeawn Speargrass	5	50	5	200			5	200			X	X													1	10	3	50	5	50
	Bothriochloa decipiens	Red Grass																					2	20			<1	10				
	Capillipedium parviflorum	Scented-top Grass									1	10									5	50									5	50
	*Chloris gayana**	Rhodes Grass																					10	10 0								
	Chloris ventricosa	Plump Windmill Grass																					<1	10			<1	10				
	Cymbopogon refractus	Barbed Wire Grass	5	50	10	200			10	500	15	1000	1	5									3	20	5	20	2	20	1	20	3	10
	Digitaria diffusa	Open Summer-grass																									<1	10				
	Digitaria parviflora	Small-flowered Finger Grass	<1	2	1	10															<1	2			<1	10			<1	1	<1	2
	Echinopogon caespitosus	Bushy Hedgehog-grass	1	20	<1	5			<1	5	<1	10									1	50									1	10
	*Ehrharta erecta**	Panic Veldtgrass																					2	50							<1	1
	Entolasia stricta		5	100																					<1	10	1	10	<1	10		
	Entolasia marginata	Bordered Panic			3	50	X	X							X	X	1	10			<1	2			<1	2	<1	2				
	Eragrostis brownii	Brown's Lovegrass	2	20					3	50																	1	20	<1	3	1	20
	Eragrostis leptostachya	Paddock Lovegrass							<1	10	10	500													<1	10	<1	3	<1	2	<1	5
	Imperata cylindrica	Blady Grass											15	2000					3	20 0	10	10 00			5	50 0	5	200	2	50 0		
	*Megathyrsus maximus**	Guinea Grass																					20	10 0								
	*Melinis repens**	Red Natal Grass																					5	50								
	Microlaena stipoides	Weeping Grass	15	1000	10	500	3	50	5	500	5	500	5	2000					3	20 0	5	10 00	5	50 0			2	50	5	50 0	25	20 00

TABLE A2.1
FLORA SPECIES OBSERVED DURING SURVEYS

Family	Scientific Name	Common Name	Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10		Q11		Q12		Q13		Q14		Q15	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
	Oplismenus aemulus	Australian Basket Grass							<1	20	1	20	2	50					1	50	5	1000	<1	10	<1	10	1	20			2	50
	Oplismenus imbecillis	Creeping Beard Grass			1	20	5	500					10	2000	3	50	5	200			<1	20			1	50						
	Panicum effusum	Hairy Panic			5	200			5	200	2	20							<1	10			2	2			4	50	<1	3	X	X
	Panicum simile	Two Colour Panic			<1	5							1	10							<1	10			<1	2					<1	5
	Paspalidium distans								1	50																	3	100			1	20
	Poa labillardierei var. *labillardierei*	Tussock											1	10							10	500										
	Sporobolus creber	Western Rat-tail Grass																									<1	1				
	Themeda triandra	Kangaroo Grass	30	500	10	200			35	1000	50	2000							5	50							5	50			20	500
Monocots (Other)																																
Anthericaceae	*Arthropodium minus*														<1	5																
Anthericaceae	*Arthropodium* sp. B sensu Harden (1993)		<1	5			<1	3					<1	10							<1	3			<1	10					<1	1
Araceae	*Gymnostachys anceps*	Settlers' Twine											5	20	X	X	1	3	X	X	<1	2										
Commelinaceae	*Aneilema acuminatum*								X	X					<1	2	<1	4														
Cyperaceae	*Carex inversa*																						<1	2			<1	3			<1	2
	Carex longebrachiata																														<1	1
	Cyperus enervis						X	X							X	X	2	20			<1	5										
	*Cyperus flavescens**																						<1	2								
	Gahnia aspera	Rough Saw-sedge							3	10	3	10	2	2							1	4	2	5	<1	1	2	5			2	5
	Lepidosperma gunnii		1	5	20	50	3	5	5	20																						
	Lepidosperma laterale	Sword-sedge	3	10	5	50							3	10							<1	10			<1	5			<1	5		
	Scleria mackaviensis				<1	20	1	50																							<1	5
Orchidaceae	*Acianthus fornicatus*	Pixie Caps	<1	20	<1	20																										
	Caladenia catenata	White Fingers	<1	20	<1	5			<1	3	<1	20	X	X																	<1	10
	Pterostylis pedunculata	Maroonhood					1	50																								
Lomandraceae	*Lomandra confertifolia*	Mat-rush									1	10	5	20					60	500	3	10			45	500	40	200	55	1000		
	Lomandra filiformis subsp. *filiformis*	Wattle Mat-rush			1	20			<1	20	<1	20											<1	10							25	2000
	Lomandra longifolia	Spiny-headed Mat-rush	1	5	3	10							10	20					2	4												
	Lomandra multiflora	Many-flowered Mat-rush	4	20	3	20			3	20	3	50											<1	3	<1	2	1	5	1	10	3	20
Phormiaceae	*Dianella caerulea* var. *cinerascens*		<1	1					1	10	<1	5	<1	2											<1	3	<1	4	<1	2	<1	2
	Dianella caerulea var. *producta*								<1	2			2	10					2	20	1	5			1	5	2	10	1	5		
	Dianella longifolia	Blueberry Lily													X	X																
	Dianella revoluta	Blue Flax-Lily	1	10					<1	1																						
	Stypandra glauca	Nodding Blue Lily	<1	1	<1	2																										
Xanthorrhoeaceae	*Xanthorrhoea latifolia*																								5	10			1	3		
Climbers / Vines																																
Aphanopetalaceae	*Aphanopetalum resinosum*	Gum Vine					<1	2																								
Apocynaceae	*Marsdenia flavescens*	Hairy Milk Vine													1	10	1	20			<1	3										
	Marsdenia rostrata	Milk Vine													<1	2					<1	3										
	Marsdenia suaveolens	Scented Marsdenia					X	X									<1	2														

TABLE A2.1
FLORA SPECIES OBSERVED DURING SURVEYS

Family	Scientific Name	Common Name	Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10		Q11		Q12		Q13		Q14		Q15	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
	Parsonsia straminea	Common Silkpod					X	X	<1	3			2	20			2	5	X	X	<1	3			<1	1						
	Parsonsia velutina																<1	1														
Asparagaceae	*Asparagus asparagoides**	Bridal Creeper			<1	1					<1	1																			1	20
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine	1	5	<1	3					<1	2	5	20	<1	3	1	3	2	10	2	10	<1	1	<1	3	<1	4	<1	5	<1	1
Dioscoreaceae	*Dioscorea transversa*	Native Yam					3	200							5	200	5	50			1	20										
Fabaceae (Faboideae)	*Austrosteenisia blackii* var. *blackii*	Blood Vine													5	2	5	5														
	Desmodium brachypodum	Large Tick-trefoil																	<1	1	<1	1	<1	10								
	Desmodium gunnii		1	50					<1	5			2	50					1	50	1	50	<1	10	2	10	1	50	<1	20	1	50
	Desmodium rhytidophyllum		1	10	<1	2			1	10									<1	5			<1	4	<1	3	1	10	<1	20		
	Desmodium varians	Tick Trefoil							<1	10															<1	2	<1	10				
	Glycine clandestina	Love Creeper																									X	X				
	Glycine microphylla	Small-leaf Glycine	<1	20	<1	3					<1	20							1	20	<1	10	<1	5	1	20	<1	10			<1	10
	Glycine tabacina		<1	3					<1	20									<1	4							<1	10			<1	5
	Hardenbergia violacea	False Sarsparilla																	<1	1												
Loranthaceae	*Amyema miquelii*										X	X																				
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry	1	20	<1	2	<1	1	<1	2			3	20	1	10			1	10	1	20			<1	5			<1	5		
	Geitonoplesium cymosum	Scrambling Lily	<1	2	<1	5	<1	5	<1	3	<1	3	2	20					<1	5			<1	2	1	20	<1	5	1	20	<1	4
Menispermaceae	*Stephania japonica*	Snake Vine																			1	4										
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry							<1	1															<1	5	<1	3	<1	3	X	X
Polypodiaceae	*Dictymia brownii*	Strap Fern													1	20																
Ranunculaceae	*Clematis aristata*	Old Man's Beard											<1	1					<1	3	<1	2					<1	1				
Rosaceae	*Rubus moluccanus*	Molucca Bramble																									<1	2				
	Rubus parvifolius	Native Raspberry											<1	2					<1	1	<1	1										
Rubiaceae	*Morinda jasminoides*	Sweet Morinda															<1	1														
Smilacaceae	*Smilax australis*	Lawyer Vine																			<1	1										
Vitaceae	*Cayratia clematidea*	Native Grape					<1	10											<1	2					<1	5						
	Cissus antarctica	Kangaroo Vine											3	5	<1	2	1	2	X	X	5	15										
	Clematicissus opaca	Pepper Vine	<1	10	1	20							1	10	<1	1	X	X	<1	10	<1	10			1	20			<1	10		
	Tetrastigma nitens				<1	1									5	20	5	20			4	10										

Key

[TS1] indicates threatened species TSC Act (1995) [TS2] indicates threatened species EPBC Act (1999) * = Introduced Species C = Cover A = Abundance Rating

A2.2 VEGETATION CONDITION DATA

The vegetation condition data for survey plots is provided in Table A2.2.

TABLE A2.2
VEGETATION PLOT CONDITION DATA

Plant Community Type	Plot Name	No. Native Plant Species	Native Over-storey Cover	Native Mid-storey Cover	Native Ground Cover (Grasses)	Native Ground Cover (Shrubs)	Native Ground Cover (Other)	Exotic Plant Cover	Number of trees with hollows	Proportion of Over-storey Regeneration	Total length of fallen logs	Easting	Northing	Zone
HU798	6	52	45.5	14	40	20	66	1	1	100	25	370821	6397951	56
HU798	9	52	42.5	4	40	0	68	5	1	100	42	371089	6397695	56
HU798	12	56	42.5	24.5	16	2	50	1.2	0	100	54	370860	6397682	56
HU798	10	72	46	7.5	18	0	42	8.25	0	100	49	371153	6397561	56
HU798	14	61	37.4	3.2	26	10	68	1.1	3	100	57	370551	6397914	56
HU816	1	25	33.5	1.4	76	12	46	1.25	3	100	51	370100	6398419	56
HU816	13	61	29.5	15	60	4	26	5.6	0	100	49	370985	6397745	56
HU619	3	30	73	19	24	2	32	9.25	2	100	0	370165	6398314	56
HU619	7	44	71.5	10	0	0	42	0.35	0	100	68	370811	6397808	56
HU619	8	47	71.5	8	2	0	52	1.65	0	100	83	370910	6397599	56
HU755	2	27	23.5	36	76	52	22	3.5	1	100	120	370180	6398435	56
HU755	4	54	12.5	20	98	16	50	2.95	0	100	17	369992	6397655	56
HU755	5	46	37	25	76	10	40	11.25	0	100	25	370511	6397523	56
HU755	11	38	28	2.7	14	2	20	70	1	100	15	370678	6397088	56
HU755	15	52	43.5	14.5	74	18	44	4.75	0	100	7	370363	6397381	56

APPENDIX 3
BIODIVERSITY CREDIT REPORT

Biodiversity credit report

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

Date of report: 23/08/2016 Time: 5:26:36PM Calculator version: v4.0

Major Project details

Proposal ID:	132/2016/2441MP
Proposal name:	Martins Creek Quarry Expansion
Proposal address:	Station Street Martins Creek NSW 2420
Proponent name:	Buttai Gravel Pty Ltd
Proponent address:	PO Box 299 Wallsend NSW 2287
Proponent phone:	02 4903 7000
Assessor name:	Jacob Manners
Assessor address:	PO Box 4300 East Gosford NSW 2250
Assessor phone:	(02)4324 7888
Assessor accreditation:	132

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast	9.40	579.00
Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	3.19	252.00
Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River	5.00	384.00
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	9.80	738.00
Total	27.39	1,953

Credit profiles

1. Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River, (HU755)

Number of ecosystem credits created	384
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River, (HU755) Sandpaper Fig - Whalebone Tree warm temperate rainforest, (HU739)	Upper Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

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

Number of ecosystem credits created	738
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley, (HU798) Blackbutt - Tallowwood dry grassy open forest of the southern NSW North Coast Bioregion, (HU511) Tallowwood - Small-fruited Grey Gum - Kangaroo Grass grassy tall open forest on foothills of the lower North Coast, (HU762) Tallowwood - Smooth-barked Apple - Blackbutt grass tall open forest of the Central and lower North Coast, (HU770) Pink Bloodwood - Thin-leaved Stringybark - Grey Ironbark shrub - grass open forest on ranges of the lower North Coast, (HU772)	Upper Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

3. Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619)

Number of ecosystem credits created	579
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619) Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815)	Upper Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

4. Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter, (HU816)

Number of ecosystem credits created	252
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter, (HU816) 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 - Broad-leaved Mahogany - Red Ironbark shrubby open forest, (HU804) 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) Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter, (HU822)	Upper Hunter 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	21.61	562
Slaty Red Gum	Eucalyptus glaucina	1,203.00	16,842

APPENDIX 4
EPBC ACT LISTED BIODIVERSITY KEY ISSUES ASSESSMENTS

APPENDIX 4
A4.1 ADDITIONAL INFORMATION AND ASSESSMENTS IN RELATION TO NATIONALLY LISTED THREATENED BIODIVERSITY

1. Identification of each EPBC Act listed Species and Communities

The Sears require that identification of each EPBC Act listed threatened species and community likely to be significantly impacted by the development is provided. The Sears also require that evidence is provided of why other EPBC Act listed threatened species and communities likely to be located in the project area or in the vicinity will not be significantly impacted in accordance with the Matters of National Environmental Significance - Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999 (Significant Impact Guidelines).

1.1 EPBC Act Listed Threatened Flora Species

A list of the threatened flora species listed within the *EPBC Act* (1999) and known to occur within the locality as identified from the Bionet Atlas of NSW Wildlife (NSW OEH 2016) and the EPBC Protected Matters Search Tool (DOE 2016) is provided in Table A4.1. An assessment of the likely occurrence is provided for each species.

TABLE A4.1
EPBC ACT LISTED THREATENED FLORA SPECIES OF THE LOCALITY

Scientific Name	EP&BC Act Listing Status	Growth Form And Habitat Requirements	Assessment of Likely Occurrence
Asperula asthenes	V	Decumbent perennial herb, trailing to 30cm. Grows in damp sites along river banks from Taree to Bulahdelah (NSW RBG 2016).	No suitable habitat present. Not likely to occur.
Cynanchum elegans	E	Climber or twiner to 1 m. Grows in rainforest gullies, scrub & on scree slopes (NSW RBG 2016).	Suitable habitat present. Not found during targeted searches of suitable habitat. Low potential for occurrence.
Eucalyptus glaucina	V	Tree to 30m. Grows in several habitats including shallow soils or stony hillsides (not on poor sandstone), grassy woodland on deep, moderately fertile with moist soils and on gentle slopes near drainage lines in alluvial and clayey soils (DOE 2016).	Suitable habitat present. Present within area of proposed action.
Grevillea parviflora subsp. parviflora	V	Open to erect shrub to 1 metre. Grows in heathy woodland on light clayey soils and may have an affinity with disturbance margins (NSW NPWS 2002).	No suitable habitat present. Not likely to occur.
Persicaria elatior	V	An erect herb to 90cm, growing in damp places especially beside streams and lakes, and occasionally in swamp forest or associated with disturbance (NSW OEH 2016c).	No suitable habitat present. Not likely to occur.
Rutidosis heterogama	V	Small perennial herb to 30cm tall. Grows in heaths in clay soils and has been recorded along disturbed roadsides (Harden 1994).	Suitable habitat present. Not found during targeted searches of suitable habitat. Low potential for occurrence.
Syzygium	V	Small tree. Subtropical and littoral	Suitable habitat present.

TABLE A4.1 EPBC ACT LISTED THREATENED FLORA SPECIES OF THE LOCALITY			
Scientific Name	**EP&BC Act Listing Status**	**Growth Form And Habitat Requirements**	**Assessment of Likely Occurrence**
paniculatum		rainforest on sandy soil (Fairley and Moore 1995).	Not found during targeted searches of suitable habitat. Low potential for occurrence.
T = Threatened , E = Endangered, CE = Critically Endangered			

The threatened flora species, *Eucalyptus glaucina*, was observed during surveys and has been identified through the EPBC Act process as likely to be significantly impacted in accordance with the Matters of National Environmental Significance - Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999 (Significant Impact Guidelines).

Attachment 1 contains an assessment of the following additional *EPBC Act* (1999) listed species with potential to occur within the project area in accordance with the Matters of National Environmental Significance - Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999 (Significant Impact Guidelines):

- *Cynanchum elegans*
- *Rutidosis heterogama*
- *Syzygium paniculatum*

The assessment has determined that the proposal is not likely to significantly impact these species.

1.2 EPBC Act Listed Threatened Fauna Species

A list of the threatened fauna species listed within the *EPBC Act* (1999) and known to occur within the locality as identified from the Bionet Atlas of NSW Wildlife (NSW OEH 2016) and the EPBC Protected Matters Search Tool (DOE 2016) is provided in Table A4.2. An assessment of the likely occurrence is provided for each species.

TABLE A4.2 EPBC ACT LISTED THREATENED FAUNA SPECIES OF THE LOCALITY			
Common Name Scientific Name	**EP&BC Act**	**Preferred Habitat**	**Likelihood of Occurrence**
Stuttering Frog *Mixophyes balbus*	V	Inhabits freshwater streams in undisturbed rainforest and wet sclerophyll forest (NSW OEH 2016c).	No suitable habitat present (not recorded within 20km). Not likely to occur.
Green and Golden Bell Frog *Litoria aurea*	V	Breeding habitat consists of shallow (<1m) ponds or slowly moving waterways which undergo disturbance regimes such as fluctuating water flow or inflow of saline water with both areas of open water and dense low vegetation (DEC 2005).	Sub-optimal habitat present. Not observed during targeted surveys. Not likely to occur.
Littlejohn's Tree Frog *Litoria littlejohni*	V	Inhabits upper reaches of permanent rocky streams and upland swamps with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops (OEH 2016c).	No suitable habitat present. Not likely to occur.

TABLE A4.2 EPBC ACT LISTED THREATENED FAUNA SPECIES OF THE LOCALITY			
Common Name Scientific Name	**EP&BC Act**	**Preferred Habitat**	**Likelihood of Occurrence**
Australasian Bittern *Botaurus poiciloptilus*	E	Inhabits shallow freshwater or brackish wetlands with tall dense beds of reeds, sedges or rush species and swamp edges. Distribution Limit - N-North of Lismore. S- Eden (Marchant and Higgins 1990).	No suitable habitat present. Not likely to occur.
Swift Parrot *Lathamus discolor*	CE	Within NSW inhabits eucalypt forests and woodlands with winter flowering eucalypts (Saunders and Tzaros 2011).	Suitable habitat present. Not observed during targeted surveys. Moderate potential of infrequent occurrence.
Regent Honeyeater *Anthochaera phrygia*	E	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts (Higgins e*t al.*, 2001).	Suitable habitat present. Not observed during targeted surveys. Moderate potential of infrequent occurrence.
Spotted-tailed Quoll *Dasyurus maculatus*	E	Inhabits a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Shelters in hollow-bearing trees, fallen logs, small caves and rock crevices (NSW NPWS 1999a).	Suitable habitat present. Not observed during targeted surveys. Low to moderate potential of occurrence.
Koala *Phascolarctos cinereus*	V	Inhabits both wet & dry eucalypt forest on high nutrient soils containing preferred feed trees (Reed *at al*., 1991).	Suitable habitat present. Observed during surveys.
New Holland Mouse Pseudomys novaehollandiae	V	Within NSW occurs in a variety of structural vegetation types including heathland and woodland, dry sclerophyll forest with a dense shrub layer and on vegetated sand dunes (Wilson and Laidlaw 2003).	No suitable habitat present. Not likely to occur.
Grey-headed Flying-fox *Pteropus poliocephalus*	V	Found in a variety of habitats including rainforest, mangroves, paperbark swamp, wet and dry open forest and cultivated areas. Forms camps commonly found in gullies and in vegetation with a dense canopy (Tidemann 1995).	Suitable habitat present. Observed during surveys.
Large-eared Pied Bat *Chalinolobus dwyeri*	V	Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies (Churchill 2008).	Suitable habitat present. Not observed during targeted surveys. Low to moderate potential of occurrence.
T = Threatened , E = Endangered, CE = Critically Endangered			

The following *EPBC Act* (1999) listed threatened species were observed within the subject site during surveys undertaken by Conacher Consulting (2016):

- Koala (*Phascolarctos cinereus*), and
- Grey-headed Flying-fox (*Pteropus Poliocephalus*).

It has been identified through the EPBC Act referral process that the proposed development is likely to significantly impact the following *EPBC Act* (1999) listed threatened fauna species:

- Koala (*Phascolarctos cinereus*) combined populations of Qld, NSW and the ACT – Vulnerable;
- Regent Honeyeater (*Anthochaera phrygia*) – Critically Endangered;
- Swift Parrot (*Lathamus discolour*) – Critically Endangered; and
- Spot-tailed Quoll (*Dasyurus maculatus maculatus*) SE mainland population – Endangered

Attachment 1 contains an assessment of the following additional *EPBC Act* (1999) listed threatened fauna species with potential to occur within the project area in accordance with the Matters of National Environmental Significance - Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999 (Significant Impact Guidelines):

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

The assessments completed have determined that the proposal is not likely to significantly impact these species.

1.3 EPBC Act Listed Threatened Ecological Communities

The threatened ecological communities listed within the *EPBC Act* (1999) and with potential to occur within the locality are listed in Table A4.3. An assessment of the likelihood of occurrence of each threatened ecological community within the subject site is provided.

TABLE A4.3
EPBC ACT LISTED THREATENED ECOLOGICAL COMMUNITIES OF THE AREA

Threatened Ecological Communities	EP&BC Act Listing Status	Description	Likelihood of Occurrence
Central Hunter Valley eucalypt forest and woodland	CE	**Location:** Hunter River Catchment. **Dominant / Characteristic Species:** *Eucalyptus crebra, Corymbia maculata, E. dawsonii* and/or *E. molluccana*. *Allocasuarina torulosa, E. acmenoides* and *E. fibrosa* are largely absent. **Topography / Soils:** Occurs on lower slopes, ridges and valley floors on soils derived from Permian sedimentary rocks.	Vegetation present does not correspond to soil requirements as site occurs on carboniferous sediments. Negative diagnostic species are also present. Not observed during surveys. Not likely to occur.
Hunter Valley Weeping Myall (Acacia pendula) Woodland	CE	**Location:** Hunter Valley geographic region **Dominant / Characteristic Species:** *Acacia pendula*. **Topography / Soils:** heavy brown clay soils on the valley floor below 200m ASL.	Dominant species and topographic / soil requirements are not present. Not observed during surveys. Not likely to occur.

TABLE A4.3 EPBC ACT LISTED THREATENED ECOLOGICAL COMMUNITIES OF THE AREA			
Threatened Ecological Communities	**EP&BC Act Listing Status**	**Description**	**Likelihood of Occurrence**
Lowland Rainforest of Subtropical Australia	CE	**Location:** below 300m ASL within the the NSW North Coast and South Eastern Queensland bioregions. **Dominant / Characteristic Species:** See Listing Advice for diagnostic species and species richness requirements. Does not include littoral rainforest, wet sclerophyll forest or dry rainforest community types. **Topography / Soils:** Occurs on soils derived from basalt or alluvium, enriched rhyolitic soils or basaltically enriched metasediments below 300m ASL.	Dry Rainforest vegetation is present which does not meet the key diagnostic characteristics of this EEC. Not observed during surveys. Not likely to occur.
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	**Location:** Western slopes and tablelands of the Great Dividing Range. **Dominant / Characteristic Species:** Woodland or derived grassland community with a domnance or prior dominance by *Eucalyptus albens*, *E. melliodora* or *E. blakelyi* **Topography / Soils:** moderate to highly fertile soils.	Locational and floristic requirements are not present. Not observed during surveys. Not likely to occur.
T = Threatened , E = Endangered, CE = Critically Endangered			

No EPBC Act listed threatened ecological communities have potential to occur and none were observed during surveys.

ATTACHMENT 1 – EPBC ACT SIGNIFICANT IMPACT ASSESSMENTS

The following assessments are provided for the *EPBC Act* (1999) listed threatened species with potential to occur, which were not identified by the Australian Government Department of the Environment and Energy, as likely to be significantly impacted by the proposed action.

A1.1 WHITE-FLOWERED WAX PLANT *(Cynanchum elegans)*

Preferred Habitat and Distribution
Cynanchum elegans is restricted to the coast and adjacent ranges of eastern NSW between Yabbra NP in far northern NSW, to the Kiama area on the NSW South Coast.

Cynanchum elegans grows in a variety of habitats including coastal scrub and littoral rainforest, wet sclerophyll forest, and the margins of dry, littoral and subtropical rainforests in the northern part of its range. It occurs on a variety of substrates such as basalt, metasediments, conglomerate, deep coastal sands and sandstone (OEH 2016c).

Details of Targeted Surveys
This species can also be identified by its vegetative parts when not in flower. Targeted searches for this species have been completed on the following dates.

- 20 August 2014 (1hr)
- 21 August 2014 (7hrs)
- 5 September 2014 (3hrs)
- 30 September 2014 (2hrs)
- 18 February 2015 (10hrs)
- 19 February 2015 (12hrs)
- 20 February 2015 (2hrs)
- 10 June 2015 (5hrs)
- 11 June 2015 (5hrs)
- 17 August 2015 (6hrs)
- 18 August 2015 (8hrs)
- 19 August 2015 (8hrs)
- 20 August 2015 (8hrs)
- 21 August 2015 (2hrs)
- 15 September 2015 (5hrs)
- 16 September 2015 (8hrs)
- 17 September 2015 (9hrs)
- 18 September 2015 (2hrs)
- 14 October 2015 (4.5hrs)

This species was targeted during all flora searches through all plant community types. Searches were conducted while undertaking vegetation mapping and while searching for seasonal flowering threatened flora species. This species was not observed within the subject site during surveys.

Significant Impact Assessment
Criteria identified within the EPBC Act Policy Statement 1.1 *Significant Impact Guidelines* (Department of the Environment 2013), have been addressed below to determine whether there is a real chance or possibility that the proposed action is likely to have a significant impact on, *Cynanchum elegans*, a threatened flora species listed as endangered under the *EPBC Act* (1999).

Questions (**in bold**) to determine whether the proposal is likely to have a significant impact on this species have been addressed as follows.

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

1. Lead to a long-term decrease in the size of a population.

No populations of *Cynanchum elegans* have been observed within the area of the proposed action during targeted surveys.

It is considered that this species is not likely to occur in the area of the proposed action and the proposal is not likely to lead to a long-term decrease in the size of a population of this species.

2. Reduce the area of occupancy of the species;

No populations of *Cynanchum elegans* have been observed within the area of the proposed action during targeted surveys.

It is considered that *Cynanchum elegans* is not likely to occur in the area of the proposed action and the proposal is not likely to reduce the area of occupancy of a population of this species.

3. Fragment an existing important population into two or more populations;

No populations of this species have been observed within the area of the proposed action during targeted surveys.

It is considered that *Cynanchum elegans* is not likely to occur in the area of the proposed action and the proposal is not likely to fragment an existing population of this species into two or more populations.

4. Adversely affect habitat critical to the survival of a species;

Cynanchum elegans has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Cynanchum elegans* is not likely to occur in the area of the proposed action and the subject site does not contain habitat critical to the survival of this species.

It is considered that the proposal is not likely to adversely affect habitat critical to the survival of *Cynanchum elegans*.

5. Disrupt the breeding cycle of a population;

No populations of *Cynanchum elegans* have been observed within the area of the proposed action during targeted surveys.

It is considered that *Cynanchum elegans* is not likely to occur in the area of the proposed action and the proposal is not likely to disrupt the breeding cycle of a population of this species.

6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

Cynanchum elegans has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Cynanchum elegans* is not likely to occur in the area of the proposed action and the proposal is not likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that this species is likely to decline.

7. Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;

Cynanchum elegans has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Cynanchum elegans* is not likely to occur in the area of the proposed action and the proposal is not likely to result in invasive species that are harmful to *this* species becoming established in habitat for this species.

8. Introduce disease that may cause a species to decline; or

Cynanchum elegans has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Cynanchum elegans* is not likely to occur in the area of the proposed action and the proposal is not a type of development likely to introduce disease that may cause the species to decline.

9. Interfere with the recovery of the species.

Cynanchum elegans has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Cynanchum elegans* is not likely to occur in the area of the proposed action and the proposal is not likely to interfere with the recovery of this species.

Conclusion
It is considered that the proposed action is not likely to have a significant impact on *Cynanchum elegans*.

A1.2 HEATH WRINKLEWORT *(Rutidosis heterogama)*

Preferred Habitat and Distribution
Rutidosis heterogama occurs in heath, woodland, open forest and disturbed habitats on seasonally moist sandy and clay soils. Within New South Wales regional populations have been recorded within the Lower Hunter to northern Central Coast area, at Howes Valley, on the New England Tableland and the NSW north coast between Evans Head and Wooli (NSW OEH 2016c).

The subject site is located approximately 30 km from the nearest extant records for this species contained on the NSW OEH Bionet Atlas (NSW OEH 2016b).

This species has been recorded in Bundjalung National Park, Yuraygir National Park, Torrington State Conservation Area, Werakata National Park and State Conservation Area and Munmorah State Conservation Area (NSW OEH 2016b).

Details of Targeted Surveys
Surveys and monitoring of *R. heterogama* by Conacher Consulting has identified that the preferred flowering period for this species is November to February with sporadic flowering at other times of the year. This species can also be easily identified by its vegetative parts when not in flower. Targeted searches for this species have been completed on the following dates. Dates of searches undertaken during the peak flowering period are denoted with an asterisk.

- 20 August 2014 (1hr)
- 21 August 2014 (7hrs)
- 5 September 2014 (3hrs)
- 30 September 2014 (2hrs)
- 18 February 2015 (10hrs)*
- 19 February 2015 (12hrs)*
- 20 February 2015 (2hrs)*
- 10 June 2015 (5hrs)
- 11 June 2015 (5hrs)
- 17 August 2015 (6hrs)
- 18 August 2015 (8hrs)
- 19 August 2015 (8hrs)
- 20 August 2015 (8hrs)
- 21 August 2015 (2hrs)
- 15 September 2015 (5hrs)
- 16 September 2015 (8hrs)
- 17 September 2015 (9hrs)
- 18 September 2015 (2hrs)
- 14 October 2015 (4.5hrs)

Significant Impact Assessment
Criteria identified within the EPBC Act Policy Statement 1.1 *Significant Impact Guidelines* (Department of the Environment 2013), have been addressed below to determine whether there is a real chance or possibility that the proposed action is likely to have a significant impact on, *Rutidosis heterogama*, a threatened flora species listed as vulnerable under the *EPBC Act* (1999).

Questions (**in bold**) to determine whether the proposal is likely to have a significant impact on this species have been addressed as follows.

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

1. Lead to a long-term decrease in the size of an important population of a species.

No populations of *Rutidosis heterogama* have been observed within the area of the proposed action during targeted surveys.

It is considered that this species is not likely to occur in the area of the proposed action and the proposal is not likely to lead to a long-term decrease in the size of an important population of this species.

2. Reduce the area of occupancy of an important population;

No populations of *Rutidosis heterogama* have been observed within the area of the proposed action during targeted surveys.

It is considered that *Rutidosis heterogama* is not likely to occur in the area of the proposed action and the proposal is not likely to reduce the area of occupancy of an important population of this species.

3. Fragment an existing important population into two or more populations;

No populations of this species have been observed within the area of the proposed action during targeted surveys.

It is considered that *Rutidosis heterogama* is not likely to occur in the area of the proposed action and the proposal is not likely to fragment an existing important population of this species into two or more populations.

4. Adversely affect habitat critical to the survival of a species;

Rutidosis heterogama has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Rutidosis heterogama* is not likely to occur in the area of the proposed action and the subject site does not contain habitat critical to the survival of this species.

It is considered that the proposal is not likely to adversely affect habitat critical to the survival of *Rutidosis heterogama*.

5. Disrupt the breeding cycle of an important population;

No populations of *Rutidosis heterogama* have been observed within the area of the proposed action during targeted surveys.

It is considered that *Rutidosis heterogama* is not likely to occur in the area of the proposed action and the proposal is not likely to disrupt the breeding cycle of an important population of this species.

6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

Rutidosis heterogama has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Rutidosis heterogama* is not likely to occur in the area of the proposed action and the proposal is not likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that this species is likely to decline.

7. Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat;

Rutidosis heterogama has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Rutidosis heterogama* is not likely to occur in the area of the proposed action and the proposal is not likely to result in invasive species that are harmful to *this* species becoming established in habitat for this species.

8. Introduce disease that may cause a species to decline; or

Rutidosis heterogama has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Rutidosis heterogama* is not likely to occur in the area of the proposed action and the proposal is not a type of development likely to introduce disease that may cause *Rutidosis heterogama* to decline.

9. Interfere with the recovery of the species.

Rutidosis heterogama has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Rutidosis heterogama* is not likely to occur in the area of the proposed action and the proposal is not likely to interfere with the recovery of this species.

Conclusion
It is considered that the proposed action is not likely to have a significant impact on *Rutidosis heterogama*.

A1.3 MAGENTA LILLY PILLY *(Syzygium paniculatum)*

Preferred Habitat and Distribution
Syzygium paniculatum is distributed in coastal areas along a 400 km stretch of coastal NSW between Upper Lansdowne in the north to Conjola National Park in the south (NSW OEH 2012).

The species occurs naturally in the Jervis, Sydney Cataract, Pittwater and Wyong subregions of the Sydney Basin Bioregion, and in the Karuah-Manning and Macleay-Hastings subregions of the NSW North Coast Bioregion. It has also been planted extensively as a landscape species throughout Australia (NSW OEH 2012).

The National Recovery Plan for this species provides information on the features used to distinguish Magenta Lilly Pilly from similar species, including features distinguishable for when the species does not bear fruit (NSW OEH 2012).

There are 44 naturally occurring *Syzygium paniculatum* subpopulations currently recognised, of which 18 occur at least partly within conservation reserves. A total of 10 subpopulations occur entirely on private property and the remainder occur on publicly managed land or on the boundaries of public and private lands (NSW OEH 2012).

The nearest coastal record for this species on the Bionet Atlas (NSW OEH 2016b) is located approximately 43 km to the south-west of the subject site. Other closer records are considered likely to be misidentifications, outlier plants or planted specimens.

Details of Targeted Surveys
This species can also be identified by its vegetative parts when fruit is not present. Targeted searches for this species have been completed on the following dates.

- 20 August 2014 (1hr)
- 21 August 2014 (7hrs)
- 5 September 2014 (3hrs)
- 30 September 2014 (2hrs)
- 18 February 2015 (10hrs)
- 19 February 2015 (12hrs)
- 20 February 2015 (2hrs)
- 10 June 2015 (5hrs)
- 11 June 2015 (5hrs)
- 17 August 2015 (6hrs)
- 18 August 2015 (8hrs)
- 19 August 2015 (8hrs)
- 20 August 2015 (8hrs)
- 21 August 2015 (2hrs)
- 15 September 2015 (5hrs)
- 16 September 2015 (8hrs)
- 17 September 2015 (9hrs)
- 18 September 2015 (2hrs)
- 14 October 2015 (4.5hrs)

The targeted searches undertaken were conducted across the site and in particular areas of Dry Rainforest and Wet Sclerophyll Forest habitats. This species was not observed within the subject site during surveys.

Significant Impact Assessment
Criteria identified within the EPBC Act Policy Statement 1.1 *Significant Impact Guidelines* (Department of the Environment 2013), have been addressed below to determine whether there is a real chance or possibility that the proposed action is likely to have a significant impact on, *Syzygium paniculatum*, a threatened flora species listed as vulnerable under the *EPBC Act* (1999).

Questions (**in bold**) to determine whether the proposal is likely to have a significant impact on this species have been addressed as follows.

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

1. **Lead to a long-term decrease in the size of an important population of a species.**

   No populations of *Syzygium paniculatum* have been observed within the area of the proposed action during targeted surveys.

It is considered that this species is not likely to occur in the area of the proposed action and the proposal is not likely to lead to a long-term decrease in the size of an important population of this species.

2. Reduce the area of occupancy of an important population;

No populations of *Syzygium paniculatum* have been observed within the area of the proposed action during targeted surveys.

It is considered that *Syzygium paniculatum* is not likely to occur in the area of the proposed action and the proposal is not likely to reduce the area of occupancy of an important population of this species.

3. Fragment an existing important population into two or more populations;

No populations of this species have been observed within the area of the proposed action during targeted surveys.

It is considered that *Syzygium paniculatum* is not likely to occur in the area of the proposed action and the proposal is not likely to fragment an existing important population of this species into two or more populations.

4. Adversely affect habitat critical to the survival of a species;

Syzygium paniculatum has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Syzygium paniculatum* is not likely to occur in the area of the proposed action and the subject site does not contain habitat critical to the survival of this species.

It is considered that the proposal is not likely to adversely affect habitat critical to the survival of *Syzygium paniculatum*.

5. Disrupt the breeding cycle of an important population;

No populations of *Syzygium paniculatum* have been observed within the area of the proposed action during targeted surveys.

It is considered that *Syzygium paniculatum* is not likely to occur in the area of the proposed action and the proposal is not likely to disrupt the breeding cycle of an important population of this species.

6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

Syzygium paniculatum has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Syzygium paniculatum* is not likely to occur in the area of the proposed action and the proposal is not likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that this species is likely to decline.

7. Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat;

Syzygium paniculatum has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Syzygium paniculatum* is not likely to occur in the area of the proposed action and the proposal is not likely to result in invasive species that are harmful to *this* species becoming established in habitat for this species.

8. Introduce disease that may cause a species to decline; or

Syzygium paniculatum has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Syzygium paniculatum* is not likely to occur in the area of the proposed action and the proposal is not a type of development likely to introduce disease that may cause *Syzygium paniculatum* to decline.

9. Interfere with the recovery of the species.

Syzygium paniculatum has not been observed within the area of the proposed action during targeted surveys.

It is considered that *Syzygium paniculatum* is not likely to occur in the area of the proposed action and the proposal is not likely to interfere with the recovery of this species.

Conclusion
It is considered that the proposed action is not likely to have a significant impact on *Syzygium paniculatum*.

A1.4 GREY-HEADED FLYING-FOX (*Pteropus poliocephalus*)

Preferred Habitat and Distribution
Grey-headed Flying-foxes occupy the coastal lowlands and slopes of south eastern Australia at altitudes usually less than 200m from Bundaberg to Geelong (DECCW 2009).

Grey-headed Flying-foxes congregate in roost camps during the day, and disperse to surrounding areas to forage at night. This species forages over wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and urbanised and agricultural areas. Camps are commonly formed. Camps may also be formed in urban parkland areas (Tidemann 1995).

Details of Targeted Surveys
Diurnal and nocturnal searches were undertaken for this species during surveys. Two Grey-headed Flying-foxes were observed foraging within the central area of the site during nocturnal surveys on 17 September 2015. No roost or camp sites were observed within the subject site.

Important Population Criteria
The Grey-headed Flying-foxes observed within the site are considered to be part of a larger population which on occasion forages within the site. An important population is a population that is necessary for a species' long term survival and recovery. The following consideration of the Important Population Criteria provided by DOE (2013), has been undertaken with regard to the Grey-headed Flying-foxes observed within the site.

1. Identified as important populations in recovery plans, and/or

The Grey-headed Flying-fox Draft National Recovery Plan (DECCW 2009) does not identified any important populations of this species.

2. Key source populations either for breeding or dispersal.

The site contains suitable foraging habitat for this species, which is utilised on occasion. No roost or camp sites for this species are present within the site. The site of the proposed action does not contain a key source population for breeding or dispersal.

3. Populations that are necessary for maintaining genetic diversity.

The site contains suitable foraging habitat for this species, which is utilised on occasion. No roost or camp sites for this species are present within the site. The site does not contain a population that is necessary for maintaining genetic diversity.

4. Populations that are near the limit of the species range.

The Grey-headed Flying-fox is known to occupy the coastal lowlands and slopes of south-eastern Australia from Bundaberg to Geelong and are usually found at altitudes < 200 m. Areas of repeated occupation extend inland to the tablelands and western slopes in northern New South Wales and the tablelands in southern Queensland. Sightings in inland areas of southern New South Wales and Victoria are uncommon. There are rare records of individuals or small groups west to Adelaide, north to Gladstone and south to Flinders Island (DECCW 2009). The site of the proposed action is not near the limit of this species range.

Significant Impact Assessment
Criteria identified within the EPBC Act Policy Statement 1.1 *Significant Impact Guidelines* (Department of the Environment 2013), have been addressed below to determine whether there is a real chance or possibility that the proposed action is likely to have a significant impact on the Grey-headed Flying-fox, a threatened fauna species listed as vulnerable under the *EPBC Act* (1999).

Questions (**in bold**) to determine whether the proposal is likely to have a significant impact on this species have been addressed as follows.

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

1. **Lead to a long-term decrease in the size of an important population of a species.**
   The proposal is not likely to have a direct impact on the size of the population of this species and the individuals observed are considered to not form an important population.

2. **Reduce the area of occupancy of an important population;**

   The Grey-headed Flying-fox is a highly mobile and nomadic species and no roost or camp sites were observed within the subject site during surveys. It is considered that the proposal will not reduce the area of occupancy of an important population of Grey-headed Flying-foxes.

3. **Fragment an existing important population into two or more populations;**

   This species is mobile and highly nomadic. The proposal is not likely to fragment an existing important population of Grey-headed Flying-foxes into two or more populations.

4. **Adversely affect habitat critical to the survival of a species;**

   The subject site contains a relatively small proportion of the overall area of habitat available to this species and does not contain any maternity camp or roost sites for this species. It is therefore considered that the proposal is not likely to affect habitat critical to the survival of the species.

5. **Disrupt the breeding cycle of an important population;**

   The subject site does not contain any maternity roost or camp sites for this species. It is considered that the proposal is not likely to disrupt the breeding cycle of an important population of Grey-headed Flying-foxes.

6. **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

   The subject site contains a relatively small proportion of the overall area of habitat available to this species and does not contain any maternity camp or roost sites for this species. It is therefore considered that the proposal is not likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7. **Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat;**

   The proposal is not a type of development which is likely to result in invasive species that are harmful to the Grey-headed Flying-fox becoming established in adjoining and retained Grey-headed Flying-fox habitats.

8. **Introduce disease that may cause a species to decline; or**

   The proposal is not a type of development which is likely to introduce disease that may cause the Grey-headed Flying-fox to decline.

9. **Interfere with the recovery of the species.**

   The proposal will result in the extent of Grey-headed Flying-fox habitat within the site. The proposal is not likely to substantially interfere with the recovery of any offsite occurrences of this species or its habitats.

Conclusion

It is considered that the proposed action is not likely to have a significant impact on the Grey-headed Flying-fox. The AGDEE did not determine that the proposal would have a significant impact on this species at the referral stage.

A1.5 LARGE-EARED PIED-BAT (*Chalinolobus dwyeri*)

Preferred Habitat and Distribution
The Large-eared Pied Bat is known from Shoalwater Bay, north of Rockhampton, Qld, south to the vicinity of Ulladulla in NSW (DERM 2011).

This species is typically associated with habitat areas near extensive cliffs and caves which provide suitable roost sites. Suitable roost sites also include disused mine shafts and abandoned fairy martin nests (Churchill 2008; Schulz 1998).

No suitable roost sites for this species were observed within the subject site and this species was not recorded within the subject site during surveys.

Details of Targeted Surveys
Ultrasonic call recording surveys were undertaken for the Large-eared Pied-bat across all fauna survey stratification units over 22 ultrasonic call recording nights. Searches for suitable roost sites were also undertaken across the entire site totalling 111.8 hours over 19 days. Harp trap surveys (4 harp trap nights) were also undertaken along drainage line areas.

This species was not observed within the subject site during targeted surveys and no suitable roost sites were detected.

Important Population Criteria
An important population is a population that is necessary for a species' long term survival and recovery. The following consideration of the Important Population Criteria provided by DOE (2013), has been undertaken with regard to the Large-eared Pied-bat.

1. Identified as important populations in recovery plans, and/or

The Large-eared Pied-bat National Recovery Plan (DERM 2011) does not identify any important populations of this species within the vicinity of the subject site.

2. Key source populations either for breeding or dispersal.

This species was not observed within the subject site during surveys and the subject site does not contain suitable roost habitat for this species. The site of the proposed action does not contain a key source population for breeding or dispersal.

3. Populations that are necessary for maintaining genetic diversity.
This species was not observed within the subject site during surveys and the subject site does not contain suitable roost habitat for this species. The site does not contain a population that is necessary for maintaining genetic diversity.

4. Populations that are near the limit of the species range.

The subject site is not at the limit of this species range which extends from Shoalwater Bay, north of Rockhampton, Qld, south to the vicinity of Ulladulla in NSW

Significant Impact Assessment
Criteria identified within the EPBC Act Policy Statement 1.1 *Significant Impact Guidelines* (Department of the Environment 2013), have been addressed below to determine whether there is a real chance or possibility that the proposed action is likely to have a significant impact on the Large-eared Pied Bat , a threatened flora species listed as vulnerable under the *EPBC Act* (1999).

Questions (**in bold**) to determine whether the proposal is likely to have a significant impact on this species have been addressed as follows.

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

1. **Lead to a long-term decrease in the size of an important population of a species.**

   No populations of the Large-eared Pied Bat have been observed within the area of the proposed action during targeted surveys.

   It is considered that this species is not likely to occur in the area of the proposed action and the proposal is not likely to lead to a long-term decrease in the size of an important population of this species.

2. **Reduce the area of occupancy of an important population;**

   No populations of the Large-eared Pied Bat have been observed within the area of the proposed action during targeted surveys.

   It is considered that the Large-eared Pied Bat is not likely to occur in the area of the proposed action and the proposal is not likely to reduce the area of occupancy of an important population of this species.

3. **Fragment an existing important population into two or more populations;**

   No populations of this species have been observed within the area of the proposed action during targeted surveys.

   It is considered that the Large-eared Pied Bat is not likely to occur in the area of the proposed action and the proposal is not likely to fragment an existing important population of this species into two or more populations.

4. **Adversely affect habitat critical to the survival of a species;**

   The Large-eared Pied Bat has not been observed within the area of the proposed action during targeted surveys.

   It is considered that the Large-eared Pied Bat is not likely to occur in the area of the proposed action and the subject site does not contain habitat critical to the survival of this species.

   It is considered that the proposal is not likely to adversely affect habitat critical to the survival of the Large-eared Pied Bat.

5. **Disrupt the breeding cycle of an important population;**

   No populations of the Large-eared Pied Bat have been observed within the area of the proposed action during targeted surveys.

   It is considered that the Large-eared Pied Bat is not likely to occur in the area of the proposed action and the proposal is not likely to disrupt the breeding cycle of an important population of this species.

6. **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

   The Large-eared Pied Bat has not been observed within the area of the proposed action during targeted surveys.

   It is considered that the Large-eared Pied Bat is not likely to occur in the area of the proposed action and the proposal is not likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that this species is likely to decline.

7. **Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat;**

The Large-eared Pied Bat has not been observed within the area of the proposed action during targeted surveys.

It is considered that the Large-eared Pied Bat is not likely to occur in the area of the proposed action and the proposal is not likely to result in invasive species that are harmful to *this* species becoming established in habitat for this species.

8. Introduce disease that may cause a species to decline; or

The Large-eared Pied Bat has not been observed within the area of the proposed action during targeted surveys.

It is considered that the Large-eared Pied Bat is not likely to occur in the area of the proposed action and the proposal is not a type of development likely to introduce disease that may cause Large-eared Pied Bat to decline.

9. Interfere with the recovery of the species.

The Large-eared Pied Bat has not been observed within the area of the proposed action during targeted surveys.

It is considered that the Large-eared Pied Bat is not likely to occur in the area of the proposed action and the proposal is not likely to interfere with the recovery of this species.

Conclusion
It is considered that the proposed action is not likely to have a significant impact on the Large-eared Pied Bat.

ATTACHMENT 2
PROVISION OF ADDITIONAL INFORMATION FOR SPECIES LIKELY TO BE SIGNIFICANTLY IMPACTED

A2.1 - SLATY RED GUM (*Eucalyptus glaucina*)

1. Habitat, Survey and Species Range Details

1.1 Description of species habitat and habits

The approved conservation advice (ACA) for *Eucalyptus glaucina* identifies that it occurs in the Rappville district, south of Casino, and in a number of localities in the Taree, Stroud, Dungog and Paterson districts, NSW (DoEE 2016a).

The ACA also identifies that this species grows in a range of situations, from shallow soils or stony hillsides, but not on poor sandstones to grassy woodlands and on deep, moderately fertile and well-watered soil to gentle slopes near drainage lines in alluvial and clayey soils (DoEE 2016a). This species has been described as locally frequent, but sporadic across its range (NSW RBG 2016).

Within the subject site *E. glaucina* has an estimated population of approximately 2827 individuals, associated with approximately 22.09 hectares of the Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast plant community type. This habitat type occurs within the site at elevations of approximately 40 to 100m. A map of the site habitats occupied by this species within the subject site is shown in Figure A4.1.

Some potential hybridisation between *E. glaucina* and *Eucalyptus tereticornis* was observed, however these potential hybrid trees were assumed to be *E. glaucina* as a precautionary measure.

The habitats occupied by this species within the site are underlain by a rock material identified on the Newcastle geological map as Andesitic Iginimbrite of the Martins Creek Andersite formation, the petrological assessments of this rock has identified this as a Latite Tuff (VGT 2015).

The areas occupied by this species within the site occur mostly on the erosional Ten Mile Road Soil Landscape, a minor occurrence on the colluvial Birdsview Soil Landscape in the east of the site. The Ten Mile Road Soil Landscape is characterized by moderately deep to deep, well to imperfectly drained brown Soloths, yellow Soloths and shallow, well drained Bleached Loams and Lithosols. These soils are identified as of low to moderate fertility, and have potential to be strongly to extremely acidic (Matthei 1995).

Disturbances to the site habitats of this species include historical clearing associated with previous quarry activities and likely previous stock grazing. The habitats within the site have also been separated from areas to the south and west by the Main Northern Railway.

This species is currently conserved in the Bremer State Forest. Two additional occurrences of this species, on private land at Bremer and a local population on private land and within the Belford National Park at Minimbah are proposed to be established as Key Management Sites under the OEH program Saving Our Species OEH (2016e). These local populations have been identified as containing 10000 and 5000 individuals respectively and are considered to constitute important populations and contain habitat critical to the survival of this species over the next 100 years, as identified by the OEH (2016c). The subject site has not been identified as habitat critical to the survival of this species.

An important population is a population that is necessary for a species' long term survival and recovery. The following consideration of the Important Population Criteria provided by DoE (2013), has been undertaken to determine whether the *E.glaucina* within the site is an important population.

Criteria 1: Identified as important populations in recovery plans.

Response 1: There is no recovery plan for this species.

Criteria 2: Key source populations either for breeding or dispersal.

Response 2: The *E. glaucina* present is considered to form one of several local populations and is not likely to constitute a key source population for breeding or dispersal.

Criteria 3: Populations that are necessary for maintaining genetic diversity.
Response 3: The *E. glaucina* present has not been identified as genetically diverse from other populations, or necessary for maintaining the genetic diversity of the species.

Criteria 4: Populations that are near the limit of the species range.

Response 4: This species occurs within the Hunter/Central Rivers and the Northern Rivers regions. It occurs near Casino where it is locally common and further south from Taree to Broke and west of Maitland. The site is not near the limit of the species range.

It is therefore considered that the *Eucalyptus glaucina* present within the subject site is not part of an important population.

1.2 Details of Surveys Undertaken

Scope
The site surveys undertaken for *E. glaucina* were completed to determine presence, abundance and provide an extrapolated total of the number of trees to be removed and retained for the purpose of impact assessment and the determination of biodiversity offsets.

Timing
Targeted quadrat counts for *E. glaucina* were undertaken on the 16th and 17th of September 2015. The surveys undertaken coincided with the spring flowering period.

Methodology
Field traverses were undertaken across the vegetated areas of the subject site to determine the distribution of this species as part of vegetation mapping surveys. The *E. glaucina* specimens observed were mapped within the Slaty Red Gum Grassy Woodland on Hinterland Foothills of the Southern North Coast plant community type.

A total of thirteen (13) quadrats of 20x50m (1000m^2) size were surveyed within the identified distribution of this species within the subject site. The quadrat surveys for *E. glaucina* were undertaken on the 16th and 17th of September 2015.

Each quadrat was set out with a compass and marked in the field with flagging tape during the survey. GPS coordinates were recorded for each quadrat to enable mapping of survey quadrat locations on a plan of the site. The total number of all *E. glaucina* trees and saplings present within the quadrats were counted. Each *E. glaucina* individual within the quadrats was marked within spray paint to ensure none were missed or double counted.

The density of *E. glaucina* individuals present was determined for each quadrat which enabled the average density of the combined quadrats to be calculated and determination of the average density of *E. glaucina* per square metre of habitat.

The total number of *E. glaucina* individuals present across the site and within both areas to be retained and areas to be removed was estimated based on extrapolation of the survey results.

Some potential hybridisation between *Eucalyptus glaucina* and *Eucalyptus tereticornis* was observed, however these potential hybrid trees were assumed to be *Eucalyptus glaucina* as a precautionary measure.

1.3 Consistency with published Australian Government Guidelines and Policy Statements

There are no published Australian Government Guidelines or policy statements of relevance to this species.

1.4 Description of Impacts with regard to the National Extent of the Species Range

The national range of this species extends from the Northern Rivers region in the north from near Casino where it is locally common to areas south from Taree to Broke and west of Maitland and around Cessnock. The site is not near the limit of the national extent of the species range.

The proposal will result in the direct removal of approximately 1203 *E. glaucina* individuals within the proposed development footprint over an area of 9.4 ha. Specimens not proposed for removal will be retained within the site.

2. Impact Assessment and Offset Package Details

2.1 Details on Significant Residual Adverse Impacts Likely to Occur

The proposed adverse residual impact on this species will be the removal of approximately 1203 *E. glaucina* individuals within the proposed development footprint over an area of 9.4 ha.

2.2 Details on Application of the FBA in accordance with the objects of the EPBC Act with regard to Offsets

A Biodiversity Offset Strategy has been prepared for the proposal as separate documentation to this report (Conacher Consulting 2016a). A total of 16,842 *Eucalyptus glaucina* species credits are required for offsetting under the FBA. The offset rules in relation to EPBC Act listed species will be complied with for this species. The delivery of offsets for the proposed development is to follow a staged approach. Biodiversity offsets are to be delivered for each stage prior to the clearing of any vegetation within the defined stage area.

The following statement has been provided to identify proposal compliance with the NSW Biodiversity Offsets Policy for Major Projects Principles. The principles are identified as follows in bold font.

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

Details regarding impact avoidance are provided in the main body of this Biodiversity Assessment Report. Mitigation measures are provided in the Flora and Fauna Management Plan prepared for the proposal by Conacher Consulting (2016b).

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

The reliable and transparent methodology for assessing losses and gains associated with major projects has been identified as the NSW Framework for Biodiversity Assessment (2014). Assessment of losses has been undertaken in accordance with the NSW Framework for Biodiversity Assessment (OEH 2014a), and is detailed in the Biodiversity Assessment Report prepared by Conacher Consulting (2016). Further assessment of gains achieved through offsets is also to be assessed in accordance with this methodology.

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

Offsets are proposed to be targeted to biodiversity values being lost, in accordance with the like-for-like and like-for-like variation rules outlined in the NSW Biodiversity Offsets Policy for Major Projects (OEH 2014b).

Principle 4: Offsets must be additional to other legal requirements.

All offsets associated with the proposal will be additional to existing legal obligations for conservation that are attached to proposed offset lands.

Principle 5: Offsets must be enduring, enforceable and auditable.

Direct offsets delivered for the proposal are to be secured through an enduring, enforceable and auditable Biobanking agreement.

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

Supplementary measures are proposed to be utilised where offsets cannot be secured under a Biobanking agreement and the rules for use of supplementary measures are achieved.

2.3 Details of the Offset Package

The locations of the biodiversity offset sites are proposed to be finalised following project approval. The delivery of offsets for the proposed development is to follow a staged approach. Biodiversity offsets are to be delivered for each stage prior to the clearing of any vegetation within the defined stage area. Biodiversity offsets are to be delivered for each stage prior to the clearing of any vegetation within the defined stage area.

Figure A4.1
Suitable Slaty Red Gum (*Eucalyptus glaucina*) Habitat within Subject Site
Martins Creek

A2.2 - KOALA *(Phascolarctos cinereus)* COMBINED POPULATIONS OF QLD, NSW AND ACT

1. Habitat, Survey and Species Range Details

1.1 Description of species habitat and habits

The approved conservation advice (ACA) for *the Koala combined populations of QLD, NSW and the ACT* identifies that Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi -arid communities dominated by species from the genus Eucalyptus. The ACA also identifies that the listed Koala populations extend from the latitude of Cairns to the New South Wales – Victorian Border, including some island populations. The distribution of koalas is also affected by altitude (limited to <800m ASL), temperature and, at the western and northern ends of the range, leaf moisture (DoEE 2016b).

The Koala was observed within the subject site during surveys, the following observation details are provided:

One Koala was observed during the spotlighting survey undertaken on 20 August 2014 at the top of the hill in the eastern portion of the subject site. A male Koala was recorded calling on a songmeter device during call recording surveys on the 6th, 7th, 9th and 10th September within the vicinity of the initial spotlighting observation location.

A Koala was observed during the spotlighting surveys undertaken on 18 and 19 February 2015 to the west of the detention basin and the western alternate access road.

A Koala was heard calling from the forested area within the northern section of the site during a spotlighting survey undertaken on 19 February 2015.

No Koala scats were observed during the koala spot assessment surveys and the activity levels of Koalas on the site were accordingly determined to be low.

Within the subject site the Koala was observed in all habitat areas, with the exception of the rainforest habitats and the portion of the Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast plant community type which was in moderate to good/low condition. It is considered that this species is not likely to utlise the rainforest habitats due to the lack of preferred feed trees. It is also considered that Koalas are not likely to inhabit the small patch of Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast vegetation community in poor condition and identified as HU619B in Figure 3.1 of the Biodiversity Assessment Report, due to the presence of dense lantana growth.

The suitable habitats available for this species within the subject site are considered as known foraging habitats and potential breeding habitats. The identified habitat areas likely to be utilized by the Koala within the subject site comprise the following:

- HU798 White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley
- HU816 Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter
- HU755 Slaty Red Gum grassy woodland on the hinterland of the southern North Coast

The subject site contains only low levels of one primary koala food tree listed in the Approved Recovery Plan for the mid-North Coast management area, prepared for the Koala by DECC (2008), *Eucalyptus tereticornis*. The site also contains the following secondary Koala food trees identified by DECC (2008) for the mid-North Coast management area:

- *Eucalyptus glaucina* (occurs extensively within the Slaty Red Gum grassy woodland on the hinterland of the southern North Coast plant community type)

- *Eucalyptus canaliculata* (occurs at low to moderate densities present in the White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley plant community type)
- *Eucalyptus moluccana* (Occurs at low densities within the Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter and Slaty Red Gum grassy woodland on the hinterland of the southern North Coast plant community types.

One supplementary / Stringybark species identified by DECC (2008) for the mid-North Coast management area also occurs within the subject site. This species is *Eucalyptus globoidea* and it occurs at low to moderate densities within all identified vegetation types likely to be utilised by Koalas.

A map of the suitable habitat areas for this species is provided in Figure A4.2.

Assessment in accordance with the EPBC Act Referral Guidelines for the Vulnerable proposal is likely to affect habitat critical to the survival of the Koala. Important populations of Koalas have not been separated throughout the range of the listed species (DoE 2014). The extent of habitat available to this species within the subject site is shown in Figure A4.2.

1.2 Details of Surveys Undertaken

Scope
The site surveys undertaken were designed to determine whether the Koala was inhabiting the site and where present, the activity levels of any population of Koalas present. These surveys were undertaken in accordance with the requirements of the Framework for Biodiversity Assessment (OEH 2014) and the associated guidelines prepared by DEC (2004).

Timing
The timing of Koala surveys is documented in Table A4.2.1.

TABLE A4.2.1
KOALA SURVEY TIMING

Diurnal Surveys	20 August 2014	1hr 1145-1245 (2 persons)
	21 August 2014	7hrs 0900-1400 / 1530-1730 (2 persons)
	5 September 2014	3hrs 20 min / 0930-1250 (2 persons)
	30 September 2014	2hrs 30 min 0940-1210 (2 persons)
	18 February 2015	8hrs 1100-1930 (2 persons)
	19 February 2015	12hrs 0830-1330 / 1430-1930 (2 persons)
	20 February 2015	2hrs 0740-0940 2 persons)
	10 June 2015	5hrs 15min 1130-1645 (2 persons)
	11 June 2015	5hrs 0730-1230 (2 persons)
	17 August 2015	6hrs 30min 1000-1800 (2 persons)
	18 August 2015	8hrs 15min 0815-1630 (2 persons)
	19 August 2015	8hrs 30min 0800-1830 (2 persons)
	20 August 2015	8hrs 45min 0815-1700 (2 persons)
	21 August 2015	2hrs 45min 0815-1100 (2 persons)
	15 September 2015	7hrs 1100-1600 (2 persons)
	16 September 2015	9hrs 0730-1630 (2 persons)
	17 September 2015	8hrs 0745-1145 / 1400-1800 (2 persons)
	18 September 2015	2 hrs 30min 0740-1010 (2 persons)
	14 October 2015	4hrs 30min 1000-1200 / 1300-1530
Nocturnal Surveys	20 August 2014	2hrs1730-1930 (2 persons)
	21 August 2014	2hrs 1730-1930 (2 persons)
	18 February 2015	2hrs 1930-2130 (2 persons)
	19 February 2015	2hrs 1930-2130 (2 persons)
	17 August 2015	1hr 1830-1930 (2 persons)

TABLE A4.2.1 KOALA SURVEY TIMING		
	19 August 2015	1hr 1830-1930 (2 persons)
	17 September 2015	1hr 1800-1900 (2 persons)

Methodology
An initial desktop survey of Koalas was undertaken which involved review of previous ecological studies prepared for the site and review of the Bionet Atlas of NSW Wildlife records (OEH 2016).

Diurnal field habitat searches and nocturnal spotlight searches were undertaken for Koalas. Where Koalas were observed during searches, the locations and number of individuals observed was recorded. Mapping and ground-truthing of vegetation types present within the site was undertaken as part of the flora surveys conducted for this Biodiversity Assessment Report.

The Spot Assessment Technique (SAT) (Phillips and Callaghan 2011) was utilised for Koala activity levels surveys. A scale grid of 150m spacing was placed over an aerial photograph of the site. At each grid intersect point (or the nearest suitable location), a scat search utilising the SAT Technique and a diurnal search of trees was conducted for Koalas. All scats collected were formally identified by Scats About P/L, a specialised hair and scat identification business.

1.3 Consistency with published Australian Government Guidelines and Policy Statements

The Survey Effort EPBC Act Referral Guidelines for the Vulnerable Koala have been addressed as follows:

Note: The guidelines do not prescribe survey effort standards for koala surveys, due to the high level of variation in environmental variables across the koala's range and survey effort must be determined on a case-by-case basis. The following key principles (where relevant) underpin the design and implementation of koala surveys:

i. **Sampling is only considered appropriate for moderate or large study areas (i.e. several hectares or more); census (surveying the entire site) is relevant for small sites and improves confidence in the data.**

   Extensive field surveys were undertaken across the site, with sampling undertaken in stratified habitat types and at plot locations determined by a survey grid of 150m spacings. Surveys were completed to meet the DEC (2004) guidelines for arboreal mammals for diurnal searches and spotlighting surveys as detailed in Table 3.4 of the Biodiversity Assessment Report.

   Sampling for the SAT surveys was completed in addition to the DEC (2004) guideline requirements and was completed over sample 22 plots.

ii. **Surveys for animals (direct observation) or signs (scats, scratches etc.), for the purposes of gathering presence/absence data, must be undertaken in a manner which maximises the chance of detecting the species.**

   The species was detected in all habitat types likely to be occupied during spotlighting surveys.

iii. **Failure to detect animals or sign in a single survey does not necessarily mean the koala is absent; spatial and temporal replication of the survey is required in order to infer true absence.**

   Koalas were detected during surveys.

iv. **The strengths and limitations of different methods must be acknowledged and considered when designing the survey.**

   Koalas were detected during surveys, multiple methods of detection were utlised to maximise detection probability.

v. **The species' ecology varies across its range; it is not appropriate to extrapolate ecological findings to different communities or bioregions.**

This requirement was complied with.

vi. **Care must be taken not to violate the assumptions of the statistical or methodological analyses used when making comparisons between sites or strata (not relevant to census surveys).**

This is not relevant to the surveys undertaken.

1.4 Description of Impacts with regard to the National Extent of the Species Range

The approved conservation advice for this species identifies that the listed Koala populations extend from the latitude of Cairns to the New South Wales – Victorian Border, including some island populations. The distribution of koalas is also affected by altitude (limited to <800m ASL), temperature and, at the western and northern ends of the range, leaf moisture (DoEE 2016b).

The proposal will result in the removal of 21.61 hectares of suitable low activity level habitat for this species. It is considered that the extent of proposed habitat loss is not significant when compared to the national extent of the species range, and the adjoining habitat areas available to this species.

2. Impact Assessment and Offset Package Details

2.1 Details on Significant Residual Adverse Impacts Likely to Occur

The proposal will result in the removal of 21.61 hectares of suitable low activity level habitat for the Koala.

2.2 Details on Application of the FBA in accordance with the objects of the EPBC Act with regard to Offsets

A Biodiversity Offset Strategy has been prepared for the proposal as separate documentation to this report (Conacher Consulting 2016a). A total of 562 Koala species credits are required for offsetting under the FBA. The offset rules in relation to EPBC Act listed species will be complied with for this species. The delivery of offsets for the proposed development is to follow a staged approach. Biodiversity offsets are to be delivered for each stage prior to the clearing of any vegetation within the defined stage area.

The following statement has been provided to identify proposal compliance with the NSW Biodiversity Offsets Policy for Major Projects Principles. The principles are identified as follows in bold font.

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

Details regarding impact avoidance are provided in the main body of this Biodiversity Assessment Report. Mitigation measures are provided in the Flora and Fauna Management Plan prepared for the proposal by Conacher Consulting (2016b).

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

The reliable and transparent methodology for assessing losses and gains associated with major projects has been identified as the NSW Framework for Biodiversity Assessment (2014). Assessment of losses has been undertaken in accordance with the NSW Framework for Biodiversity Assessment (OEH 2014a), and is detailed in the Biodiversity Assessment Report prepared by Conacher Consulting (2016). Further assessment of gains achieved through offsets is also to be assessed in accordance with this methodology.

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

Offsets are proposed to be targeted to biodiversity values being lost, in accordance with the like-for-like and like-for-like variation rules outlined in the NSW Biodiversity Offsets Policy for Major Projects (OEH 2014b).

Principle 4: Offsets must be additional to other legal requirements.

All offsets associated with the proposal will be additional to existing legal obligations for conservation that are attached to proposed offset lands.

Principle 5: Offsets must be enduring, enforceable and auditable.

Direct offsets delivered for the proposal are to be secured through an enduring, enforceable and auditable Biobanking agreement.

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

Supplementary measures are proposed to be utilised where offsets cannot be secured under a Biobanking agreement and the rules for use of supplementary measures are achieved.

2.3 Details of the Offset Package

The locations of the biodiversity offset sites are proposed to be finalised following project approval. The delivery of offsets for the proposed development is to follow a staged approach. Biodiversity offsets are to be delivered for each stage prior to the clearing of any vegetation within the defined stage area. Biodiversity offsets are to be delivered for each stage prior to the clearing of any habitats within the defined stage area.

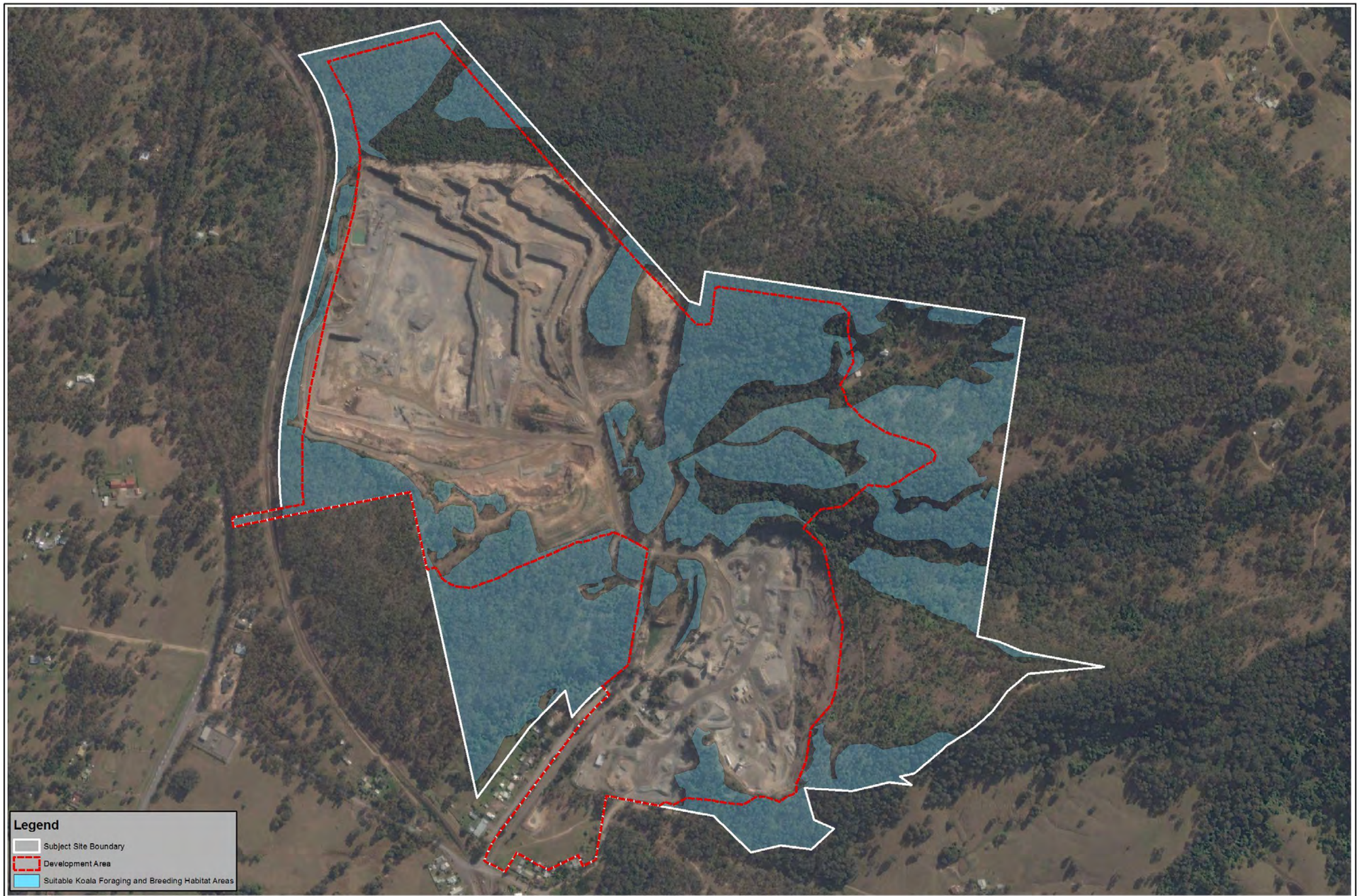

Figure 2
Map of Suitable Koala Habitat within Subject Site
Martins Creek

A2.3 - REGENT HONEYEATER (*Anthochaera phrygia*)

1. Habitat, Survey and Species Range Details

1.1 Description of species habitat and habits

The National Recovery Plan for the Regent Honeyeater (DoE 2016) identifies that most records for this species are from habitats which consist of box-ironbark eucalypt associations on sites with more fertile soils and higher water content, including creek flats, broad river valleys and lower slopes. Other forest types identified as providing regularly used habitats include wet lowland coastal forest dominated by Swamp Mahogany, Spotted Gum – Ironbark Associations and riverine woodlands. Riparian habitats are also selected as breeding habitat in some years (often adjacent to box-ironbark woodlands). Remnant stands of timber, roadside reserves, travelling stock routes and street trees are also identified as providing important habitat at certain times (DoE 2016).

One key tree species for the Regent Honeyeater, *Corymbia maculata*, is present within the subject site (DoE 2016). Other tree species present, such as stringybarks and ironbarks may also contribute to the available nectar food resources present.

This species has not been observed within the subject site during targeted surveys completed in accordance with the requirements of the FBA (OEH 2014a) and DEC (2004) requirements.

DoE (2016) have identified that habitat critical to the survival of the regent honeyeater includes:

- Any breeding or foraging habitat in areas where the species is likely to occur (as defined by the distribution map provided in Figure 2); and

- Any newly discovered breeding or foraging locations.

The subject site is located within the area mapped by DoE (2016) the area where this species is likely to occur, and suitable foraging habitat is present for this species within the following plant community types mapped within the subject site:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley
- Spotted Gum – Narrow-leaved Ironbark shrub-grass open forest of the Central and Lower Hunter
- Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast

Remnant trees within mostly cleared areas of the site also provide potential habitat for this species. A map of the areas of suitable forested habitat for this species within the subject site is provided as Figure A4.3.

The remaining individuals of the national population are considered to be an important population, in accordance with the criteria provided by DoE (2013). No Regent Honeyeaters have been observed within the subject site during surveys.

1.2 Details of Surveys Undertaken

Scope
The site surveys undertaken were designed to determine whether suitable habitat was present within the subject site for this species, and to determine whether this species was using the subject site. The surveys completed were undertaken at various times of the year in order to maximise the probability of detection and included site visits when key food tree species for the Regent Honeyeater were flowering within the site.

Timing
Survey undertaken for this species included 111.25hrs of targeted and opportunistic searches which completed during both summer and winter survey periods on the following dates:

- 20-21 August 2014 (8hrs x 2 persons)

- 5 September 2014 (3hrs 20min x 2 persons)
- 30 September 2014 (2.5hrs x 2 persons)
- 18-20 February 2015 (22hrs x 2 persons)
- 10-11 June (10hrs x 2 persons)
- 17-21 August 2015 (34.75hrs x 2 persons)
- 15-18 September 2015 (26.5 hrs x 2 persons)
- 14 October 2015 (4.5hrs)

Methodology
Surveys for the Regent Honeyeater were undertaken during both the cooler months during late autumn, winter and early spring and during the warmer months of late spring and summer. Diurnal census plots (targeted surveys) were conducted for diurnal birds at the same locations as flora plots during August and September 2015. A total of 15 plots were sampled for diurnal bird species. Targeted and opportunistic areas searches were also completed across all stratification units during both warm and cool season survey periods. Searches for the Regent Honeyeater included surveys completed during August 2014 and August – September 2015, when *Corymbia maculata* and *Eucalyptus glaucina* trees were flowering within the site. Sporadic flowering of ironbark species was also observed throughout the survey period.

1.3 Consistency with published Australian Government Guidelines and Policy Statements

The Survey Guidelines for Australia's Threatened Birds (DEWHA 2010) identify survey effort requirements of 20 hours of area searches over 10 days and 20 hours of targeted searches over 5 days. These requirements were exceeded during the completion of both the warm and cool season surveys undertaken.

1.4 Description of Impacts with regard to the National Extent of the Species Range

The National Recovery Plan for the Regent Honeyeater (DoE 2016) identifies this species has an extremely patch distribution with a small number of breeding sites across its current range which extends from 100km north of Brisbane west to the coastal areas of NSW and Victoria and west to Narrabri, Dubbo, Parkes and Finley in NSW to as far as Bendigo in central Victoria.

There are four known breeding sites, these are in Bundarra-Barraba, Capertee Valley and the Hunter Valley of NSW within the Hunter Economic Zone and within the Chiltern area in north-east Victoria.

Threats to the Regent Honeyeater across its national range include habitat loss, fragmentation and degradation, small population size, nest site predation and competition for food resources. Recent research has begun to highlight the high levels of predation to Regent Honeyeater nest sites by Sugar Gliders, Squirrel Glider gliders and other bird species, when conservation groups in Victoria are installing hundreds of nest boxes for glider species in areas of key Regent Honeyeater breeding habitats.

The subject site does not contain known breeding or foraging habitat for this species, however does provide potential foraging resources across the following vegetation types:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley
- Spotted Gum – Narrow-leaved Ironbark shrub-grass open forest of the Central and Lower Hunter
- Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast

The proposal will result in the removal of 9.8 ha, 3.19 ha and 9.4 ha of these vegetation types respectively.

2. Impact Assessment and Offset Package Details

2.1 Details on Significant Residual Adverse Impacts Likely to Occur

The proposal will result in the removal of 21.61 hectares of suitable habitat for this species.

2.2 Details on Application of the FBA in accordance with the objects of the EPBC Act with regard to Offsets

A Biodiversity Offset Strategy has been prepared for the proposal as separate documentation to this report (Conacher Consulting 2016a). A total of 1569 ecosystem credits will be required for offsetting of suitable habitat for this species under the FBA. Species credits for this species will not be required as this species has not been observed within the subject site. The offset rules in relation to EPBC Act listed species will be complied with for this species. The delivery of offsets for the proposed development is to follow a staged approach. Biodiversity offsets are to be delivered for each stage prior to the clearing of any vegetation within the defined stage area.

The following statement has been provided to identify proposal compliance with the NSW Biodiversity Offsets Policy for Major Projects Principles. The principles are identified as follows in bold font.

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

Details regarding impact avoidance are provided in the main body of this Biodiversity Assessment Report. Mitigation measures are provided in the Flora and Fauna Management Plan prepared for the proposal by Conacher Consulting (2016b).

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

The reliable and transparent methodology for assessing losses and gains associated with major projects has been identified as the NSW Framework for Biodiversity Assessment (2014). Assessment of losses has been undertaken in accordance with the NSW Framework for Biodiversity Assessment (OEH 2014a), and is detailed in the Biodiversity Assessment Report prepared by Conacher Consulting (2016). Further assessment of gains achieved through offsets is also to be assessed in accordance with this methodology.

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

Offsets are proposed to be targeted to biodiversity values being lost, in accordance with the like-for-like and like-for-like variation rules outlined in the NSW Biodiversity Offsets Policy for Major Projects (OEH 2014b).

Principle 4: Offsets must be additional to other legal requirements.

All offsets associated with the proposal will be additional to existing legal obligations for conservation that are attached to proposed offset lands.

Principle 5: Offsets must be enduring, enforceable and auditable.

Direct offsets delivered for the proposal are to be secured through an enduring, enforceable and auditable Biobanking agreement.

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

Supplementary measures are proposed to be utilised where offsets cannot be secured under a Biobanking agreement and the rules for use of supplementary measures are achieved.

2.3 Details of the Offset Package

The locations of the biodiversity offset sites are proposed to be finalised following project approval. The delivery of offsets for the proposed development is to follow a staged approach. Biodiversity offsets are to be delivered for each stage prior to the clearing of any vegetation within the defined stage area. Biodiversity offsets are to be delivered for each stage prior to the clearing of any habitats within the defined stage area.

Figure A4.3
Map of Suitable Regent Honeyeater Habitat within Subject Site
Martins Creek

A2.4 - SWIFT PARROT (*Lathamus discolor*)

1. Habitat, Survey and Species Range Details

1.1 Description of species habitat and habits

The National Recovery Plan for the Swift Parrot (Saunders and Tzaros 2011) identifies that the Swift Parrot breeds in Tasmania during the austral summer and the entire population migrates north to mainland Australia for the austral winter. The Swift Parrot disperses widely across Victoria and New South Wales in the dry forests and woodlands of the box-ironbark region on the inland western slopes of the Great Dividing Range and coastal forests particularly in times of drought. Their non-breeding range extends as far north as south-eastern Queensland and as far west as south-eastern Australia in areas of suitable habitat (Saunders and Tzaros 2011).

Two key tree species for the Swift Parrot identified by (Saunders and Tzaros 2011) are present within the subject site, these are *Corymbia maculata* and *Eucalyptus tereticornis*. *Eucalyptus glaucina* is also present, with some potential hybrids between this species and *Eucalyptus tereticornis.*

The Swift Parrot has not been observed within the subject site during targeted surveys completed in accordance with the requirements of the FBA (OEH 2014a) and DEC (2004) requirements.

Saunders and Tzaros (2011) have identified 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.

Saunders and Tzaros (2011) have listed the following habitats of particular importance for conservation management for Swift Parrots:
• those used for nesting,
• those used by large proportions of the Swift Parrot population,
• those used repeatedly between seasons (site fidelity), or
• those used for prolonged periods of time (site persistence).

Suitable foraging habitat is present for this species within the following plant community types mapped within the subject site:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley
- Spotted Gum – Narrow-leaved Ironbark shrub-grass open forest of the Central and Lower Hunter
- Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast

Remnant trees within mostly cleared areas of the site also provide potential habitat for this species.

A map of the suitable forested habitat areas for this species within the subject site is provided as Figure A4.4.

The remaining individuals of the national population are considered to be an important population, in accordance with the criteria provided by DoE (2013). This species does not breed on mainland Australia and no Swift Parrots have been observed within the subject site during surveys,

1.2 Details of Surveys Undertaken

Scope
The site surveys undertaken were designed to determine whether suitable habitat was present within the subject site for this species, and to determine whether this species was using the subject site. The surveys completed were undertaken at various times of the year in order to maximise the probability of detection and included site visits when key food tree species for the Swift Parrot were flowering within the site.

Timing

This species is present on the Australian mainland between February / March to September / October. Survey undertaken for this species included 111.25hrs of targeted and opportunistic searches completed over 19 days on the following dates:

- 20-21 August 2014 (8hrs x 2 persons)
- 5 September 2014 (3hrs 20min x 2 persons)
- 30 September 2014 (2.5hrs x 2 persons)
- 18-20 February 2015 (22hrs x 2 persons)
- 10-11 June (10hrs x 2 persons)
- 17-21 August 2015 (34.75hrs x 2 persons)
- 15-18 September 2015 (26.5 hrs x 2 persons)
- 14 October 2015 (4.5hrs)

Methodology

Surveys for the Swift Parrot were undertaken throughout the non-breeding period in 2014 and 2015 when it is present on the Australian mainland. Diurnal census plots (targeted surveys) were conducted for diurnal birds at the same locations as flora plots during August and September 2015. A total of 15 plots were sampled for diurnal bird species. Targeted and opportunistic areas searches were also completed across all stratification units during these times and throughout the survey period when the *Corymbia maculata* and *Eucalyptus glaucina* trees were flowering. Sporadic flowering of ironbark species was also observed throughout the survey period. Only low numbers of *Eucalyptus tereticornis* are present within the site and effort to distinguish flowering of these trees from that of *E. glauca* was not undertaken.

1.3 Consistency with published Australian Government Guidelines and Policy Statements

The Survey Guidelines for Australia's Threatened Birds (DEWHA 2010) identify survey effort requirements of 20 hours of area searches over 8 days and 20 hours of targeted searches over 8 days. These requirements were exceeded during the completion of the surveys undertaken.

1.4 Description of Impacts with regard to the National Extent of the Species Range

The National Recovery Plan for the Swift Parrot (Saunders and Tzaros 2011) identifies that it breeds in Tasmania disperses widely across Victoria and New South Wales in the dry forests and woodlands of the box-ironbark region on the inland western slopes of the Great Dividing Range and coastal forests particularly in times of drought. Their non-breeding range extends as far north as south-eastern Queensland and as far west as south-eastern Australia in areas of suitable habitat (Saunders and Tzaros 2011).

Threats to the Swift Parrot across its national range include habitat loss, fragmentation and degradation, small population size, nest site predation and competition for food resources. DoEE (2016) have identified that in Tasmania, predation by the introduced Sugar Glider (*Petaurus breviceps*) is a severe. Predation has been identified by DoEE (2016c) as the principal cause of breeding failure for the Swift Parrot, and in most instances the adult female and the egg are killed and equates to an annual mortality of 42% for breeding females across Tasmania.

The subject site does not contain potential breeding or foraging habitat for this species, however does provide potential foraging resources across the following vegetation types:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley
- Spotted Gum – Narrow-leaved Ironbark shrub-grass open forest of the Central and Lower Hunter
- Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast

The proposal will result in the removal of 9.8 ha, 3.19 ha and 9.4 ha of these vegetation types respectively.

2. Impact Assessment and Offset Package Details

2.1 Details on Significant Residual Adverse Impacts Likely to Occur

The proposal will result in the removal of 21.61 hectares of suitable habitat for this species.

2.2 Details on Application of the FBA in accordance with the objects of the EPBC Act with regard to Offsets

A Biodiversity Offset Strategy has been prepared for the proposal as separate documentation to this report (Conacher Consulting 2016a). A total of 1569 ecosystem credits will be required for offsetting of suitable habitat for this species under the FBA. Species credits for this species will not be required as this species has not been observed within the subject site. The offset rules in relation to EPBC Act listed species will be complied with for this species. The delivery of offsets for the proposed development is to follow a staged approach. Biodiversity offsets are to be delivered for each stage prior to the clearing of any vegetation within the defined stage area.

The following statement has been provided to identify proposal compliance with the NSW Biodiversity Offsets Policy for Major Projects Principles. The principles are identified as follows in bold font.

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

Details regarding impact avoidance are provided in the main body of this Biodiversity Assessment Report. Mitigation measures are provided in the Flora and Fauna Management Plan prepared for the proposal by Conacher Consulting (2016b).

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

The reliable and transparent methodology for assessing losses and gains associated with major projects has been identified as the NSW Framework for Biodiversity Assessment (2014). Assessment of losses has been undertaken in accordance with the NSW Framework for Biodiversity Assessment (OEH 2014a), and is detailed in the Biodiversity Assessment Report prepared by Conacher Consulting (2016). Further assessment of gains achieved through offsets is also to be assessed in accordance with this methodology.

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

Offsets are proposed to be targeted to biodiversity values being lost, in accordance with the like-for-like and like-for-like variation rules outlined in the NSW Biodiversity Offsets Policy for Major Projects (OEH 2014b).

Principle 4: Offsets must be additional to other legal requirements.

All offsets associated with the proposal will be additional to existing legal obligations for conservation that are attached to proposed offset lands.

Principle 5: Offsets must be enduring, enforceable and auditable.

Direct offsets delivered for the proposal are to be secured through an enduring, enforceable and auditable Biobanking agreement.

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

Supplementary measures are proposed to be utilised where offsets cannot be secured under a Biobanking agreement and the rules for use of supplementary measures are achieved.

2.3 Details of the Offset Package

The locations of the biodiversity offset sites are proposed to be finalised following project approval. The delivery of offsets for the proposed development is to follow a staged approach. Biodiversity offsets are to be delivered for each stage prior to the clearing of any vegetation within the defined stage area. Biodiversity offsets are to be delivered for each stage prior to the clearing of any habitats within the defined stage area.

Figure A4.4
Map of Suitable Swift Parrot Habitat within Subject Site
Martins Creek

A4.2.5 - SPOTTED-TAILED QUOLL (*Dasyurus maculatus maculatus*) SE MAINLAND POPULATION

1. Habitat, Survey and Species Range Details

1.1 Description of species habitat and habits

There is no approved conservation advice or national recovery plan for this species under the *EPBC Act* (1999). The DoEE (2016) Species Profile and Threats Database identifies that the south-east mainland population of this species has a reduced distribution across its former range of between north-east Queensland, eastern NSW, Victoria, south-east Victoria (DoEE 2016c). DoEE (2016) have identified that it has been recorded from a variety of habitats including:

- temperate and subtropical rainforests in mountain areas
- wet sclerophyll forest (preferred habitat)
- lowland forests
- open and closed eucalypt woodlands
- inland riparian and River Red Gum (*Eucalyptus camaldulensis*) forests
- dry 'rainshadow' woodland
- sub-alpine woodlands
- coastal heathlands
- occasional sightings from open country, grazing lands, rocky outcrops and other treeless areas

The DEH (2004) Administrative Guidelines on Significance - Supplement for the Tiger Quoll (Southeastern Mainland Population) and the use of 1080 identify that the Spotted-tailed Quoll (or Tiger Quoll) has been found on the margins of farmland and its preferred habitat includes escarpments, gullies, saddles and riparian habitat as well as rocky areas where it finds den sites. Highly disturbed forests and exotic plantations are unlikely to be important habitat.

The Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River plant community type present within the subject site contains rocky riparian gully type habitat areas for this species, however the surrounding habitats have been disturbed by the operation of the existing quarry and historical clearing and weed invasion. These impacts are likely to have reduced the quality of the areas of potential habitat for this species within the site. Despite targeted searches for den sites for this species, none were observed.

Suitable foraging habitat is present for this species within all plant community types present and potential breeding habitat is also present within the Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River plant community type. Due to the large extent of similar habitats connected to the subject site it is considered that the subject site does not contain habitat critical to the survival of this species. A map of the suitable forested habitat areas for this species within the subject site is provided as Figure A4.5.

An important population is a population that is necessary for a species' long term survival and recovery. The following consideration of the Important Population Criteria provided by DoE (2013), has been undertaken to determine whether an important population of the Spotted-tailed Quoll is present.

Criteria 1: Identified as important populations in recovery plans.

Response 1: There is no recovery plan for this species.

Criteria 2: Key source populations either for breeding or dispersal.

Response 2: No Spotted-tailed Quoll dens have been observed within the subject site and the site is therefore considered to not contain a key source population for breeding or dispersal.

Criteria 3: Populations that are necessary for maintaining genetic diversity.

Response 3: No Spotted-tailed Quoll dens have been observed within the subject site and the site is therefore considered to not contain a population necessary for maintaining genetic diversity.

Criteria 4: Populations that are near the limit of the species range.

Response 4: The subject site does not occur near the limit of the range of the Spotted-tailed Quoll (SE Mainland Population).

It is therefore considered that an important population of the Spotted-tailed Quoll is not present within the subject site.

1.2 Details of Surveys Undertaken

Scope
The DoEE have requested that details of the information on the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements be provided.

Divergence was undertaken for the Under the FBA Methodology (OEH 2014a) the Spotted-tailed Quoll is identified as an 'ecosystem credit' type species. Ecosystem credit type species are those threatened species that can be reliably predicted to occur within the plant community types present and have been assumed to be present. Offsets are required for these species even when they are not identified as present within a site.

Under the FBA Methodology detailed surveys for this species are not required. Regardless of the lack of requirement to undertake surveys for this species, surveys were conducted prior to the adoption of the FBA Methodology for the proposal and during the completion of targeted fauna surveys which are capable of detecting a range of fauna species.

Timing
The SEWPaC (2011) Survey Guidelines for Australia's threatened mammals identifies that the optimal survey time is during the breeding season, with peak activity occurring between May and August. The timing of Spotted-tailed Quoll surveys is documented in Table A4.5.1.

TABLE A4.5.1
SPOTTED-TAILED QUOLL SURVEY TIMING

Diurnal Surveys	20 August 2014	1hr 1145-1245 (2 persons)
	21 August 2014	7hrs 0900-1400 / 1530-1730 (2 persons)
	5 September 2014	3hrs 20 min / 0930-1250 (2 persons)
	30 September 2014	2hrs 30 min 0940-1210 (2 persons)
	18 February 2015	8hrs 1100-1930 (2 persons)
	19 February 2015	12hrs 0830-1330 / 1430-1930 (2 persons)
	20 February 2015	2hrs 0740-0940 2 persons)
	10 June 2015	5hrs 15min 1130-1645 (2 persons)
	11 June 2015	5hrs 0730-1230 (2 persons)
	17 August 2015	6hrs 30min 1000-1800 (2 persons)
	18 August 2015	8hrs 15min 0815-1630 (2 persons)
	19 August 2015	8hrs 30min 0800-1830 (2 persons)
	20 August 2015	8hrs 45min 0815-1700 (2 persons)
	21 August 2015	2hrs 45min 0815-1100 (2 persons)
	15 September 2015	7hrs 1100-1600 (2 persons)
	16 September 2015	9hrs 0730-1630 (2 persons)
	17 September 2015	8hrs 0745-1145 / 1400-1800 (2 persons)
	18 September 2015	2 hrs 30min 0740-1010 (2 persons)
	14 October 2015	4hrs 30min 1000-1200 / 1300-1530
Nocturnal Surveys	20 August 2014	2hrs1730-1930 (2 persons)

TABLE A4.5.1 SPOTTED-TAILED QUOLL SURVEY TIMING		
	21 August 2014	2hrs 1730-1930 (2 persons)
	18 February 2015	2hrs 1930-2130 (2 persons)
	19 February 2015	2hrs 1930-2130 (2 persons)
	17 August 2015	1hr 1830-1930 (2 persons)
	19 August 2015	1hr 1830-1930 (2 persons)
	17 September 2015	1hr 1800-1900 (2 persons)
Baited Terrestrial IR Camera Surveys	21 August – 4 September 2014	28 camera nights (2 cameras x 14 nights)
Terrestrial hair tube survey	21 August – 4 September 2014	10 hair tubes (over 2 transects) x 14 nights

Methodology

The following survey methods were undertaken:

- Daytime habitat searches and searches for scats and signs;
- Spotlighting surveys;
- Hair tube surveys (preliminary surveys only); and
- Terrestrial IR camera surveys.

Diurnal searches were undertaken in areas of potential habitat for scats and potential den sites. This species targeted during all daytime mammal searches undertaken, including dusk searches. This species was also targeted during nocturnal spotlight searches of suitable habitats.

Baited terrestrial remote camera surveys were undertaken for terrestrial mammals. Bait holders contained baits of chicken wings and tuna oil, with two camera deployed for 14 nights.

A total of 10 hair tubes were deployed for 14 nights in areas of suitable habitat as a supplementary survey method to the other surveys which were undertaken.

1.3 Consistency with published Australian Government Guidelines and Policy Statements

The requirements of the following SEWPaC (2011) survey methods were exceeded during surveys

- Daytime searches for potentially suitable habitat resources (One hectare area search over 2hrs per 100 hectares)
- Daytime searches for signs of activity, scats and latrines (One hectare area search over 2hrs per 100 hectares)

SEWPaC (2011) recommends that remote camera surveys be undertaken for 3 weeks per 100 hectares. The guidelines identify that further research on survey effort is necessary. More recent studies in the Watagans Mountains have identified that most recordings are made at 6-8 days after deployment, with few at 14 days (McLean *et a*l., 2015). Accordingly the remote camera survey effort requirement was varied to include 2 cameras deployed for fourteen nights.

The hair tube survey undertaken was not intended to meet the full stratification and effort requirements of DECC (2004) or SeWPAC (2011) as it was only undertaken as a supplementary survey method.

1.4 Description of Impacts with regard to the National Extent of the Species Range

The DoEE (2016) Species Profile and Threats Database identifies that the south-east mainland population of this species has a reduced distribution across its former range of between north-east Queensland, eastern NSW, Victoria, south-east Victoria. Within NSW this species is generally confined to within 200km of the coast and range from the QLD border to Kosciuszko National Park. Inhabited locations identified by DoEE (2016) include:

- Hunter Valley, Taree, Port Macquarie and Coffs Harbour through to the gorges and escarpments of the New England Tableland
- locally abundant populations occur in the south of the state (i.e. Kosciuszko NP and coastal national parks)
- isolated records near Hay
- several disjunct populations between the Border Ranges and the Blue Mountains/Illawarra area

The proposal is likely to result in the removal of approximately 27.39 hectares of suitable habitat for this species comprised of the following plant community types:

- HU798 White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley (9.8 ha);
- HU816 Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter (3.19 ha);
- HU619 Whalebone Tree – Red Kamala dry subtropical rainforest of the lower Hunter River (5 ha); and
- HU755 Slaty Red Gum grassy woodland on the hinterland of the southern North Coast (9.4 ha).

2. Impact Assessment and Offset Package Details

2.1 Details on Significant Residual Adverse Impacts Likely to Occur

The proposal is likely to result in the removal of approximately 27.39 hectares of suitable habitat for this species.

2.2 Details on Application of the FBA in accordance with the objects of the EPBC Act with regard to Offsets

A Biodiversity Offset Strategy has been prepared for the proposal as separate documentation to this report (Conacher Consulting 2016a). A total of 1953 ecosystem credits will be required for offsetting of suitable habitat for this species under the FBA. This species is not subject to a requirement for offsetting with species credits as it is predicted to occur at any future offset sites based on the presence of suitable habitat. The offset rules in relation to EPBC Act listed species will be complied with for this species. The delivery of offsets for the proposed development is to follow a staged approach. Biodiversity offsets are to be delivered for each stage prior to the clearing of any vegetation within the defined stage area.

The following statement has been provided to identify proposal compliance with the NSW Biodiversity Offsets Policy for Major Projects Principles. The principles are identified as follows in bold font.

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

Details regarding impact avoidance are provided in the main body of this Biodiversity Assessment Report. Mitigation measures are provided in the Flora and Fauna Management Plan prepared for the proposal by Conacher Consulting (2016b).

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

The reliable and transparent methodology for assessing losses and gains associated with major projects has been identified as the NSW Framework for Biodiversity Assessment (2014). Assessment of losses has been undertaken in accordance with the NSW Framework for Biodiversity Assessment (OEH 2014a), and is detailed in the Biodiversity Assessment Report prepared by Conacher Consulting (2016). Further assessment of gains achieved through offsets is also to be assessed in accordance with this methodology.

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

Offsets are proposed to be targeted to biodiversity values being lost, in accordance with the like-for-like and like-for-like variation rules outlined in the NSW Biodiversity Offsets Policy for Major Projects (OEH 2014b).

Principle 4: Offsets must be additional to other legal requirements.

All offsets associated with the proposal will be additional to existing legal obligations for conservation that are attached to proposed offset lands.

Principle 5: Offsets must be enduring, enforceable and auditable.

Direct offsets delivered for the proposal are to be secured through an enduring, enforceable and auditable Biobanking agreement.

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

Supplementary measures are proposed to be utilised where offsets cannot be secured under a Biobanking agreement and the rules for use of supplementary measures are achieved.

2.3 Details of the Offset Package

The locations of the biodiversity offset sites are proposed to be finalised following project approval. The delivery of offsets for the proposed development is to follow a staged approach. Biodiversity offsets are to be delivered for each stage prior to the clearing of any vegetation within the defined stage area. Biodiversity offsets are to be delivered for each stage prior to the clearing of any habitats within the defined stage area.

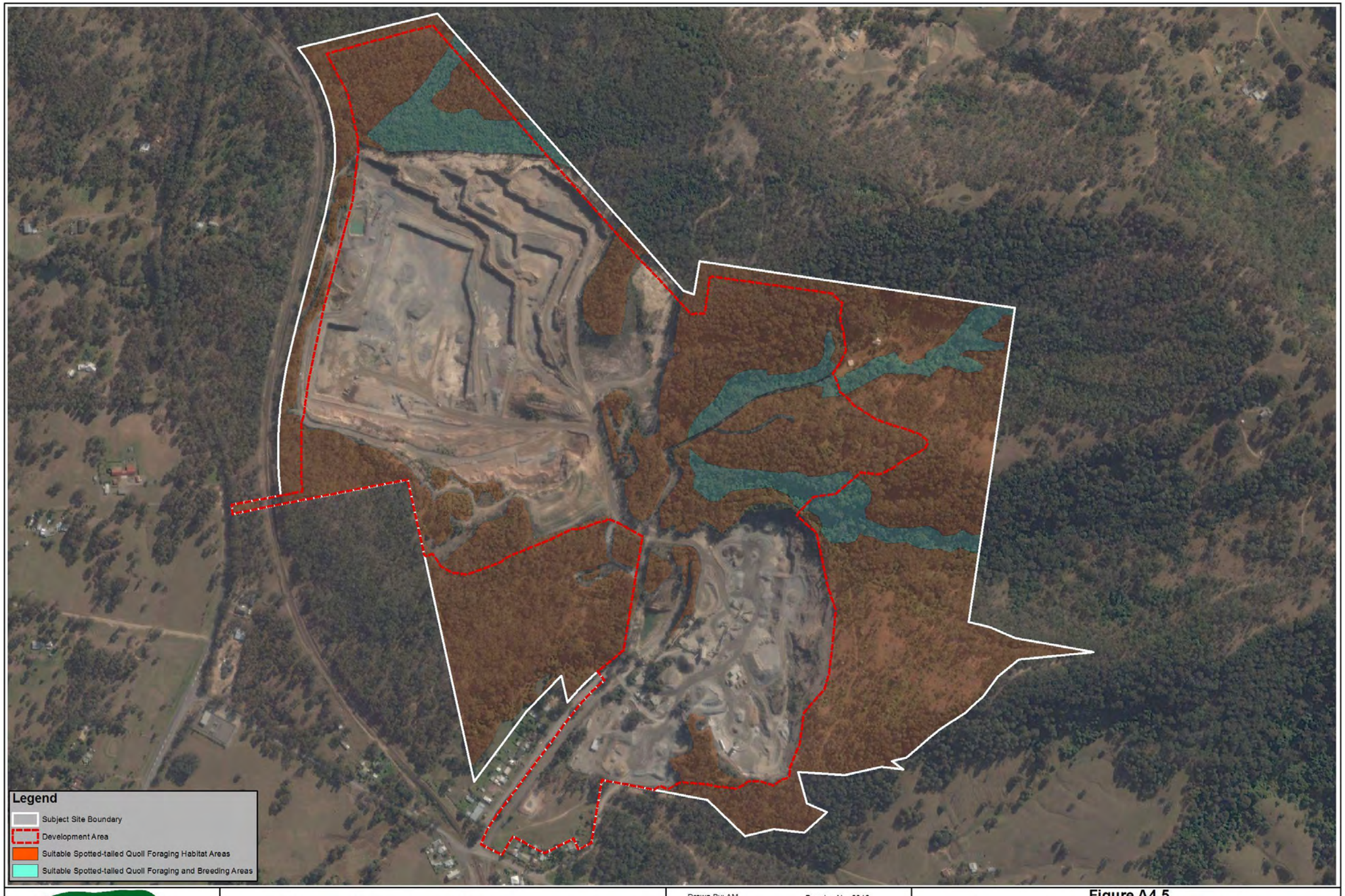

Figure A4.5
Map of Suitable Spotted-tailed Quoll Habitat within Subject Site
Martins Creek

APPENDIX 5
FLORA AND FAUNA MANAGEMENT PLAN

FLORA AND FAUNA MANAGEMENT PLAN

PREPARED FOR
MARTINS CREEK QUARRY

STATION STREET
MARTINS CREEK

AUGUST 2016
REF: 6016

FLORA AND FAUNA MANAGEMENT PLAN

PREPARED FOR
MARTINS CREEK QUARRY

STATION STREET
MARTINS CREEK

AUGUST 2016

Conacher Consulting Pty Ltd

Environmental and Land Management Consultants

PO Box 4082, East Gosford NSW
Phone: 02 4324 7888
conacherconsulting@gmail.com

PREFACE

Conacher Consulting has been engaged to prepare a Flora and Fauna Management Plan for the proposed Martins Creek Quarry Extension Project (Application Number SSD 6612) as part of the Environmental Impact Statement (EIS) documentation for the Project.

PROJECT TEAM

PHILLIP ANTHONY CONACHER B.Sc.(Hons), Dip.Urb Reg Planning, M.Nat.Res.
NPWS Scientific Licence Number: SL100361
Project Director
Conacher Consulting

JACOB MANNERS B.Sc.
NPWS Scientific Licence Number: SL100361
BioBanking Assessor Accreditation Number: 0132
Senior Ecologist / Project Manager
Conacher Consulting

DOCUMENT DETAILS	
Project Name	Martins Creek Quarry Extension Project (SSD 6612)
Our Reference No.	6016
Status	Final Report
Version Number / Date	FV1 / 15 April 2016 (5008)
Previous Versions	NA

TABLE OF CONTENTS

1. INTRODUCTION AND BACKGROUND

1.1 BACKGROUND

Conacher Consulting has been engaged to prepare a Flora and Fauna Management Plan for the proposed Martins Creek Quarry Extension Project (Application Number SSD 6612) as part of the Environmental Impact Statement (EIS) documentation for the Project.

The Biodiversity Assessment Report prepared by Conacher Consulting (2016) was reviewed as part of the preparation of this Management Plan.

1.2 PROPOSED DEVELOPMENT DESCRIPTION

The development assessed in this report is the Martins Creek Quarry Expansion Project. The proposal involves:

- Expanding into new extraction areas and clearing of vegetation;
- Increasing the hours of operation
- Consolidating existing operations and approvals; and
- Rehabilitating the site.

1.3 STUDY AREA DETAILS

The planning and cadastral details of the subject site and study area are provided in Table 1.1.

TABLE 1.1
SITE DETAILS

Subject Site	Lots 2, 5 & 6 DP 242210, Lot 42 DP 815628, Lot 21 DP 773220, Lot 1 DP 1006375 & Lot 1 DP 204377
Subject Site Size	125.5 ha approx.
Study Area (Proposed Impact / Development Area Footprint)	82.8 ha
Local Government Area	Dungog
Major Catchment Area	Hunter – Central Rivers
Existing Land Use	Extractive industries

2. HABITAT CLEARING MANAGEMENT MEASURES

2.1 Pre-clearing

Induction of Personnel
All supervising contractors involved in vegetation clearing works will require an environmental site induction by the project ecologist to in relation to the importance of the correct ecological protocols for site clearing works.

Vegetation and Tree Protection Measures
Trees and vegetation to be retained in close proximity to works areas are to be protected by the erection of temporary fencing in accordance with direction of the project ecologist.

Identification of Fauna Habitats
A search for hollow bearing trees, trees containing nesting fauna is to be undertaken prior to site clearing works. All habitat trees identified are to be marked for further treatment during clearing works.

Fauna Relocation
Prior to site clearing works a search is to be undertaken for sedentary fauna species. Clearing is not to occur until any fauna encountered has been moved out of the clearing area.

Pre-clearing trapping for fauna species is also to be undertaken prior to clearing works, with any fauna captured to be relocated to site areas proposed for retention.

2.2 Clearing

Vegetation and Tree Protection Measures
Clearing works are to be undertaken in a manner which avoids damage to retained vegetation and habitats.

Fauna Protection Protocol
The following procedures are to be observed during all site clearing works:

- Any hollow bearing trees in the areas to be cleared will be identified and marked;
- Marked hollow bearing trees will be left after initial vegetation clearing for a period of at least 24 hours (to encourage any resident fauna to disperse into adjacent uncleared habitat);
- Immediately prior to any clearing a diurnal survey is to be undertaken by the project ecologist to capture and remove ground fauna that have potential to be disturbed by clearing activities.
- After the 24 hour waiting period standing hollow bearing trees may also be felled commencing with the most distant trees from secure habitat;
- A machine is to be used for hollow bearing tree removal. The machine operator will tap the tree with the machine several times in an effort to encourage resident fauna to leave hollows and find refuge elsewhere. The tree will then be nudged over by the machine grabbing the trunk or holding the root bowl in an effort to lower the tree as gently as possible. Once the tree is lowered all hollows will be inspected by the consulting ecologist with the assistance of an arborist if necessary and any resident fauna is to be cared for or released.
- Displaced fauna species will be checked for injury. If fauna is injured during vegetation clearing operations they will be immediately transported to the nearest convenient veterinary hospital for appropriate treatment. If immature fauna species are displaced and a deemed unable to care for themselves then they will be handed over to local wildlife career organizations such as WIRES or Wildlife Arc for care and rehabilitation. If captured, healthy displaced fauna will be released into a nest box temporarily placed on the subject site.

3. REPORTING

3.1 Reporting Requirements

A record of displaced fauna including species and health is to be maintained for compliance reporting purposes. The project ecologist is to provide a monitoring report after the completion of each stage of site clearing which is to be submitted with annual compliance reporting documentation.

REFERENCES

Conacher Consulting (2016) Biodiversity Assessment Report, Martins Creek Quarry, Station Street Martins Creek.

ASSESSMENT OF SIGNIFICANCE

PREPARED FOR
MARTINS CREEK QUARRY EXTENSION PROJECT

STATION STREET
MARTINS CREEK

REF: 6016
MAY 2016

ASSESSMENT OF SIGNIFICANCE

PREPARED FOR
MARTINS CREEK QUARRY EXTENSION PROJECT

STATION STREET
MARTINS CREEK

MAY 2016

Conacher Consulting Pty Ltd

Environmental and Land Management Consultants

PO Box 4082, East Gosford NSW
Phone: 02 4324 7888
conacherconsulting@gmail.com

PREFACE

Conacher Consulting has been engaged to prepare an Assessment of Significance in accordance with Section 5A of the *Environmental Planning and Assessment Act* (1979), for the proposed Martins Creek Quarry Extension Project.

PROJECT TEAM

PHILLIP ANTHONY CONACHER B.Sc.(Hons), Dip.Urb Reg Planning, M.Nat.Res.
NPWS Scientific Licence Number: SL100361
Project Director
Conacher Consulting

JACOB MANNERS B.Sc.
NPWS Scientific Licence Number: SL100361
BioBanking Assessor Accreditation Number: 0132
Senior Ecologist / Project Manager
Conacher Consulting

TABLE OF CONTENTS

SECTION 1

INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

Conacher Consulting has been engaged to prepare an Assessment of Significance in accordance with Section 5A of the *Environmental Planning and Assessment Act* (1979), for the proposed Martins Creek Quarry Extension Project.

The proposed development is State Significant Development under the Environmental Planning and Assessment Act (1979) (Application Number SSD 6612) and the biodiversity assessment requirements for the proposal are set out in the revised Secretary's Environmental Assessment Requirements dated 22 May 2015.

Conacher Consulting has prepared a Biodiversity Assessment Report for the proposed Martins Creek Quarry Extension Project as separate documentation to this report as part of the Environmental Impact Statement (EIS) documentation for the Project. The details of flora and fauna surveys, the biodiversity characteristics of the site and the biodiversity impacts and offset requirements, are assessed and documented in accordance with the Framework for Biodiversity Assessment in the Biodiversity Assessment Report prepared by Conacher Consulting (2016).

1.2 PROPOSED DEVELOPMENT DESCRIPTION

The proposed development is known as the Martins Creek Quarry Expansion Project. The proposal involves:

- Expanding into new extraction areas and clearing of vegetation;
- Increasing the hours of operation
- Consolidating existing operations and approvals; and
- Rehabilitating the site.

Full details of the proposed development are included in the documentation prepared for the project under the provisions of State Significant Development.

1.3 SITE AREA DETAILS

The planning and cadastral details of the study area are provided in Table 1.1.

TABLE 1.1
SITE DETAILS

Site Survey Area	Lots 2, 5 & 6 DP 242210 Lot 42 DP 815628 Lot 21 DP 773220 Lot 1 DP 1006375 Lot 1 DP 204377
Site Size	125 ha approx.
Local Government Area	Dungog
Major Catchment Area	Hunter – Central Rivers
Existing Land Use	Extractive industries

SECTION 2

ASSESSMENT OF SIGNIFICANCE

2.1 SECTION 5A ASSESSMENT OF SIGNIFICANCE

A search of the Bionet Atlas of NSW Wildlife (NSW OEH 2016) was undertaken to identify records of threatened biodiversity within the Upper Hunter IBRA Subregion within which the subject site occurs. Flora and fauna surveys and assessments were also undertaken in accordance with the requirements of the Framework for Biodiversity Assessment (NSW OEH 2014), the results of these are presented in the Biodiversity Assessment Report prepared for the project by Conacher Consulting (2016).

The following Assessment of Significance has been prepared for the threatened species and populations known to occur within the Upper Hunter IBRA Subregion and the endangered ecological communities observed within the subject site.

For the purposes of the following assessments the definitions of specific terminology and interpretations of the key terms used are as per the DECC (2007) Threatened species assessment guidelines. Further clarification is also provided where deemed appropriate.

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,

Context
This factor refers only to those species listed on Part 1 and Part 4 of Schedule 1, Part 1 of Schedule 1A and Part 1 of Schedule 2 of the TSC Act, and Part 1 and Part 4 of Schedule 4 and Schedule 5 of the FM Act.

Interpretation of key terms used in this factor

Life cycle: the series or stages of reproduction, growth, development, ageing and death of an organism.

Viable: the capacity to successfully complete each stage of the life cycle under normal conditions.

Local population: the population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions.

- The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.
- The local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area.
- The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time.

In cases where multiple populations occur in the study area, each population should be assessed separately.

Risk of extinction: the likelihood that the local population will become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the viability of that population.

Application
The key assessment is risk of extinction of the local population. The risk of extinction will increase if any factor operates to reduce population size or reproduction success. The components of the life cycle of a species are dependent on its habitat and affected by threats to the species. The removal or modification of habitat or changes to the nature of important periodic disturbances such as fire or flood may affect the survival of that species. Therefore, it is important that the applicant/proponent not only has an understanding of the species' life cycle, but also an understanding of the way in which a species makes use of its habitat, the way this may change at particular times or in certain seasonal conditions, and whether the life cycle is dependent on a particular disturbance.

Demonstrating that a population is not viable would require considerable effort and study. Therefore any known or presumed local population should be assumed viable unless the contrary can be conclusively demonstrated through analysis of local ecological information, records, references and knowledge of species' behaviour and habitat or through a comprehensive on-site ecological study.

Assessment

Threatened Flora Species

Angophora inopina
This species In open woodland with a dense shrub understorey on deep white sandy soils over sandstone (Harden 1994).

This species was not observed during surveys and it is considered that no suitable habitat for this species is present within the subject site. It is considered that the action proposed is not 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.

Callistemon linearifolius
This species grows in open forest and scrubland in damp places such as gullies on sandstone. This species is easily identifiable when not in flower (Fairley and Moore 1995).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Corybas dowlingii
This species is a tuberous terrestrial orchid which occurs in gullies in tall open forest on well-drained gravely soil. It is known from four localities including Port Stephens, Bulahdelah and Freemans Waterhole (OEH 2016).

This species was not observed during surveys and it is considered that no suitable habitat for this species is present within the subject site. It is considered that the action proposed is not 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.

Cynanchum elegans
This species is a climber which grows to approximately 10m in length, in dry rainforest, littoral rainforest, coastal scrub, *Eucalyptus tereticornis* aligned open forest and woodland; *Corymbia maculata* aligned open forest and woodland and *Melaleuca armillaris* scrub (OEH 2016).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Eucalyptus largeana
This species is a tree which grows to 40m. It has a restricted and local distribution and grows in wet forest on sloping sites in subcoastal ranges within the Gloucester-Craven

district and near Pokolbin NSW (NSW RBG 2016).

This species was not observed during surveys and it is considered that no suitable habitat for this species is present within the subject site. It is considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Eucalyptus glaucina
This species is a tree which grows to approximately 30m in several habitats including shallow soils or stony hillsides (not on poor sandstone), grassy woodland on deep, moderately fertile with moist soils and on gentle slopes near drainage lines in alluvial and clayey soils (Australian Government Department of the Environment 2008).

This species was observed within the subject site during surveys.

Surveys have identified that approximately 2826 specimens of *E. glaucina* are present within the study site over approximately 22 ha. There are additional areas containing *E. glaucina* offsite to the north-east and west of the subject site and study area.

Impacts of the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

Grevillea parviflora subsp. parviflora
This species grows in sandy or light clay soils usually over thin shales. It occurs in a range of vegetation types from open forest and heath to shrubby woodland. It occurs over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests and is often found in open, slightly disturbed sites (NSW NPWS 2002).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Pterostylis chaetophora
This species is a terrestrial orchid which occurs in Queensland and NSW. In NSW it is currently known from 18 scattered locations in a relatively small area between Taree and Kurri Kurri. Its preferred habitat is seasonally moist, dry sclerophyll forest with a grass and shrub understorey (OEH 2016).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Rutidosis heterogama
This species grows in heath in clay soils and has been recorded along disturbed roadsides. The flowering period for this species is from November to February with spot flowers occurring at other times of the year (Harden 1994).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Senna acclinis

This species is a shrub which grows to 3m, in coastal districts and adjacent tablelands of NSW from the Illawarra in NSW to Queensland. Its preferred habitat is within and adjacent to subtropical and dry rainforest (NSW OEH 2016).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Syzygium paniculatum
It is usually found growing in or near rainforests on sandy soils, stabilised dunes near the sea or sheltered gullies, especially near watercourses (Fairly and Moore 1995).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Tetratheca juncea
Tetratheca juncea occurs chiefly in coastal districts in sandy, and occasionally swampy, heath and open forest habitats, particularly those with a southerly aspect. The preferred soil types in descending order are of the Awaba, Warners Bay, Gateshead, Norah Head, Doyalson and Killingworth Soil Landscapes (Ecological Surveys & Management 2000).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Threatened Fauna Species

Red-crowned Toadlet (*Pseudophryne australis*)
This species occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. It inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings and shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters (NSW OEH 2016).

This species was not observed during surveys and it is considered that no suitable habitat for this species is present within the subject site. It is considered that the action proposed is not 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.

Green and Golden Bell Frog (*Litoria aurea*)
The Green and Golden Bell Frog is largely aquatic and is found among vegetation within or at the edges of permanent water. The males call mainly after rain from spring to autumn while afloat among vegetation, usually in larger permanent dams, swamps and lagoons. Breeding often peaks after heavy rains in January to February (NSW NPWS 1999).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Pink-tailed Legless Lizard (*Aprasia parapulchella*)
The Pink-tailed Legless Lizard belongs to a small group of very small worm like, burrowing, legless lizards. The Pink-tailed Legless Lizard is usually found under weathered granite rocks on grazed, grassy riverside slopes where they burrow freely in loose sand and soil, often found in association with the litter below, and the root systems of, arid shrubs. They are sometimes found underground debris and logs, or in ant and termite nests (Cogger

2000).

This species was not observed during surveys and it is considered that no suitable habitat for this species is present within the subject site. It is considered that the action proposed is not 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.

Pale-headed Snake (*Hoplocephalus bitorquatus*)
The Pale-headed Snake is found in a wide variety of habitats, from rainforest or moist hardwood forest to the drier eucalypt forests and open woodland in New South Wales and inland Queensland. The species is usually found beneath loose bark, or in hollow trunks and limbs of dead timber, especially along watercourses (Wilson & Knowles, 1988).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Magpie Goose (*Anseranas semipalmata*)
Magpie Geese inhabit terrestrial wetlands live in shallow swamps and associated grasslands, feeding on seeds or tubers and grasses. They occur across northern Australia and throughout eastern Australia including parts of western NSW. A small colony has established within the Hexham Swamp and Shortland Wetlands at Newcastle. This colony was first established via introduction of birds to the wetland with wild birds joining the colony thereafter (Garnett & Crowley 2000).

This species was not observed during surveys and it is considered that no suitable habitat for this species is present within the subject site. It is considered that the action proposed is not 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.

Wompoo Fruit-dove (*Ptilinopus magnificus*)
The Wompoo Fruit-dove mainly inhabits large undisturbed patches of tall tropical or subtropical evergreen rainforest. It is an obligate frugivore, taking fruits of many species of rainforest trees, palms, vines and epiphytes, feeding mostly in the canopy (Higgins & Davies 1996).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Black-necked Stork (*Ephippiorhynchus asiaticus*)
This species prefers still and permanent, shallow freshwater floodplain habitats including wetlands, swamps, watercourses, farm dams and shallow floodwaters and adjacent areas of grasslands, heathlands, paddocks, and woodlands. This species also forages around estuaries and along intertidal shorelines (Marchant & Higgins 1990).

This species was not observed during surveys and it is considered that no suitable habitat for this species is present within the subject site. It is considered that the action proposed is not 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.

Australasian Bittern (*Botaurus poiciloptilus*)
This species inhabits shallow freshwater and brackish wetlands, ponds and streams, favouring those with tall dense beds of sedges, reeds or rushes (Marchant and Higgins 1990).

This species was not observed during surveys and it is considered that no suitable habitat for this species is present within the subject site. It is considered that the action proposed is

not 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.

Black Bittern (*Ixobrychus flavicollis*)
This species primarily inhabits permanent freshwater and estuarine wetlands, ponds and streams with tall dense vegetation. It also utilises adjacent habitats of flooded grassland, forest, woodland, rainforest and mangroves (Lindsey 1992).

This species was not observed during surveys and it is considered that no suitable habitat for this species is present within the subject site. It is considered that the action proposed is not 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.

Red Goshawk (*Erythrotriorchis radiatus*)
The Red Goshawk occurs over wooded and forested lands of tropical and warm-temperate coastal and sub coastal Australia. This species prefers forest, riverine vegetation and woodland with a mosaic of vegetation types with large population of birds suitable for prey (Marchant & Higgins 1993).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Spotted Harrier (*Circus assimilis*)
Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. Also inhabits agricultural land and forages over open habitats including edges of inland wetlands (Marchant & Higgins 1993).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Little Eagle (*Hieraaetus morphnoides*)
This species forages in a variety of habitats including woodland open forest, partially cleared areas, along watercourses and around wetlands, avoiding large areas of dense forest. This species nests in mature living trees in open forest, woodland and remnant areas including farmland and areas close to urban development (Marchant and Higgins 1993).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Grey Falcon (*Falco hypoleucos*)
The Grey Falcon inhabits semi-arid and arid woodlands. The primary prey of the Grey Falcon is birds with its secondary prey being reptiles and mammals. The Grey Falcon ranges throughout inland drainage systems of open plains and lightly timbered country with watercourses present. The predominant habitat is acacia scrub and spinifex and tussock grasslands of central Australia. Major breeding areas are in the Lake Eyre and Murray-Darling regions (Blakers et al., 1984).

This species was not observed during surveys and it is considered that no suitable habitat for this species is present within the subject site. It is considered that the action proposed is not 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.

Bush Stone-curlew (*Burhinus grallarius*)
The Bush Stone-curlew occurs in open woodland with fallen branches, leaf-litter, sparse

grass, timber along dry watercourses, sand plains with spinifex and mallee, sandy scrub near beaches, mangrove-fringes, country golf courses, timber remnants on roadsides, plantations and urban areas (Marchant and Higgins 1993).

This species was not observed during surveys and it is considered that no suitable habitat for this species is present within the subject site. It is considered that the action proposed is not 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.

Comb-crested Jacana (*Irediparra gallinacea*)

This species inhabits freshwater wetlands, lagoons, billabong, swamps, rivers, generally with abundant floating and emergent vegetation, especially water-lilies. Within NSW this species ranges from Queensland to the Hunter Valley wherever suitable habitat is found. This species is dispersive and moves in response to the condition of wetlands (Marchant & Higgins 1993).

This species was not observed during surveys and it is considered that no suitable habitat for this species is present within the subject site. It is considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Gang-gang Cockatoo (*Callocephalon fimbriatum*)

The Gang-gang Cockatoo is associated with a variety of woodland and forest habitats, and occasionally more open areas in south–eastern New South Wales and Victoria. This species utilises eucalypt forests and exotic trees, and is known to feed on the seeds of native shrubs and trees, in addition to some exotic species such as the Hawthorn and Cupressus species (Higgins 1999).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Glossy Black-Cockatoo (*Calyptorhynchus lathami*)

The Glossy Black-Cockatoo inhabits woodlands and open sclerophyll forests dominated by or with a middle stratum of Allocasuarina. They choose trees with larger cone crops, concentrating foraging in trees with a high ratio of total seed weight to cone weight. They breed in hollow trees or stumps usually in Eucalypts (Higgins 1999).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Swift Parrot (*Lathamus discolor*)

This species feeds mainly on nectar and lerp from eucalypt flowers, particularly Blue Gum (Eucalyptus globulus). On the mainland, the Swift Parrot congregates where winter flowering species such as Yellow Gum, Red Ironbark, Mugga Ironbark, Box Gums and Swamp Gum. This species also occurs within Blackbutt, Forest Red Gum, Swamp Mahogany and Spotted Gum dominated communities along the coast. The Swift Parrot is a migratory species that breeds in Tasmania and its offshore islands in summer. In late March almost the entire population migrates to mainland Australia spreading from Victoria through to central and coastal NSW and south east Queensland (Saunders and Tzaros 2011).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Turquoise Parrot (*Neophema pulchella*)

The Turquoise Parrot is a sedentary species inhabiting the foothills of the Great Divide,

including steep rocky ridges and gullies, rolling hills, valleys and river-flats and nearby plains. This species feeds on the ground on grass seeds usually beneath trees. This species is endemic to eastern Australia, and is known from south-east Queensland through eastern New South Wales to north-east Victoria (Higgins 1999).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Little Lorikeet (*Glossopsitta pusilla*)
Little Lorikeets forage in forests and woodlands from the coast to the western slopes of the Great Dividing Range, from near Cooktown to the south-eastern South Australia. Little Lorikeets are gregarious, usually foraging in small flocks, often with other species of lorikeet. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including, melaleucas and mistletoes (Courtney & Debus 2006).

Two Little Lorikeets (*Glossopsitta pusilla*) were observed flying over the survey area during diurnal fauna surveys undertaken on 20 August 2014. This species has not been recorded foraging or breeding within the subject site.

This species is a nomadic fauna species and the local population comprises those individuals that are likely to occur in the survey area from time to time.

It is considered that suitable foraging habitat for this species is present on the subject site and comprises of the following:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley (18.7 ha)
- Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter (6.3 hectares)
- Slaty Red Gum grassy woodland on the hinterland of the southern North Coast (22 hectares)
- Whalebone Tree – Red Kamala dry subtropical rainforest of the lower Hunter River (8.1 hectares)

The proposal will result in the removal of approximately 32.5 hectares of suitable habitat for this species. Approximately 22.6 hectares of suitable habitat for this species will be retained within the subject site.

The proposed action will result in the removal of an estimated 1562 *Eucalyptus glaucina* trees over approximately 12.2 hectares of habitat.

Impacts ot the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

Barking Owl (*Ninox connivens*)
The Barking Owl utilises dry sclerophyll forests and woodlands of tropical, temperate and semi-arid zones, particularly those associated with watercourses, wetlands and forest edges. Nests in large hollows in live eucalypts, often near open country (Higgins 1999).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Powerful Owl (*Ninox strenua*)
The Powerful Owl breeds in open or closed sclerophyll forests and woodlands, including wet sclerophyll forest and dry sclerophyll forest and woodlands. They nest in hollows in large old trees; usually living Eucalyptus, within or below canopy in stumps or broken-off trunks. Powerful Owls are sedentary within home ranges of about 1,000 hectares within open eucalypt, casuarina or Callitris pine forest and woodlands, though they often roost in denser vegetation, including rainforest or exotic pine plantations. Powerful Owls feed mainly on medium-sized arboreal marsupials (Higgins 1999).

A likely roost site of the Powerful Owl was observed during diurnal surveys on 20 August 2015, in the canopy of a large rainforest tree. Below the tree, remnants of a Brush Turkey kill were observed with a small amount of whitewash. It is considered that the roost site is only occasionally used as this species was not observed at this location during site visits.

This species was also heard calling during nocturnal surveys on 17 September 2015 to the south-west of the development area.

The suitable habitat for this species within the subject site comprises of the following:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley (18.7 ha)
- Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter (6.3 hectares)
- Slaty Red Gum grassy woodland on the hinterland of the southern North Coast (22 hectares)
- Whalebone Tree – Red Kamala dry subtropical rainforest of the lower Hunter River (8.1 hectares)

The proposal will result in the removal of approximately 32.5 hectares of suitable habitat for this species. Approximately 22.6 hectares of suitable habitat for this species will be retained within the subject site.

Impacts of the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

Masked Owl (*Tyto novaehollandiae*)
The Masked Owl is widespread through forests and woodlands. The Masked Owl is known to utilise forest margins and isolated stands of trees within agricultural land. This species is often found in heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained. The Masked Owl is dependent upon hollow bearing trees all year round requiring old mature trees with large hollows for breeding and as diurnal roosting sites (Higgins 1999).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Sooty Owl (*Tyto tenebricosa*)
The Sooty Owls habitat is often tall old-growth montane forests, including temperate and subtropical rainforest. This species occurs mostly in uplands in gullies and on slopes of valleys but rarely on ridges. Optimal habitat contains tall eucalypts with large hollows suitable for nesting and roosting, but also a range of hollows that provide shelter for prey.

The same nest is used repeatedly, and the owls also roost and occasionally nest in caves. The Sooty Owl preys on arboreal and terrestrial mammals and occasionally birds (Higgins 1999).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Brown Treecreeper (*Climacteris picumnus victoriae*)
This species inhabits eucalypt woodlands and dry open forest of the inland slopes and plains, inland of the Great Dividing Range and less commonly on the coastal ranges and plains. Suitable woodland habitat is dominated by stringy-bark or rough-barked eucalypts, usually with an open grassy understorey and the presence of fallen timber. It is also found in River Red Gum (E. camaldulensis) Forest bordering wetlands with an open understorey. It is generally absent from woodlands with a dense shrub layer and requires hollows for nesting (Higgins et al., 2001).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Speckled Warbler (*Pyrrholaemus sagittata*)
Speckled Warblers inhabit mainly the grassy ground layer of dry sclerophyll forests and woodlands, often with scattered shrubs in the understorey. This species is mainly insectivorous but will also take seeds and other plant material. They are sedentary with no migratory or seasonal movements known. They nest solitary with large exclusive breeding territories, the boundaries of which change little over successive years. They breed most of the year round with a peak from September to November (Higgins & Peters 2002).

The Speckled Warbler was observed within the subject site during previous surveys during 2007. This species was not observed during several surveys undertaken by Conacher Consulting between 2014 and 2016.

It is considered that suitable foraging habitat for this species is present on the subject site and comprises of the following:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley (18.7 ha)
- Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter (6.3 hectares)
- Slaty Red Gum grassy woodland on the hinterland of the southern North Coast (22 hectares)

The proposal will result in the removal of approximately 27.6 hectares of suitable habitat for this species. Approximately 19.4 hectares of suitable habitat for this species will be retained within the subject site.

Impacts of the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

Regent Honeyeater (*Xanthomyza phrygia*)
The Regent Honeyeater inhabits mostly dry eucalypt woodlands and forests dominated by box ironbark eucalypts; on inland slopes of Great Divide, especially associations in moister

more fertile sites, along creeks, broad river valleys and on lower slopes of foothills. Nectar is the principle food but sugary exudates from insects are also used. The Regent Honeyeater is known to breed along the western Slopes of the Great Dividing Range in New South Wales (Higgins *et al*., 2001).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

White-fronted Chat (*Epthianura albifrons*)
The White-fronted Chat inhabits damp habitats near both saltwater and freshwater wetlands, in saltmarsh, surrounding grassland, amoung reeds and rushes, and shrubs. This species has also been recorded in sand-dune vegetation and on sandy beaches and at the edges of mangroves (Higgins *et al*., 2001).

This species was not observed during surveys and it is considered that no suitable habitat for this species is present within the subject site. It is considered that the action proposed is not 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.

Black-chinned Honeyeater (*Melithreptus gularis spp. gularis*)
This species inhabits forest and woodland habitats particularly those containing box and ironbark and red gum eucalypts and River Red Gum (Higgins *et al*., 2001).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)
The Grey-crowned Babbler occupies open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs and an intact groundcover of grass and forbs. This species forages in leaf litter and on the bark of trees. The whole group roosts each night in a dormitory nest (Higgins and Peter 2002).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Varied Sittella (*Daphoenositta chrysoptera*)
This species inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland (Higgins & Peter 2002).

Three Varied Sittellas were observed foraging within the survey area during diurnal fauna surveys undertaken on 17 September 2015.

It is considered that suitable foraging habitat for this species is present on the subject site and comprises of the following:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley (18.7 ha)
- Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter (6.3 hectares)
- Slaty Red Gum grassy woodland on the hinterland of the southern North Coast (22 hectares)

The proposal will result in the removal of approximately 27.6 hectares of suitable habitat for

this species. Approximately 19.4 hectares of suitable habitat for this species will be retained within the subject site.

Impacts of the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

Olive Whistler (*Pachycephala olivacea*)
The preferred habitat of this species is tall wet forests, woodlands and alpine heaths. In NSW it has a disjunct distribution (OEH 2016).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Hooded Robin (*Melanodryas cucullata*)
The Hooded Robin occupies drier eucalypt forest, woodland and scrub, grasses and low shrubs, as well as cleared paddocks with regrowth or stumps. In most areas it is considered to be sedentary, and territorial pairs may be found in the same locality for several years. The size of territories throughout Australia has been estimated at between 5 to 50 hectares (Higgins and Peter 2002).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Scarlet Robin (*Petroica boodang*)
This species inhabits mainly dry eucalypt forest and woodlands with open shrubby and grassy understorey on ridges and slopes during the spring-summer breeding season, dispersing during autumn–winter into open habitats including urban areas (Higgins and Peter 2002).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Flame Robin (*Petroica phoenicea*)
This species inhabits upland wet to moist eucalypt forests and woodlands with an open understorey, often on ridges and slopes to 1800m above sea level during the spring-summer breeding season. During the autumn to winter non breeding season this species disperses to open lowland habitats including grasslands, farmland dry sclerophyll forests and woodlands (Higgins and Peter 2002).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Diamond Firetail (*Stagonopleura guttata*)
The Diamond Firetail inhabits grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands, open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities. This species is also often found in riparian areas, and sometimes in lightly wooded farmland (Higgins et al.,

2006).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Spotted-tailed Quoll (*Dasyurus maculatus*)
The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry open forest and rainforest. It appears to prefer moist forest types and riparian habitat. It has been recorded from dry sclerophyll forest, open woodland and coastal heathland, and despite its occurrence in inland riparian areas, it also ranges over dry ridges (NSW NPWS 1999).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Brush-tailed Phascogale (*Phascogale tapoatafa*)
Brush-tailed Phascogale (Phascogale tapoatafa)
The preferred habitat of the Brush-tailed Phascogale is Dry Sclerophyll Forest with sparse understorey cover. It may also utilise heath, swamp forest, rainforest and wet sclerophyll forest vegetation (OEH 2016).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Koala (*Phascolarctos cinereus*)
Koalas inhabit forested areas with acceptable Eucalypt food trees, also utilising some other non-Eucalypt species as a food source. Koalas inhabit both wet and dry eucalypt forests that contain a canopy cover of between 10 and 70% as well as suitable feed trees (Reed et al., 1991).

One Koala was observed during the spotlighting survey undertaken on 20 August 2014 on the top of the hill in the eastern portion of the survey area. A male Koala was detected during call recording surveys on the 6th, 7th, 9th and 10th September within the vicinity of the initial spotlighting observation location.

A Koala was observed during the spotlighting survey undertaken on 18 and 19 February 2015 to the west of the detention basin and western alternate access road.

A Koala was heard calling from the forested area within the northern section of the site during a spotlighting survey undertaken on 19 February 2015.

The Koala was observed in all habitat areas with the exception of the rainforest habitats and the portion of the Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast vegetation community which was in mod-good/low condition. It is considered that this species is not likely to utlise the rainforest habitats due to the lack of preferred feed trees. It is also considered that Koalas are not likely to utlise the Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast vegetation community which in mod-good/low condition due to the presence of a dense understorey of lantana.

No Koala scats were observed during the koala spot assessment surveys and the Koala activity level as determined through the scat spot assessment, corresponded to the low category.

The proposal will result in the removal of 26.9 hectares of suitable habitat for this species and the retention of 19.4 hectares of suitable habitat for this species.

Impacts of the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

Eastern Pygmy Possum (*Cercartetus nanus*)
The Eastern Pygmy-possum is found from rainforest through sclerophyll forest to tree heath. Banksia and myrtaceous shrubs and trees are favoured. Eastern Pygmy-possums usually shelter alone in tree cavities, rotten stumps, holes in the ground, disused bird nests and possum dreys and in vegetation thickets. The home ranges of males, about 0.65 hectares are larger than those of females, about 0.35 hectares and not exclusive with home ranges broadly overlapping. Apart from females with young in the nest, individuals may utilise a number of nest sites within the home range (Turner & Ward 1995).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Yellow-bellied Glider (*Petaurus australis*)
The Yellow-bellied Glider is an arboreal tree-dwelling mammal. The Yellow-bellied Glider is restricted to tall mature eucalypt forests found within high rainfall regions of temperate through to sub-tropical eastern Australia. The bulk of the diet of the Yellow-bellied Glider consists of plant and insect exudates including sap, nectar, honeydew and manna while arthropods and pollen are also eaten. Yellow-bellied Gliders occupy home ranges between 30 and 65 hectares in size (Goldingay & Kavanagh 1991).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Squirrel Glider (*Petaurus norfolcensis*)
The Squirrel Glider inhabits dry sclerophyll forest and woodland nesting in small tree hollows. The presence of mature, hollow-bearing eucalypts is a critical characteristic of habitat occupied by Squirrel Gliders as they are utilised for nesting and breeding (Suckling, 1995).

A Squirrel Glider was observed by spotlight leaving a tree hollow during surveys undertaken on 19 February 2015 in the southern section of the site. The Squirrel Glider was also detected during infrared baited camera surveys in the western section of the site.

The suitable habitat for this species within the subject site comprises of the following:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley (18.7 ha)
- Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter (6.3 hectares)
- Slaty Red Gum grassy woodland on the hinterland of the southern North Coast (22 hectares)
- Whalebone Tree – Red Kamala dry subtropical rainforest of the lower Hunter River (8.1 hectares)

The proposal will result in the removal of approximately 32.5 hectares of suitable habitat for this species. Approximately 22.6 hectares of suitable habitat for this species will be retained within the subject site.

Impacts of the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

Long-nosed Potoroo (*Potorus tridactylus*)
The Long-nosed Potoroo occupies a wide range of habitats, from heath to dry and moist hardwood forests. It requires thick groundcover and may be commoner on light sandy soils. Home ranges have been found to vary considerably, from 1.5 to 19 hectares, and may depend upon suitable habitat availability (Seebeck et al., 1989).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Parma Wallaby (*Macropus parma*)
This species inhabits wet sclerophyll forest and forages on the edges of grassy clearings. Shelters in dense vegetation cover (Menkhorst and Knight 2001).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*)
In NSW the Eastern Chestnut Mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps (NSW OEH 2016).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Grey-headed Flying-fox (*Pteropus poliocephalus*)
Grey-headed Flying-foxes roost in camps during the day, which may contain tens of thousands of individuals, and then disperse to surrounding areas to forage at night. This species inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and urbanised and agricultural areas. Camps are commonly formed in gullies, typically not far from water and usually in vegetation with a dense canopy. Camps may also be formed in urban parkland areas (Tidemann 1995).

Two Grey-headed Flying-foxes were observed foraging within the central area of the site during nocturnal surveys on 17 September 2015. No Grey-headed Flying-fox roost or camp sites were observed within the subject site during surveys.

The suitable habitat for this species within the subject site comprises of the following:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley (18.7 ha)
- Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter (6.3 hectares)
- Slaty Red Gum grassy woodland on the hinterland of the southern North Coast (22 hectares)
- Whalebone Tree – Red Kamala dry subtropical rainforest of the lower Hunter River (8.1 hectares)

The proposal will result in the removal of approximately 32.5 hectares of suitable habitat for this species. Approximately 22.6 hectares of suitable habitat for this species will be retained within the subject site.

Impacts of the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)
The Yellow-bellied Sheathtail-bat inhabits a wide variety of habitats from wet and dry sclerophyll forest, to open woodland, shrubland, mallee, grassland and desert. They fly fast and straight usually over the canopy, and lower over open spaces and at forest edges. This species roosts in large tree hollows (Churchill 2008).

This species was observed within the subject site during previous surveys, however was not observed during current surveys undertaken by Conacher Consulting.

The suitable habitat for this species within the subject site comprises of the following:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley (18.7 ha)
- Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter (6.3 hectares)
- Slaty Red Gum grassy woodland on the hinterland of the southern North Coast (22 hectares)
- Whalebone Tree – Red Kamala dry subtropical rainforest of the lower Hunter River (8.1 hectares)

The proposal will result in the removal of approximately 32.5 hectares of suitable habitat for this species. Approximately 22.6 hectares of suitable habitat for this species will be retained within the subject site.

Impacts of the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

Eastern Freetail Bat (*Mormopterus norfolkensis*)
The Eastern Freetail-bat utilises dry eucalypt forest and woodland on the coastal side of the Great Dividing Range. They show a preference for open spaces in woodland or forest, and are more active in the upper slopes of forest areas rather than in riparian zones. They also forage over large waterways. This species roosts in hollow trees (usually in hollow spouts), under exfoliating bark and in various man-made structures (Churchill 2008).

This species was observed within the subject site during previous surveys, however was not observed during current surveys undertaken by Conacher Consulting.

The suitable habitat for this species within the subject site comprises of the following:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley (18.7 ha)
- Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and

lower hunter (6.3 hectares)
- Slaty Red Gum grassy woodland on the hinterland of the southern North Coast (22 hectares)
- Whalebone Tree – Red Kamala dry subtropical rainforest of the lower Hunter River (8.1 hectares)

The proposal will result in the removal of approximately 32.5 hectares of suitable habitat for this species. Approximately 22.6 hectares of suitable habitat for this species will be retained within the subject site.

Impacts of the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

Large-eared Pied Bat (*Chalinolobus dwyeri*)
In the Sydney Basin this species is most commonly recorded in areas of high fertility soils in wet sclerophyll forest along the edges of sandstone escarpments. This species is also recorded in dry sclerophyll forest and woodlands, sub-alpine woodland, at the edges of rainforest, Callitris forest and within sandstone outcrop country. Large-eared Pied Bats roost in clusters in fairy martin nests and on the ceilings of caves, crevices in cliffs and mines in twilight areas (Churchill 2008).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
The Eastern False Pipistrelle inhabits wet sclerophyll forest, open forest, rainforest and coastal mallee. They generally prefer tall and wet forests where the trees are more than 20 metres high and the understorey is dense. This species predominantly roosts in hollow trunks of eucalypts, however have also been reported to roost in caves and old buildings (Churchill 2008).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not 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.

Golden Tipped Bat (*Kerivoula papuensis*).
This species forages on small spiders within rainforests and moist gully habitats and adjacent upper slope eucalypt forests. They roost in tree hollows, beneath clumps of hanging moss, and in hanging abandoned dome-shaped nests of the Brown Gerygone and Yellow-throated Scrubwern in rainforests and gully lines (Law and Chidel 2004).

It is considered that suitable habitat for this species is present on the subject site, however this species was not observed within the subject site during surveys. It is considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Little Bentwing-bat (*Miniopterus australis*)
The Little Bentwing-bat forages below the canopy within well-timbered areas including rainforest, vine thicket, wet and dry melaleuca swamps and coastal forests. This species is a cave dweller with individuals congregating during the summer months in maternity colonies and disperse during the winter. Other roost sites used by this species include abandoned mines, tunnels, stormwater drains and occasionally in buildings, banana trees

and tree hollows (Churchill 2008).

This species was observed within the subject site during previous surveys, however was not observed during current surveys undertaken by Conacher Consulting.

The suitable habitat for this species within the subject site comprises of the following:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley (18.7 ha)
- Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter (6.3 hectares)
- Slaty Red Gum grassy woodland on the hinterland of the southern North Coast (22 hectares)
- Whalebone Tree – Red Kamala dry subtropical rainforest of the lower Hunter River (8.1 hectares)

The proposal will result in the removal of approximately 32.5 hectares of suitable habitat for this species. Approximately 22.6 hectares of suitable habitat for this species will be retained within the subject site.

Impacts of the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)
Preferred habitats for this species include rainforest, wet and dry sclerophyll forest, open woodland, Melaleuca forests and open grassland. The Eastern Bentwing-bat forages high in forested areas from just above canopy height to many times canopy height. In more open areas such as grasslands, flight may be within a few metres of the ground. Eastern Bentwing-bats are cave dwellers, but will also roost in man-made structures such as road culverts and mines (Churchill 2008).

One male and one female Eastern Bentwing-bat were captured in a harp trap on 18 February 2015 within the creekline along the road to the old house.

The suitable habitat for this species within the subject site comprises of the following:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley (18.7 ha)
- Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter (6.3 hectares)
- Slaty Red Gum grassy woodland on the hinterland of the southern North Coast (22 hectares)
- Whalebone Tree – Red Kamala dry subtropical rainforest of the lower Hunter River (8.1 hectares)

The proposal will result in the removal of approximately 32.5 hectares of suitable habitat for this species. Approximately 22.6 hectares of suitable habitat for this species will be retained within the subject site.

Impacts of the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

Southern Myotis (*Myotis macropus*)
The Large-footed Myotis has a strong association with streams and permanent waterways, most commonly within vegetated areas at lower elevations and in flat undulating country. This species forages over water for small insects, fish and invertebrates and have a preference for large pools rather than flowing streams. Roost habitats for this species are near water and include caves, tree hollows, abandoned fairy martin nests, among vegetation, in clumps of Pandanus, and man-made structures including under bridges, in mines, tunnels, road culverts and stormwater drains (Churchill 2008).

Three female Southern Myotis bats were captured in a harp trap on 18 February 2015 within the creek line north of the quarry pit.

The suitable habitat for this species within the subject site comprises of the following:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley (18.7 ha)
- Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter (6.3 hectares)
- Slaty Red Gum grassy woodland on the hinterland of the southern North Coast (22 hectares)
- Whalebone Tree – Red Kamala dry subtropical rainforest of the lower Hunter River (8.1 hectares)

The proposal will result in the removal of approximately 32.5 hectares of suitable habitat for this species. Approximately 22.6 hectares of suitable habitat for this species will be retained within the subject site.

Impacts of the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

Greater Broad-nosed Bat (*Scoteanax rueppellii*)
A wide variety of habitats are utilised by this species including moist gullies in mature coastal forest, rainforest, open woodland, Melaleuca swamp woodland, wet and dry sclerophyll forest, cleared areas with remnant trees and tree-lined creeks in open areas. The Greater Broad-nosed Bat forages about 5m from the edge of isolated trees, forest remnants or along forest crowns with a slow direct flight pattern. This species is known to roost in tree hollows, cracks and fissures in trunks and dead branches, under exfoliating bark, as well as in man-made structures including roofs of old buildings (Churchill 2008).

This species was observed within the subject site during previous surveys, however was not observed during current surveys undertaken by Conacher Consulting.

The suitable habitat for this species within the subject site comprises of the following:

- White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley (18.7 ha)
- Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter (6.3 hectares)
- Slaty Red Gum grassy woodland on the hinterland of the southern North Coast (22 hectares)
- Whalebone Tree – Red Kamala dry subtropical rainforest of the lower Hunter River (8.1 hectares)

The proposal will result in the removal of approximately 32.5 hectares of suitable habitat for this species. Approximately 22.6 hectares of suitable habitat for this species will be retained within the subject site.

Impacts of the proposed development on this species will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

It is considered that the action proposed is not 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.

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,

Context
This factor is essentially identical to factor (a) except that it refers only to endangered populations listed in Part 2 of Schedule 1 of the TSC Act and Part 2 of Schedule 4 of the FM Act, whereas factor (a) refers to species.

The key assessment is risk of extinction of the local population. The risk of extinction will increase if any factor operates to reduce population size or reproduction success. The components of the life cycle of the individuals that comprise an endangered population of a species are dependent on its habitat and threats to the population. The removal or modification of habitat or changes to the nature of important periodic disturbances such as fire or flood may affect the survival of that population. Therefore, it is important that the applicant/proponent not only has an understanding of the life cycles of the species involved, but also an understanding of the way in which a species makes use of its habitat, the way this may change at particular times or in certain seasonal conditions, and whether the life cycle is dependent on particular disturbances.

Demonstrating that a population is not viable would require considerable effort and study. Therefore any known or presumed local population should be assumed to be viable unless the contrary can be conclusively demonstrated through analysis of local ecological information, records, references and knowledge of species' behaviour and habitat, or through a comprehensive on-site ecological study.

Assessment
The endangered populations known from the Upper Hunter IBRA Sub-region are:

- *Acacia pendula* population in the Hunter catchment
- *Eucalyptus camaldulensis* population in the Hunter catchment
- *Cymbidium canaliculatum* population in the Hunter Catchment

No endangered flora or fauna populations were observed within the subject site. Therefore the proposed action is not likely to have an adverse effect on any endangered populations.

c) In the case of a critically endangered or endangered ecological community, whether the action proposed:

Context
This factor applies to endangered ecological communities listed under Part 3 of Schedule 1 of the *TSC Act* and Part 3 of Schedule 4 of the *FM Act*, and critically endangered ecological communities listed under Part 2 of Schedule 1A of the *TSC Act* and Part 2 of Schedule 4A of the *FM Act*. Endangered and critically endangered ecological communities are defined in determinations made by the respective Scientific Committees.

It is important to note that the size or age of a remnant are not determining factors as to whether that remnant constitutes a listed endangered or critically endangered ecological community.

Ecological communities are usually defined by two major components – the geographical distribution and the species composition which influences the physical structure and ecological function of the ecological community. The relative importance of the geographical distribution and the species composition varies according to the specific listed ecological community. Hence this factor provides for consideration of two criteria:
(i) local occurrence of the ecological community
(ii) modification of the ecological community's composition.

Interpretation of key terms used in this factor
Local occurrence: the ecological community that occurs within the study area. However the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.

Risk of extinction: similar to the meaning set out in factor (a), this is the likelihood that the local occurrence of the ecological community will become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the ecological community, and includes changes to ecological function.

Composition: both the plant and animal species present, and the physical structure of the ecological community. Note that while many ecological communities are identified primarily by their vascular plant composition, an ecological community consists of all plants and animals as defined under the TSC and FM Acts that occur in that ecological community.

Application
Determining the risk of extinction of an ecological community is difficult. Critical thresholds of remnant size, and species and structural composition required to maintain ecological functioning will vary from ecological community to ecological community. When evaluating the significance of the impact, consideration must be given to whether the life cycles of the species which make up the ecological community will be disrupted in a similar manner to the consideration of individual species described in factor (a). Disproportionate impacts may occur on certain components of the community that may cause those components to be placed at a greater risk of extinction without explicitly placing the entire ecological community at risk. Loss of individual species from a community may simplify faunal, floristic or vegetation structure and have flow-on effects to other plant and animal species. This may increase its susceptibility to extreme events and decrease its resilience. An assessment of ecological functioning is critical to this factor.

Assessment

The Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter plant community type observed within the subject site does not correspond to the Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin endangered ecological community (EEC) currently listed within the *TSC Act* (1995).

The Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter plant community type does correspond to the NSW Scientific Committee Preliminary Determination to list Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions as an Endangered Ecological Community.

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

Approximately 6.3 hectares of the Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter plant community type are present within the subject site.

The proposal will reduce the extent of the Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter plant community type within the site by approximately 3.7 hectares. This impact is proposed to be offset in accordance with the NSW

Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

The local occurrence of Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter vegetation also occurs over approximately 2.6 hectares of lands proposed for retention within the site, and adjoining areas offsite. The proposal is not likely to have an adverse effect on the extent of these retained areas.

It is considered that the proposal is not 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.

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

Approximately 6.3 hectares of the Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter plant community type are present within the subject site.

The proposal will reduce the extent of the Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter present by approximately 3.7 hectares. This impact will be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

The local occurrence of Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter vegetation also occurs over approximately 2.6 hectares of lands proposed for retention within the site, and adjoining areas offsite. The proposal is not likely to substantially and adversely modify the composition of the remaining local occurrence of Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter vegetation.

It is considered that the proposal is not likely to substantially and adversely modify the composition such that its local occurrence is likely to be placed at risk of extinction.

d) In relation to the habitat of threatened species, populations or ecological community:

Interpretation of key terms used in this factor

Habitat: the area occupied, or periodically or occasionally occupied, by any threatened species, population or ecological community and includes all the different aspects (both biotic and abiotic) used by species during the different stages of their life cycles.

Extent: the physical area removed and/or to the compositional components of the habitat and the degree to which each is affected.

Importance: related to the stages of the species' life cycles and how reproductive success may be affected.

Locality: the same meaning as ascribed to local population of a species or local occurrence of an ecological community.

Application
When applying this factor, consideration must be given to all short- and long-term impacts (direct and indirect) on habitat which are likely to support threatened species, populations and ecological communities regardless of whether the habitat occurs on the subject site. This applies to both occupied and unoccupied habitat because the recovery of threatened species, populations and ecological communities relies on them having access to suitable habitat to move into as numbers increase.

The extent to which habitat is likely to be removed or modified should be determined by estimating the total area of habitat to be directly and indirectly impacted by the proposed development, activity or

action. This may be an estimation of the surface area of land to be affected, and/or in some cases the number of key habitat components to be affected.

When deciding whether an area of habitat is likely to become fragmented or isolated from other areas of habitat, it is necessary to identify and assess the patterns and extent of habitat connectivity. The affected habitat may form part of a habitat corridor, cul-de-sac or an isolated area. Recent Landsat imagery, aerial photographs, vegetation maps, topographic maps and data obtained from on-ground investigations are useful information sources for assessing this. The dispersal and genetic exchange mechanisms of individual species should be considered. For example, will the isolation of habitat for threatened species, populations or ecological communities that are currently connected or near to each other adversely affect the maintenance of gene flow and the ability to sustain viable populations. It should also be noted that isolation can occur through a variety of habitat modifications and is not confined to the clearing of vegetation.

When assessing the importance of the habitat likely to be removed, modified, fragmented or isolated in the locality, a quantitative and qualitative approach should be adopted as follows:

- an assessment of the area and quality of habitat of the threatened species, population or ecological community that occurs within the locality from recent Landsat imagery, vegetation mapping, topographic maps, air photos and in some cases data obtained from on-ground investigations
- an estimate of the area and quality that the habitat of the study area represents in relation to the area and quality of that habitat within the locality
- an assessment of the role of the habitat to be affected in sustaining habitat connectivity in the locality
- an assessment of the ecological integrity of the habitat to be affected in the study area, in relation to the ecological integrity, tenure and security of the habitat which will remain both in the study area and in the locality.

Assessment

i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The extent of proposed habitat removal and modification for vegetated areas is provided in Table 1.1.

TABLE 1.1
EXTENT OF HABITAT REMOVAL AND MODIFICATION

Plant Community Type	Extent within the Subject Allotments	Extent Proposed for Removal or Modification	Extent Proposed Retention
White Mahogany – Spotted Gum – Grey Myrtle semi mesic shrubby open forest of the central and lower Hunter Valley	18.7	11.7	7
Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter	6.3	3.7	2.6
Slaty Red Gum grassy woodland on the hinterland of the southern North Coast	22	12.2	9.8
Whalebone Tree – Red Kamala dry subtropical rainforest of the lower Hunter River	8.1	4.9	3.2
Total	55.1	32.5	22.6

In addition there are approximately 67.3 hectares of Cleared Land within the subject allotments, of which 56.1 hectares is located within the development footprint.

ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The connectivity width before development is >100m-500m and the connectivity score after development is >0m-5m with woody vegetation over storey and mid storey/ground cover projected foliage cover at benchmark before development and no cover present after development.

The proposal is likely to result in the further fragmentation and isolation of habitats currently located between the North Coast Railway and western side of the existing quarry operations. This area of habitat is already isolated to the west by the North Coast Railway and by clearing along the existing haul road through the site. It is considered that the further isolation of this habitat area is not likely to adversely affect the maintenance of gene flow or its ability to sustain viable populations.

iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

- ***Assessment of the area and quality of habitat of the threatened species and ecological communities that occurs within the locality***

Assessment of recent air photos has identified that the patch size of adjoining habitat within the locality is approximately 7900 ha. This area is likely to contain habitat for the threatened fauna species observed during surveys. Habitats which correspond to the preliminary determination for the Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions EEC and habitats which contain *Eucalyptus glaucina* are likely to be substantially more restricted.

The condition of the habitat in the locality is variable, however most habitats are estimated to be in similar condition to those present within the site.

- ***Estimate of the area and quality that the habitat of the study area represents in relation to the area and quality of that habitat within the locality***

The proposed development area contains approximately 32.5 hectares of habitats for threatened fauna species, 12.2 hectares of habitat for the threatened flora species *Eucalyptus glaucina* and 3.7 hectares of Spotted Gum – Narrow-leaved Ironbark shrub – grass open forest of the central and lower hunter, which corresponds to a preliminary determination for listing as the Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions EEC.

Assessment of recent air photos has identified that the patch size of adjoining habitat within the locality is approximately 7900 ha. The condition of the habitat in the locality is variable, however most habitats are estimated to be in similar condition to those present within the site.

The native vegetation extent for the outer assessment circle is 36-40% (1114 ha) before development and 36-40% (1081.7 ha) after development. The native vegetation extent for the inner assessment circle is 56-60% (181 ha) before development and 46-50% (148.6 ha) after development.

- ***Assessment of the role of the habitat to be affected in sustaining habitat connectivity in the locality***

The habitats within the site to be removed are considered not likely to be of high importance for sustaining habitat connectivity in the locality, due to the isolation which has already been created by the existing quarry site, associated haul road and construction and operation of the North Coast Railway.

- ***Assessment of the ecological integrity of the habitat to be affected in the study area in relation to the ecological integrity, tenure and security of the habitat which will remain both in the study area and in the locality.***

A desktop assessment has identified that the ecological integrity of the habitat to be affected in the study area is similar to the ecological integrity of the habitats present within the study area and locality which will remain after development. The habitats present within the study area and locality which will remain following development are considered to mostly consist of vacant land or lands utilised for rural-residential purposes under private tenure.

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

Application

This factor is aimed at assessing whether the proposal is likely to affect (directly or indirectly) areas of critical habitat present in the study area. Critical habitat refers only to those areas of land listed on the appropriate Critical Habitat Registers.

Assessment

The subject site has not been classed as critical habitat within the provisions of the *Threatened Species Conservation Act* (1995). Therefore it is considered that the proposed action will not have an adverse effect on critical habitat (either directly or indirectly).

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Application

When deciding whether the proposal is consistent with the objectives or actions of a recovery plan or threat abatement plan, applicants/proponents must consider all relevant approved recovery plans and threat abatement plans. In addition, it is recommended that they refer to draft recovery plans and draft threat abatement plans, and threatened species profiles and related guidelines, which are available through the OEH and DPI websites.

In applying this factor, consideration should be given to measures outlined in the priorities action statements as well as existing recovery plans and threat abatement plans which will remain in place.

Assessment

Recovery Plans

Recovery plans have been prepared for the following species within potential habitat present within the subject site:

- *Syzygium paniculatum;*
- Green and Golden Bell Frog;
- Regent Honeyeater;
- Swift Parrot;
- Barking Owl;
- Powerful Owl, Masked Owl and Sooty Owl;
- Koala;
- Yellow-bellied Glider;
- Grey-headed Flying-fox; and
- Large-eared Pied Bat.

These species were not observed within the subject site during surveys. Implementation of actions required to meet the objectives listed in the identified recovery plans are primarily the responsibility of public authorities such as the NSW OEH and Local Government. It is considered that the proposed development is not likely to obstruct the implementation of the identified recovery objectives. The proposal is therefore considered to be not inconsistent with the objectives or actions of the identified recovery plans.

Threat Abatement Plans

The following threat abatement plans have been prepared by the NSW OEH.

- Bitou Bush and Boneseed Threat Abatement Plan
- Predation by the Red Fox (*Vulpes vulpes*) Threat Abatement Plan
- Predation by *Gambusia holbrooki* (plague minnow) Threat Abatement Plan

The proposal is considered to be not inconsistent with the objectives or actions identified within these plans.

Priority Action Statements

The proposal will result in the loss of habitat for the threatened biodiversity observed during surveys. These impacts are to be offset in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the NSW Framework for Biodiversity Assessment (OEH 2014).

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.

Context

This factor refers only to those key threatening processes (KTPs) listed in Schedule 3 of the *TSC Act* and Schedule 6 of the FM Act.

Application

In addition to deciding whether the action/activity constitutes a KTP, consideration must also be given to whether the proposal is likely to exacerbate a KTP. Species listed in the determination as being 'at risk' warrant particular consideration if these species are known or likely to occur within the study area of the development or activity.

Assessment

An assessment of the likely impact of the proposal on Key Threatening Processes is provided in Table 1.2.

TABLE 1.2
ASSESSMENT OF KEY THREATENING PROCESSES

Key Threatening Processes Listed under the *TSC Act* (1995)	Likely to result or increase in impact due to the proposal	Impact likely to be mitigated or reduced as a result of the proposal	Comments
Aggressive exclusion of birds by noisy miners (*Manorina melanocephala*)	No	No	-
Alteration of habitat following subsidence due to longwall mining	No	No	-
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Yes	Yes	To be mitigated through suitable controls and provision of biodiversity offsets
Anthropogenic climate change	No	No	-
Bushrock removal	Yes	Yes	To be mitigated through implementation of a Flora and Fauna Management Plan and provision of biodiversity offsets
Clearing of native vegetation	Yes	Yes	To be mitigated through provision of biodiversity offsets

TABLE 1.2 ASSESSMENT OF KEY THREATENING PROCESSES			
Key Threatening Processes Listed under the *TSC Act* (1995)	**Likely to result or increase in impact due to the proposal**	**Impact likely to be mitigated or reduced as a result of the proposal**	**Comments**
Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*)	No	No	-
Competition and habitat degradation by feral goats (*Capra hircus*)	No	No	-
Competition from feral honey bees (*Apis mellifera*)	No	No	-
Death or injury to marine species following capture in shark control programs on ocean beaches	No	No	-
Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments	No	No	-
Forest Eucalypt dieback associated with over-abundant psyllids and bell miners	No	No	-
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	No	No	-
Herbivory and environmental degradation caused by feral deer	No	No	-
Importation of red imported fire ants (*Solenopsis invicta*)	No	No	-
Infection by psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations	No	No	-
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	No	No	-
Infection of native plants by *Phytophthora cinnamomi*	No	No	-
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	No	No	-
Introduction of the large earth bumblebee (*Bombus terrestris*)	No	No	-
Invasion and establishment of exotic vines and scramblers	No	No	-
Invasion and establishment of Scotch broom (*Cytisus scoparius*)	No	No	-
Invasion and establishment of the cane toad (*Bufo marinus*)	No	No	-
Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*	No	No	-
Invasion, establishment and spread of *Lantana camara*	No	No	-
Invasion of native plant communities by *Chrysanthemoides monilifera* (bitou bush and boneseed)	No	No	-
Invasion of native plant communities by exotic perennial grasses	No	No	-

TABLE 1.2 ASSESSMENT OF KEY THREATENING PROCESSES			
Key Threatening Processes Listed under the *TSC Act* (1995)	**Likely to result or increase in impact due to the proposal**	**Impact likely to be mitigated or reduced as a result of the proposal**	**Comments**
Invasion of the yellow crazy ant (*Anoplolepis gracilipes* (Fr. Smith)) into NSW	No	No	-
Loss of hollow-bearing trees	Yes	Yes	To be mitigated through implementation of a Flora and Fauna Management Plan and provision of biodiversity offsets
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	No	No	-
Loss or degradation (or both) of sites used for hill-topping by butterflies	No	No	-
Predation and hybridisation of feral dogs (*Canis lupus familiaris*)	No	No	-
Predation by the European red fox (*Vulpes vulpes*)	No	No	-
Predation by the feral cat (*Felis catus*)	No	No	-
Predation by *Gambusia holbrooki* (plague minnow or mosquito fish)	No	No	-
Predation by the ship rat (*Rattus rattus*) on Lord Howe Island	No	No	-
Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)	No	No	-
Removal of dead wood and dead trees	Yes	Yes	To be mitigated through implementation of a Flora and Fauna Management Plan and provision of biodiversity offsets

2.2 CONCLUDING COMMENTS

It is concluded that:

i. The impacts associated with the proposed development are to be assessed and offset in accordance with the NSW Offsets Policy for Major Projects and the Framework for Biodiversity Assessment.

ii. A Species Impact Statement is not required for State Significant Development.

REFERENCES

Australian Government Department of the Environment (2008) *Approved Conservation Advice for Eucalyptus glaucina (Slaty Red Gum)*. Available Online: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=5670

Blakers, M, Davies, S and Reilly, PN 1984, *The Atlas of Australian Birds*, RAOU Melbourne University Press.

Churchill, S (2008) "*Australian Bats*" (Second edition) Allen and Unwin, Crows Nest, NSW.

Cogger, H.G., (2000) *Reptiles and Amphibians of Australia*. (6th Edition) Reed New Holland, Frenchs Forest NSW.

Courtney J, Debus SJS (2006) *Breeding habits and conservation status of the Musk Lorikeet Glossopsitta concinna and Little Lorikeet G. pusilla in Northern New South Wales*. Australian Field Ornithology 23, 109-124.

Department of Environment and Conservation (NSW) (2006). *NSW Recovery Plan for the Large Forest Owls: Powerful Owl (Ninox strenua), Sooty Owl (Tyto tenebricosa) and Masked Owl (Tyto novaehollandiae)*. DEC, Sydney.

Department of Environment, Climate Change and Water NSW. 2009. *Draft National Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus*. Prepared by Dr Peggy Eby. Department of Environment, Climate Change and Water NSW, Sydney.

Ecological Survey and Management 2000, *Lake Macquarie Tetratheca juncea Conservation Management Plan*, Prepared for NSW National Parks and Wildlife Service, BHP Pty Ltd and Lake Macquarie City Council, (Final - July 2001).

Environmental Planning and Assessment Act (1979). New South Wales Government.

Fairley, A. & Moore, P. (1995) *Native Plants of the Sydney District*. Kangaroo Press.

Garnett, ST & Crowley, GM 2000, *The Action Plan for Australian Birds 2000*, (Natural Heritage Trust), Environment Australia Canberra ACT.

Goldingay, R.L. and Kavanagh, R.P. (1991) *The Yellow-bellied Glider: a review of its ecology and management considerations. In Conservation of Australia's Forest Fauna*. D. Lunney (Ed.). The Royal Zoological Society of New South Wales, Sydney, pp. 365-375.

Harden, G.J. (1994) *Flora of New South Wales Vols 1-4, and supplements*. Royal Botanic Gardens. New South Wales University Press, Kensington NSW.

Higgins, P.J. (Ed. (1999) *Handbook of Australian, New Zealand and Antarctic Birds*. Volume 4. Oxford University Press, Melbourne.

Higgins, P.J., & J.M. Peter. (Eds) 2002. *Handbook of Australian New Zealand and Antarctic Birds*. Volume 6: Pardalotes to shrike-thrushes. Oxford University Press, Melbourne.

Higgins, P.J., & S.J.J.F. Davies. (Eds) 1996. *Handbook of Australian New Zealand & Antarctic Birds*. Volume 3: Snipe to Pigeons. Oxford University Press, Melbourne.

Higgins, P.J., J.M. Peter & W.K. Steel. (Eds) 2001. *Handbook of Australian New Zealand and Antarctic Birds*. Volume 5: Tyrant-flycatchers to Chats. Oxford University Press, Melbourne.

Law B. S., and Chidel M. (2004) *Roosting and foraging ecology of the golden-tipped bat (Kerivoula papuensis) on the south coast of New South Wales*. Wildlife Research, 31, 73-82.

Menkhorst, P. & Knight F. 2010, *A Field Guide to the Mammals of Australia*, Oxford University Press

Melbourne.

Lindsey, T. R. (1992) *Encyclopaedia of Australian Animals - Birds*. Angus and Robertson Publishers, Sydney.

Marchant, S., & P.J. Higgins (Eds) (1990). *Handbook of Australian, New Zealand and Antarctic Birds.* Volume 1 Ratite's to Ducks Part A Ratite's to Petrels Oxford University Press, Melbourne.

Marchant, S., & P.J. Higgins (Eds) (1993). *Handbook of Australian, New Zealand and Antarctic Birds*. Volume 2: Raptors to Lapwings. Oxford University Press, Melbourne.

Menkhorst P., Schedvin N., and Geering D. (1999) *Regent Honeyeater Recovery Plan 1999-2003*. National Heritage Trust, Melbourne.

National Herbarium of NSW Royal Botanic Garden (2016) NSW Flora Online. [Online]. Available from: http://plantnet.rbgsyd.nsw.gov.au

NSW Department of Environment and Climate Change (2008) *Approved Recovery Plan for the Koala (Phascolarctos cinereus)*. Department of Environment and Climate Change NSW, Sydney.

NSW Department of Environment and Conservation (2004) *Threatened Biodiversity and Assessment: Guidelines for Developments and Activities (working draft)*, New South Wales Department of Environment and Conservation, Hurstville, NSW.

Department of Environment and Conservation NSW (2005) Draft Recovery Plan for the Green and Golden Bell Frog (Litoria aurea). DEC NSW, Hurstville, NSW.

NSW National Parks and Wildlife Service (1999) Green and Golden Bell Frog (*Litoria aurea*) Threatened Species Information. NPWS Hurstville NSW.

NSW National Parks And Wildlife Service (1999) *Spotted-tailed Quoll (Dasyurus maculatus) Threatened Species Information*. NPWS Hurstville NSW.

NSW National Parks and Wildlife Service 2002, *Grevillea parviflora* subsp. *parviflora* Threatened Species Information, NPWS Hurstville NSW.

NSW National Parks and Wildlife Service (2003). *Draft Recovery Plan for the Barking Owl*. New South Wales National Parks and Wildlife Service, Hurstville, NSW

NSW National Parks and Wildlife Service (2003). Recovery Plan for the Yellow-bellied Glider (*Petaurus australis*) NSW National Parks and Wildlife Service, Hurstville.

NSW Office of Environment and Heritage (2012) National Recovery Plan Magenta Lilly Pilly *Syzygium paniculatum*, Office of Environment and Heritage Sydney NSW.

NSW Office of Environment and Heritage (2016) *BioNet Atlas of NSW Wildlife*. [Online]. Available from: http://www.bionet.nsw.gov.au/

NSW Office of Environment and Heritage (2016) *Profiles for NSW Threatened Species*. [Online]. Available from: http://www.environment.nsw.gov.au/threatenedspecies/

Reed, P.C., Lunney, D. and Walker, P. (1991). *A 1986-1987 survey of the Koala Phascolarctos cinereus (Goldfuss) in New South Wales and an ecological interpretation of its distribution. In: Biology of the Koala. A. K. Lee, K. A. Handasyde and G. D. Sanson*, (Eds). Surrey Beatty and Sons, Chipping Norton, Sydney. Pp. 55-73.

Saunders, D.L. and Tzaros, C.L. 2011. *National Recovery Plan for the Swift Parrot Lathamus discolor*, Birds Australia, Melbourne.

Seebeck, J. H., Bennett, A.F., and Scotts, D.J. (1989). *Ecology of the Potoroidae - a review. In*

"Kangaroos, Wallabies and Rat-kangaroos". (Eds G. Grigg, P. Jarman and I. Hume). pp 67-88. Surrey Beatty and Sons Sydney

Suckling, G.C. (1995). *Squirrel Glider (Petaurus norfolcensis)*. In The Mammals of Australia. R. Strahan (Ed.). Reed Books, Chatswood.

Threatened Species Conservation Act (1995). New South Wales Government.

Tidemann, C. (1995). "*The Mammals of Australia"*. (R. Strahan (Ed)). New Holland Publishers Pty. Ltd. Melbourne.

Turner, V & S.J. Ward (1995) in The Mammals of Australia, The Australian Museum, Sydney.

Wilson, SK & Knowles DG 1988, *Australia's Reptiles; a photographic reference to the terrestrial reptiles of Australia*, Collins Publishers, Sydney.